

z/OS



# DFSORT: Getting Started



z/OS



# DFSORT: Getting Started

**Note**

Before using this information and the product it supports, be sure to read the general information under “Notices” on page 163.

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## About this document

*z/OS DFSORT: Getting Started* is a user's guide and tutorial for DFSORT™ (Data Facility Sort). You should read it if you are new to z/OS V1R5, and need to learn the many ways you can use DFSORT and DFSORT's ICETOOL utility to process data sets. Both new and experienced DFSORT users can use this document as a general guide to the many features available with DFSORT and ICETOOL. This document introduces you to the JCL, control statements and features of DFSORT and ICETOOL with numerous examples. *z/OS DFSORT: Getting Started* can help you get the most out of *z/OS DFSORT Application Programming Guide*, which has the complete details on all of the topics introduced in this document.

The chapters in this document assume that you have used job control language (JCL) and understand how to work with data sets. You should also know what data sets are available at your site.

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## How to use this document

This document gives you all of the information and instructions you need to build and submit DFSORT jobs. You can use DFSORT by writing JCL and DFSORT program control statements, or by entering values on interactive, full-screen panels. This document describes the first method of creating DFSORT jobs. The second method is detailed in *DFSORT Panels Guide*.

**Restriction:** DFSORT Panels only support a subset of the functions available with DFSORT.

New users should work through *z/OS DFSORT: Getting Started* from cover to cover. Each task explained in this document builds on knowledge gained in previous tasks. The Table of Contents lists the main tasks, and summaries are included in the chapters. If you have previous experience with these tasks, you can proceed from here directly to the tutorials that begin in Chapter 2, "Sorting, Merging, and Copying Data Sets," on page 13.

Chapter 1, "What is DFSORT?" is an overview of the basic principles of sorting, merging, and copying, and explains how to create and use the sample data sets for the examples in this document.

Chapter 2, "Sorting, Merging, and Copying Data Sets," on page 13 through Chapter 9, "Using DFSORT Efficiently," on page 99 show you how to create and process DFSORT jobs by writing JCL and DFSORT program control statements (for example, SORT, MERGE, OPTION, INCLUDE, OMIT, INREC, OUTREC, SUM, and OUTFIL) to create sorted, merged or copied output data sets while performing various operations on records such as subsetting, reformatting, summing, and reporting.

Chapter 10, "Using the ICETOOL Utility," on page 105 shows you how to create and process ICETOOL jobs by writing JCL and ICETOOL statements. ICETOOL is a multipurpose DFSORT utility that uses the capabilities of DFSORT to perform multiple operations on one or more data sets in a single step. ICETOOL's thirteen operators (COPY, COUNT, DEFAULTS, DISPLAY, MODE, OCCUR, RANGE, SELECT, SORT, SPLICE, STATS, UNIQUE and VERIFY) expand DFSORT's capabilities significantly.

Chapter 11, “Defining and Using Symbols,” on page 145 shows you how to define symbols for fields and constants and use them in your DFSORT control statements and ICETOOL operators.

Several appendixes and an index follow the chapters.

---

## Required product knowledge

To use this document effectively, you should be familiar with the following information:

- Job control language (JCL)
- Data management

You should also be familiar with the information presented in the following related documents:

*Table 1. Related documents*

Document Title	Document Order Number
<i>z/OS DFSORT Application Programming Guide</i>	SC26-7523
<i>z/OS MVS JCL Reference</i>	SA22-7597
<i>z/OS MVS JCL User's Guide</i>	SA22-7598
<i>z/OS DFSMS: Using Data Sets</i>	SC26-7410

*z/OS DFSORT: Getting Started* is a part of a more extensive DFSORT library. These documents can help you work with DFSORT more effectively.

Task	Publication Title	Order Number
Application Programming	<i>z/OS DFSORT Application Programming Guide</i>	SC26-7523
Planning For and Customizing DFSORT	<i>z/OS DFSORT Installation and Customization</i>	SC26-7524
Learning to Use DFSORT Panels	<i>DFSORT Panels Guide</i>	GC26-7037
Diagnosing Failures and Interpreting Messages	<i>z/OS DFSORT Messages, Codes and Diagnosis Guide</i>	SC26-7525
Tuning DFSORT	<i>z/OS DFSORT Tuning Guide</i>	SC26-7526

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## Accessing z/OS DFSORT documents on the Internet

In addition to making softcopy documents available on CD-ROM, IBM provides access to unlicensed z/OS softcopy documents on the Internet. To find z/OS documents on the Internet, first go to the z/OS home page:  
<http://www.ibm.com/servers/eserver/zseries/zos>

From this Web site, you can link directly to the z/OS softcopy documents by selecting the Library icon. You can also link to the IBM Publications Center to order printed documentation.

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## Using LookAt to look up message explanations

LookAt is an online facility that lets you look up explanations for most of the IBM® messages you encounter, as well as for some system abends and codes. Using LookAt to find information is faster than a conventional search because in most cases LookAt goes directly to the message explanation.

You can use LookAt from the following locations to find IBM message explanations for z/OS® elements and features, z/VM®, and VSE:

- The Internet. You can access IBM message explanations directly from the LookAt Web site at <http://www.ibm.com/eserver/zseries/zos/bkserv/lookat/>.
- Your z/OS TSO/E host system. You can install code on your z/OS or z/OS.e systems to access IBM message explanations, using LookAt from a TSO/E command line (for example, TSO/E prompt, ISPF, or z/OS UNIX® System Services running OMVS).
- Your Windows® workstation. You can install code to access IBM message explanations on the *z/OS Collection* (SK3T-4269), using LookAt from a Windows DOS command line.
- Your wireless handheld device. You can use the LookAt Mobile Edition with a handheld device that has wireless access and an Internet browser (for example, Internet Explorer for Pocket PCs, Blazer, or Eudora for Palm OS, or Opera for Linux handheld devices). Link to the LookAt Mobile Edition from the LookAt Web site.

You can obtain code to install LookAt on your host system or Windows workstation from a disk on your *z/OS Collection* (SK3T-4269), or from the LookAt Web site (click **Download**, and select the platform, release, collection, and location that suit your needs). More information is available in the LOOKAT.ME files available during the download process.

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## Part 1. Introduction

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## Chapter 1. What is DFSORT?

DFSORT is IBM's high-performance sort, merge, copy, analysis, and reporting product for z/OS.

With DFSORT, you can sort, merge, and copy data sets. You can use DFSORT to do simple tasks such as alphabetizing a list of names, or you can use it to aid complex tasks such as taking inventory or running a billing system. DFSORT gives you versatile data handling capabilities at the record, field and bit level.

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### DFSORT on the World Wide Web

For articles, online documents, news, tips, techniques, examples, and more, visit the DFSORT home page at URL:

<http://www.ibm.com/storage/dfsor>

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### DFSORT FTP Site

You can obtain DFSORT articles and examples by anonymous FTP to:

<ftp.software.ibm.com/dfsor/mvs/>

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### Data Sets, Records and Fields

The information you manipulate with DFSORT is contained in *data sets*. The term *data set* refers to a file that contains one or more records. Any named group of records is called a *data set*. The terms *data set* and *file* are synonymous, and are used interchangeably in this document.

A data set contains the information that you want to sort, copy, or merge. For most of the processing done by DFSORT, the whole data set is affected. However, some forms of DFSORT processing involve only certain individual records in that data set.

Data sets can be *cataloged*, which permits the data set to be referred to by name without specifying where the data set is stored. A cataloged data set should not be confused with a cataloged *procedure*. A cataloged procedure is a named collection of JCL stored in a data set, and a cataloged data set is a data set whose name is recorded by the system.

Throughout this document, the term *record* refers to a collection of related information used as a unit, such as one item in a data base or personnel data about one member of a department. The term *field* refers to a specific portion of a record used for a particular category of data, such as an employee's name or department.

DFSORT can sort, copy or merge fixed-length or variable-length records. The type and length of a data set is defined by its record format (RECFM) and logical record length (LRECL). Fixed-length data sets have a RECFM of F, FB, FBS, and so on. Variable-length data sets have a RECFM of V, VB, VBS, and so on. For simplicity in this document, the terms "FB data set" and "FB records" are used as short-hand for

## What is DFSORT?

fixed-length data sets and records, respectively, and the terms "VB data set" and "VB records" are used as short-hand for variable-length record data sets and variable-length records, respectively.

A data set with RECFM=FB and LRECL=25 is a fixed-length (FB) data set with a record length of 25-bytes (the B is for blocked). For an FB data set, the LRECL tells you the length of each record in the data set; all of the records are the same length. The first data byte of an FB record is in position 1. A record in an FB data set with LRECL=25 might look like this:

Positions 1-3: Country Code = 'USA'  
Positions 4-5: State Code = 'CA'  
Positions 6-25: City = 'San Jose' padded with 12 blanks on the right

A data set with RECFM=VB and LRECL=25 is a variable-length (VB) data set with a maximum record length of 25-bytes. For a VB data set, different records can have different lengths. The first four bytes of each record contain the Record Descriptor Word or RDW, and the first two bytes of the RDW contain the length of that record (in binary). The first data byte of a VB record is in position 5, after the 4-byte RDW in positions 1-4. A record in a VB data set with LRECL=25 might look like this:

Positions 1-2: Length in RDW = hex 000E = decimal 14  
Positions 3-4: Zeros in RDW = hex 0000 = decimal 0  
Positions 5-7: Country Code = 'USA'  
Positions 8-9: State Code = 'CA'  
Positions 10-17: City = 'San Jose'

Unless otherwise noted, the examples in this document process FB data sets, which are easier to work with and describe. However, special considerations for processing VB data sets are discussed throughout this document whenever appropriate.

---

## Sorting Data Sets

You can use DFSORT to rearrange the records in your data sets. *Sorting* is arranging records in either ascending or descending order within a file. Table 2 shows a sample data set of names, first sorted in ascending order, then in descending order.

*Table 2. DFSORT Arranges Information in Ascending and Descending Order*

Unsorted Data Set	Sorted Ascending	Sorted Descending
Andy	Andy	Edward
Edward	Betty	Dan
Carol	Carol	Carol
Dan	Dan	Betty
Betty	Edward	Andy

You can sort data in many different formats. Table 3 shows the most commonly used DFSORT data formats and the format identifiers you use to specify them.

Table 3. Commonly Used Data Formats

Data Format	Format Identifier
EBCDIC (Character)	CH
Binary (Unsigned Numeric)	BI
Fixed-point (Signed Numeric)	FI
Zoned Decimal (Signed Numeric)	ZD
Packed Decimal (Signed Numeric)	PD
Floating Sign (Signed Numeric)	FS
Free Form (Unsigned Numeric)	UFF
Free Form (Signed Numeric)	SFF

Refer to *z/OS DFSORT Application Programming Guide* for complete details of the available formats.

## Merging Data Sets

You can also use DFSORT to merge data sets. DFSORT *merges* data sets by combining two or more files of sorted records to form a single data set of sorted records.

Table 4. DFSORT Merges Two Data Sets into One Data Set

Data Set 1	Data Set 2	Merged Data Set
Andy	Amy	Amy
Betty	Chris	Andy
Carol	Sue	Betty
Dan		Carol
Edward		Chris
		Dan
		Edward
		Sue

The data sets you merge must be previously sorted into the same order (ascending or descending).

## Copying Data Sets

DFSORT can also copy data sets without any sorting or merging taking place. You copy data sets in much the same way that you sort or merge them.

## What Else Can You Do with DFSORT?

- While sorting, merging, or copying data sets, you can also perform other tasks such as the following:
- Select a subset of records from an input data set. You can include or omit records that meet specified criteria. For example, when sorting an input data set containing records of course documents from many different school departments, you can sort the documents for only one department.
  - Reformat records in a variety of ways. You can build your records one item at a time, only overlay specific columns, or reformat different records in different ways. You can edit, change, add or delete fields. You can also insert blanks, zeros, strings, current date, current time, sequence numbers, decimal constants, and the results of arithmetic instructions before, between, and after input fields. For example, you can create an output data set that contains character strings and only certain edited fields from the input data set, arranged differently.

## What is DFSORT?

- Sum the values in selected records while sorting or merging (but not while copying). In the example of a data set containing records of course books, you can use DFSORT to add up the dollar amounts of books for one school department.
- Create multiple output data sets and simple or complex reports from a single pass over an input data set. For example, you can create a different output data set for the records of each department.
- Convert VB data sets to FB data sets, or convert FB data sets to VB data sets.
- Sample or repeat records.
- Sort, merge, include or omit records according to the collating rules defined in a selected locale.
- Alter the collating sequence when sorting or merging records (but not while copying). For example, you can have the lowercase letters collate after the uppercase letters.
- Sort, merge, or copy Japanese data if the IBM Double Byte Character Set Ordering Support (DBCS Ordering) (5665-360 Licensed Program, Release 2.0 or an equivalent product) is used with DFSORT to process the records.

---

## Creating and Running DFSORT Jobs

Processing data sets with DFSORT involves two steps:

1. Creating a DFSORT job
2. Running a DFSORT job

You can run a DFSORT job by invoking processing in a number of ways:

- With a JCL EXEC statement, using the name of the program or the name of the cataloged procedure
- With interactive panels supported under ISPF and ISMF
- Within programs written in COBOL, PL/I, or basic Assembler language

In this document, the phrases *directly* or *JCL-invoked* mean that the DFSORT program is initiated by a JCL EXEC statement with PGM=SORT or PGM=ICEMAN. The phrases *called by a program* or *dynamically invoked* mean that the DFSORT program is initiated from another program.

## Writing Jobs

You can use DFSORT by writing JCL and DFSORT control statements no matter how your site has installed DFSORT. Part 1 contains instructions on writing JCL and DFSORT program control statements.

Unless you use DFSORT Panels to prepare and submit your job, you must prepare JCL statements and DFSORT program control statements to invoke DFSORT processing. JCL statements are processed by your operating system. They describe your data sets to the operating system, and initiate DFSORT processing. DFSORT program control statements are processed by DFSORT. They describe and initiate the processing you want to do.

## Summary of DFSORT Control Statements

The functions of the most important DFSORT control statements can be summarized briefly as follows:

<b>SORT</b>	Describes the fields for a sort application, or requests a copy application.
-------------	--

<b>MERGE</b>	Describes the fields for a merge application, or requests a copy application.
<b>OPTION</b>	Overrides installation defaults, or requests optional features or a copy application.
<b>INCLUDE</b>	Describes the criteria to be used to include records before they are sorted, copied or merged.
<b>OMIT</b>	Describes the criteria to be used to omit records before they are sorted, copied or merged.
<b>INREC</b>	Describes how records are to be reformatted before they are sorted, copied or merged.
<b>OUTREC</b>	Describes how records are to be reformatted after they are sorted, copied or merged.
<b>SUM</b>	Describes how fields are to be summed after sorting or merging.
<b>OUTFIL</b>	Describes various types of processing to be performed for one or more output data sets after sorting, copying or merging.

The functions of the less important DFSORT control statements can be summarized briefly as follows:

<b>ALTSEQ</b>	Describes changes to the normal translation table.
<b>MODS</b>	Describes user exit routines.
<b>RECORD</b>	Supplies data set record type and length information when needed.
<b>DEBUG</b>	Requests diagnostic features.
<b>END</b>	Marks the end of the control statements.

## Running Jobs

You can run DFSORT jobs directly with a JCL EXEC statement that uses PGM=SORT or PGM=ICEMAN. Or, you can call DFSORT dynamically from a COBOL, Assembler, PL/I, or other type of program.

---

## Creating and Using the Sample Data Sets

Many of the examples in this document refer to the sample data sets SORT.SAMPIN, SORT.SAMPADD, SORT.BRANCH and SORT.SAMPOUT. Appendix A, "Creating the Sample Data Sets" shows you how to create your own copies of these data sets if you want to try the examples in this document that use them.

**Note:** Some of the examples use data sets other than SORT.SAMPIN, SORT.SAMPOUT, SORT.SAMPADD, and SORT.BRANCH. You can either create data sets from scratch to match the ones used in the text, or else perform a similar exercise on data sets you already have.

Before you begin, turn to Appendix B, "Descriptions of the Sample Data Sets," on page 155. Many of the examples in this document refer to the sample bookstore data sets as the input data sets, so you should become familiar with them. The input data sets contain the data that you want arranged or sorted. You must specify an input data set for every DFSORT job you run. The sample bookstore data set is named **SORT.SAMPIN** and the additional bookstore data set is named **SORT.SAMPADD**.

## What is DFSORT?

Each record in the bookstore data sets has 12 fields (book title, author's last name, and so on). A record can be represented by one horizontal row on the page. A field can be represented by one vertical column on the page.

To sort a data set, you choose one or more fields that you want to use to order the records (arrange in ascending or descending order). These fields are called *control fields* (or, in COBOL, *keys*).

As you work through the exercises on the following pages, remember that each *entire* record is sorted, not just the control field. However, for the sake of simplicity, the figures in the text show only the control fields being discussed. The sorted records actually contain all of the fields, but one page is not wide enough to show them. Appendix B, "Descriptions of the Sample Data Sets," shows all of the fields in each record. It is also arranged with headings and numbers that show the byte positions of each field. The numeric fields are in binary format (see Table 3 on page 5) and therefore will not appear on most displays as they do in this document. Methods you can use to arrange and view the data are explained in the chapters on DFSORT functions that follow.

Table 5 shows an example of sorted fields. Notice the line of numbers above the sorted fields. These numbers represent the byte positions of those fields. You use byte positions to identify fields to DFSORT. The examples show the byte positions to help you while you are learning to use DFSORT. The byte positions do not actually appear in any of your processed data sets.

In Table 5, the first two records, which show nothing in the course department fields, are general purpose books not required for a particular course. For this example, the control field is the Course Department field.

Table 5. Sample Bookstore Data Set Sorted by Course Department in Ascending Order

Book Title		Course Department	Price
1	75	110 114	170 173
LIVING WELL ON A SMALL BUDGET			9900
PICK'S POCKET DICTIONARY			295
INTRODUCTION TO BIOLOGY		BIOL	2350
SUPPLYING THE DEMAND		BUSIN	1925
STRATEGIC MARKETING		BUSIN	2350
COMPUTER LANGUAGES		COMP	2600
VIDEO GAME DESIGN		COMP	2199
COMPUTERS: AN INTRODUCTION		COMP	1899
NUMBERING SYSTEMS		COMP	360
SYSTEM PROGRAMMING		COMP	3195
INKLINGS: AN ANTHOLOGY OF YOUNG POETS		ENGL	595
EDITING SOFTWARE MANUALS		ENGL	1450
MODERN ANTHOLOGY OF WOMEN POETS		ENGL	450
THE COMPLETE PROOFREADER		ENGL	625
SHORT STORIES AND TALL TALES		ENGL	1520
THE INDUSTRIAL REVOLUTION		HIST	795
EIGHTEENTH CENTURY EUROPE		HIST	1790
CRISIS OF THE MIDDLE AGES		HIST	1200
INTRODUCTION TO PSYCHOLOGY		PSYCH	2200
ADVANCED TOPICS IN PSYCHOANALYSIS		PSYCH	2600

Also notice that records in Table 5 on page 8 with *equally collating control fields* (in this case, the same department) appear in their original order. For example, within the Computer Science department (COMP), the title *Video Game Design* still appears before *Computers: An Introduction*.

You can control whether records with equally collating control fields appear in their original order or whether DFSORT orders them randomly. The system programmer sets defaults at installation time that you can change with some DFSORT options at run time. The examples in this document assume that the default is for records with equally collating control fields to appear in their original order.

### Summary

So far in Getting Started you covered the following concepts:

- You can sort, copy, or merge data sets using DFSORT.
- You can write JCL and DFSORT program control statements to create and process DFSORT jobs.
- You can run DFSORT jobs directly or call DFSORT from a program.

In addition, this chapter covered how to use and read the sample data sets provided with DFSORT. Now continue with tutorials on how to write DFSORT control statements.

## What is DFSORT?



---

## Part 2. Learning to Write JCL and DFSORT Control Statements

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---

## Chapter 2. Sorting, Merging, and Copying Data Sets

This tutorial shows you how to sort, merge, and copy data sets by writing DFSORT program control statements that are processed with JCL.

DFSORT program control statements are input in the JCL used to run DFSORT. To keep the instructions simple, the program control statements are covered first and the related JCL statements are explained afterward. For most of the tutorials you will concentrate on JCL-invoked DFSORT, that is, running DFSORT with JCL. Information on calling DFSORT from a program (dynamic invocation) is presented in Chapter 7, "Calling DFSORT from a Program," on page 87.

---

### Sorting Data Sets

To use DFSORT directly (JCL-invoked), write a SORT control statement to describe the control fields, and the order in which you want them sorted. The control statements you write are part of the SYSIN data set in the JCL. The SYSIN data set is typically specified as //SYSIN DD \* followed by "inline" control statements (as shown in the examples in this document). However, a sequential data set, or a member of a partitioned data set, with the control statements as records can also be used for the SYSIN data set.

You can use SORT with all of the other DFSORT control statements.

A SORT statement that sorts the bookstore records by the course department field (as shown in Table 7 on page 14) looks like this:

```
1 2                                     71    80
  SORT  FIELDS=(110,5,CH,A)
```

- Ascending order
- Character data
- Length of department field
- Beginning of department field

Make sure that the statement is coded between columns 2 and 71.

Here are the steps for writing this SORT statement:

*Table 6. Steps to Create the SORT Statement to Sort by Department*

Step	Action
1	Leave at least one blank, and type <b>SORT</b>
2	Leave at least one blank and type <b>FIELDS=</b>

*Table 6. Steps to Create the SORT Statement to Sort by Department (continued)*

Step	Action
3	<p>Type, in parenthesis and separated by commas:</p> <ol style="list-style-type: none"> <li>1. Where the course department field begins, relative to the beginning of the record in the bookstore data set (the first position is byte 1). The course department field begins at byte <b>110</b>.</li> <li>2. The length of the department field in bytes. The department field is <b>5</b> bytes long.</li> <li>3. A format identifier for the data format. The department field contains character data, which you specify as <b>CH</b>. ( Table 3 on page 5 shows the codes for the most commonly used data formats.)</li> <li>4. The letter <b>A</b>, for ascending order.</li> </ol>

Remember that although Table 7 shows only certain fields, the displayed fields are not the only ones in the output data set. Your output data set will more closely resemble the fold-out of the sample bookstore data set.

*Table 7. Sample Bookstore Data Set Sorted by Course Department in Ascending Order*

Book Title	Course Department
1                    75	110 114
LIVING WELL ON A SMALL BUDGET	
PICK'S POCKET DICTIONARY	
INTRODUCTION TO BIOLOGY	BIOL
SUPPLYING THE DEMAND	BUSIN
STRATEGIC MARKETING	BUSIN
COMPUTER LANGUAGES	COMP
VIDEO GAME DESIGN	COMP
COMPUTERS: AN INTRODUCTION	COMP
NUMBERING SYSTEMS	COMP
SYSTEM PROGRAMMING	COMP
INKLINGS: AN ANTHOLOGY OF YOUNG POETS	ENGL
EDITING SOFTWARE MANUALS	ENGL
MODERN ANTHOLOGY OF WOMEN POETS	ENGL
THE COMPLETE PROOFREADER	ENGL
SHORT STORIES AND TALL TALES	ENGL
THE INDUSTRIAL REVOLUTION	HIST
EIGHTEENTH CENTURY EUROPE	HIST
CRISES OF THE MIDDLE AGES	HIST
INTRODUCTION TO PSYCHOLOGY	PSYCH
ADVANCED TOPICS IN PSYCHOANALYSIS	PSYCH

To sort the records in descending order, specify **D** instead of A. For example, to sort the prices for each book in descending order, type:

```
SORT  FIELDS=(170,4,BI,D)
```

The sort order is bytes 170 through 173 as binary data in descending sequence. Table 8 shows the results of the sort in descending order.

*Table 8. Sample Bookstore Data Set Sorted by Price in Descending Order*

Book Title		Price	
1	75	170	173
LIVING WELL ON A SMALL BUDGET		9900	
SYSTEM PROGRAMMING		3195	
COMPUTER LANGUAGES		2600	
ADVANCED TOPICS IN PSYCHOANALYSIS		2600	
STRATEGIC MARKETING		2350	
INTRODUCTION TO BIOLOGY		2350	
INTRODUCTION TO PSYCHOLOGY		2200	
VIDEO GAME DESIGN		2199	
SUPPLYING THE DEMAND		1925	
COMPUTERS: AN INTRODUCTION		1899	
EIGHTEENTH CENTURY EUROPE		1790	
SHORT STORIES AND TALL TALES		1520	
EDITING SOFTWARE MANUALS		1450	
CRISES OF THE MIDDLE AGES		1200	
THE INDUSTRIAL REVOLUTION		795	
THE COMPLETE PROOFREADER		625	
INKLINGS: AN ANTHOLOGY OF YOUNG POETS		595	
MODERN ANTHOLOGY OF WOMEN POETS		450	
NUMBERING SYSTEMS		360	
PICK'S POCKET DICTIONARY		295	

## Sorting by Multiple Fields

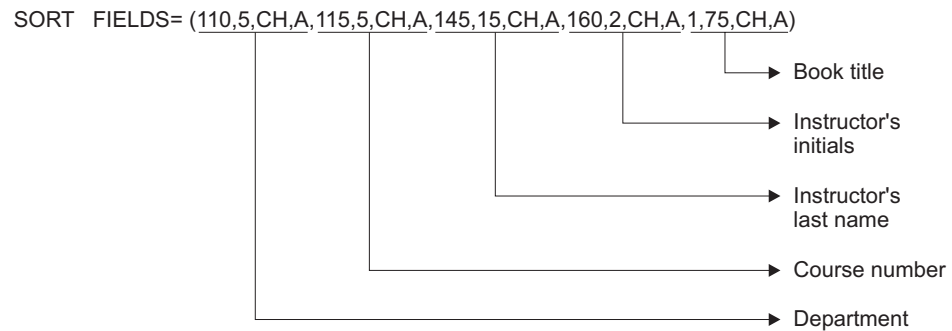
You can further sort the records in the bookstore data set by specifying multiple control fields. When you specify two or more control fields, you specify them in the order of greater to lesser priority. Note that control fields might overlap or be contained within other control fields.

Table 9 on page 16 shows how the records would be sorted if you specified the following control fields in the order they are listed:

1. Course department
2. Course number
3. Instructor's last name
4. Instructor's initials
5. Book title.

So, if two records have the same department, they are sorted by course number. If they also have the same course number, they are sorted by instructor's last name. If they also have the same last name, they are sorted by initials. Finally, if they also have the same initials, they are sorted by title.

Specify the location, length, data format, and order for each of the control fields, as follows:



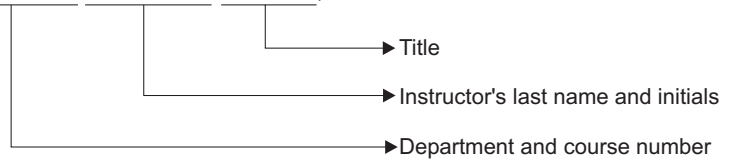
The records are sorted as shown in Table 9.

Table 9. Sample Bookstore Data Set Sorted by Multiple Fields

Book Title		Course Department		Course Number		Instructor's Last Name		Instructor's Initials	
1	75	110	114	115	119	145	159	160	161
LIVING WELL ON A SMALL BUDGET									
PICK'S POCKET DICTIONARY									
INTRODUCTION TO BIOLOGY		BIOL		80521		GREENBERG	HC		
STRATEGIC MARKETING		BUSIN		70124		LORCH	HH		
SUPPLYING THE DEMAND		BUSIN		70251		MAXWELL	RF		
NUMBERING SYSTEMS		COMP		00032		CHATTERJEE	AN		
COMPUTER LANGUAGES		COMP		00032		CHATTERJEE	CL		
COMPUTERS: AN INTRODUCTION		COMP		00032		CHATTERJEE	CL		
SYSTEM PROGRAMMING		COMP		00103		SMITH	DC		
VIDEO GAME DESIGN		COMP		00205		NEUMANN	LB		
SHORT STORIES AND TALL TALES		ENGL		10054		BUCK	GR		
EDITING SOFTWARE MANUALS		ENGL		10347		MADRID	MM		
THE COMPLETE PROOFREADER		ENGL		10347		MADRID	MM		
INKLINGS: AN ANTHOLOGY OF YOUNG POETS		ENGL		10856		FRIEDMAN	KR		
MODERN ANTHOLOGY OF WOMEN POETS		ENGL		10856		FRIEDMAN	KR		
THE INDUSTRIAL REVOLUTION		HIST		50420		GOODGOLD	ST		
CRISES OF THE MIDDLE AGES		HIST		50521		WILLERTON	DW		
EIGHTEENTH CENTURY EUROPE		HIST		50632		BISCARDI	HR		
INTRODUCTION TO PSYCHOLOGY		PSYCH		30016		ZABOSKI	RL		
ADVANCED TOPICS IN PSYCHOANALYSIS		PSYCH		30975		NAKATSU	FL		

You can often shorten the length of control statements. You can specify fields together whenever they are next to each other in the record and have the same data format and order. You can shorten this last statement by specifying the department and course number together as one field, and the instructor's last name and initials together as one field.

```
SORT  FIELDS=(110,10,CH,A,145,17,CH,A,1,75,CH,A)
```



Also, if all of the control fields have the same data format, you can specify the data format just once, using the `FORMAT=f` parameter. For example:

```
SORT  FORMAT=CH,FIELDS=(110,10,A,145,17,A,1,75,A)
```

If some of the control fields have the same data format, but others don't, you can specify the `FORMAT=f` parameter along with the individual data formats. For example:

```
SORT  FORMAT=CH,FIELDS=(110,10,A,170,4,BI,D,145,17,A,1,75,A)
```

is equivalent to:

```
SORT  FIELDS=(110,10,CH,A,170,4,BI,D,145,17,CH,A,1,75,CH,A)
```

## Continuing a Statement

If you cannot fit your `SORT` statement (or any other DFSORT control statement) between columns 2 through 71, you can continue it on the next line. If you end a line with a comma followed by a blank, DFSORT treats the next line as a continuation. The continuation can begin anywhere between columns 2 through 71.

For example:

```
SORT  FORMAT=CH,FIELDS=(110,10,A,145,17,A,
    1,75,A)
```

## Comment Statements

You can mix comment statements with your control statements by starting them with an asterisk (\*) in column 1. DFSORT prints comment statements, but otherwise ignores them.

For example:

```
* Sort by department and course number
SORT  FIELDS=(110,10,CH,A)
```

## JCL for Sorting Data Sets Directly

The job control language (JCL) you need to do a sort depends on whether you run DFSORT directly or call DFSORT from a program. For now, concentrate on running DFSORT directly. Information on calling DFSORT from a program is presented in Chapter 7, "Calling DFSORT from a Program," on page 87.

Your operating system uses the JCL you supply with your DFSORT program control statements to:

- Identify you as an authorized user
- Allocate the necessary resources to run your job
- Run your job
- Return information to you about the results
- Terminate your job

Unless you create your jobs with the interactive DFSORT Panels facility, you must supply JCL with every DFSORT job you submit.

Required JCL includes a JOB statement, an EXEC statement, and several DD statements. The statements you need and their exact form depend upon whether you:

- Invoke DFSORT with an EXEC statement in the input job stream, or with a system macro instruction within another program
- Choose to use EXEC statement cataloged procedures to invoke DFSORT
- Choose to specify PARM options on the EXEC statement
- Choose to specify PARM options or control statements in a DFSPARM data set
- Choose to specify control statements in a SYSIN data set
- Want to use program exits to activate routines of your own

Information on when you would choose each of the above options is detailed in *z/OS DFSORT Application Programming Guide*.

The JCL statements you need for most jobs are described below.

<b>//jobname JOB</b>	Signals the beginning of a job. At your site, you might be required to specify information such as your name and account number on the JOB statement.
<b>//stepname EXEC</b>	Signals the beginning of a job step and tells the operating system what program to run. To run DFSORT, write the EXEC statement like this:  <code>//stepname EXEC PGM=SORT</code>
<b>//STEPLIB DD</b>	The DFSORT program would typically be in a library known to the system, so the //STEPLIB DD statement would <b>not</b> be needed. However, if DFSORT is not in a library known to the system, the //STEPLIB DD statement defines the library containing the DFSORT program
<b>//SYSOUT DD</b>	Defines the data set in which DFSORT messages and control statements are listed.
<b>//SORTIN DD</b>	Defines the input data set or concatenated input data sets.
<b>//SORTWKdd DD</b>	Defines a work data set for a sort. Typically not needed, because DFSORT can allocate work data sets for a sort dynamically.
<b>//SORTOUT DD</b>	Defines the output data set.
<b>//SYSIN DD</b>	Precedes or contains the DFSORT program control statements.

Below is a typical example of JCL to run DFSORT.



```
//EXAMP  JOB  A492,PROGRAMMER
//SORT   EXEC PGM=SORT
//SYSOUT DD  SYSOUT=A
//SORTIN DD  DSN=A123456.SORT.SAMPIN,DISP=SHR
//SORTOUT DD DSN=A123456.SORT.SAMPOUT,DISP=OLD
//SYSIN  DD  *
          SORT FORMAT=CH,
          FIELDS=(110,10,A,145,17,A,1,75,A)
/*
```

*z/OS DFSORT Application Programming Guide* contains additional information on running DFSORT directly.

#### So Far

So far in this chapter you covered how to write a SORT program control statement and how to run that sort with JCL statements. The next tutorial explains how to use the MERGE program control statement to merge two data sets.

## Merging Data Sets

Generally, the reason for merging data sets is to add more records to a data set that is already sorted.

For example, assume that the bookstore data set is already sorted by course department and book title (as shown in Table 10), and you want to update it by merging it with a data set that contains five new records, also sorted by course department and book title.

*Table 10. Sample Bookstore Data Set Sorted by Course Department and Book Title*

Book Title	Course Department
1 75	110 114
LIVING WELL ON A SMALL BUDGET	
PICK'S POCKET DICTIONARY	
INTRODUCTION TO BIOLOGY	BIOL
STRATEGIC MARKETING	BUSIN
SUPPLYING THE DEMAND	BUSIN
COMPUTER LANGUAGES	COMP
COMPUTERS: AN INTRODUCTION	COMP
NUMBERING SYSTEMS	COMP
SYSTEM PROGRAMMING	COMP
VIDEO GAME DESIGN	COMP
EDITING SOFTWARE MANUALS	ENGL
INKLINGS: AN ANTHOLOGY OF YOUNG POETS	ENGL
MODERN ANTHOLOGY OF WOMEN POETS	ENGL
SHORT STORIES AND TALL TALES	ENGL
THE COMPLETE PROOFREADER	ENGL
CRISES OF THE MIDDLE AGES	HIST
EIGHTEENTH CENTURY EUROPE	HIST
THE INDUSTRIAL REVOLUTION	HIST
ADVANCED TOPICS IN PSYCHOANALYSIS	PSYCH
INTRODUCTION TO PSYCHOLOGY	PSYCH

For this example, use a new data set such as the one shown in Table 11 on page 20.

Table 11. Five New Records Sorted by Course Department and Book Title

Book Title		Course Department	
1	75	110	114
INTERNATIONAL COOKBOOK			
WORLD JOURNEYS BY TRAIN			
ARTS AND CRAFTS OF ASIA		ART	
BIOCHEMISTRY		BIOL	
BEHAVIORAL ANALYSIS		PSYCH	

To merge data sets, you write a MERGE control statement and several JCL statements. Whenever you merge data sets, you must make sure that their records have the same format and that they have been previously sorted by the same control fields. You can merge up to 100 data sets at a time.

You can use MERGE with all of the other DFSORT control statements.

## Writing the MERGE Control Statement

The format of the MERGE statement is the same as that of the SORT statement. To merge the bookstore master data set with the data set containing the five new records, write:

```
MERGE FORMAT=CH, FIELDS=(110,5,A,1,75,A)
```

The diagram illustrates the field mapping for the MERGE statement. The field '110' is mapped to 'Department' and the field '75' is mapped to 'Title'.

Table 12 shows the merged output.

Table 12. Sample Bookstore Data Set Merged with Five New Records

Book Title		Course Department	
1	75	110	114

Table 12. Sample Bookstore Data Set Merged with Five New Records (continued)

Book Title	Course Department
INTERNATIONAL COOKBOOK	
LIVING WELL ON A SMALL BUDGET	
PICK'S POCKET DICTIONARY	
WORLD JOURNEYS BY TRAIN	
ARTS AND CRAFTS OF ASIA	ART
BIOCHEMISTRY	BIOL
INTRODUCTION TO BIOLOGY	BIOL
STRATEGIC MARKETING	BUSIN
SUPPLYING THE DEMAND	BUSIN
COMPUTER LANGUAGES	COMP
COMPUTERS: AN INTRODUCTION	COMP
NUMBERING SYSTEMS	COMP
SYSTEM PROGRAMMING	COMP
VIDEO GAME DESIGN	COMP
EDITING SOFTWARE MANUALS	ENGL
INKLINGS: AN ANTHOLOGY OF YOUNG POETS	ENGL
MODERN ANTHOLOGY OF WOMEN POETS	ENGL
SHORT STORIES AND TALL TALES	ENGL
THE COMPLETE PROOFREADER	ENGL
CRISES OF THE MIDDLE AGES	HIST
EIGHTEENTH CENTURY EUROPE	HIST
THE INDUSTRIAL REVOLUTION	HIST
ADVANCED TOPICS IN PSYCHOANALYSIS	PSYCH
BEHAVIORAL ANALYSIS	PSYCH
INTRODUCTION TO PSYCHOLOGY	PSYCH

## JCL for Merging Data Sets Directly

As in a sort, the JCL you need depends on whether you run DFSORT directly or call it from a program. This chapter only discusses running DFSORT directly.

The JCL needed for a merge is the same as that for a sort, with the following exceptions:

- You do *not* need dynamic allocation of work data sets or SORTWKdd DD statements.
- Instead of the SORTIN DD statement, you use SORTINnn DD statements to define the input data sets. The SORTINnn DD statements name the input data sets, and tell how many data sets will be merged. You need one SORTINnn DD statement for each data set being merged. *nn* in SORTIN*nn* is a number from 00 to 99. Thus, if you wanted to merge 5 data sets, you would typically use DD statements for SORTIN01, SORTIN02, SORTIN03, SORTIN04 and SORTIN05.

To merge the pre-sorted bookstore data set and the data set containing the new records, code the following JCL statements for this example. The new data set is called A123456.NEW and the sorted version of the bookstore data set is called A123456.MASTER. For this example, it is assumed that the input data sets are cataloged and that the output data set will be cataloged.

```
//EXAMP JOB A492,PROGRAMMER
//MERGE EXEC PGM=SORT
//SYSOUT DD SYSOUT=A
//SORTIN01 DD DSN=A123456.MASTER,DISP=SHR
//SORTIN02 DD DSN=A123456.NEW,DISP=SHR
//SORTOUT DD DSN=A123456.SORT.SAMPOUT,DISP=OLD
//SYSIN DD *
MERGE FIELDS=(110,5,CH,A,1,75,CH,A)
/*
```

In Chapter 7, “Calling DFSORT from a Program,” on page 87, you learn how to merge data sets when calling DFSORT from a program.

#### So Far

So far in this chapter you covered how to write both the SORT and MERGE program control statements and how to process those control statements using JCL statements. Now you continue with the tutorial on COPY.

## VB Data Set Considerations

A record in a VB data set looks like this:

RDW	Fixed data	Variable data
-----	------------	---------------

The RDW (Record Descriptor Word) is a 4-byte binary field with the length of the record in the first two bytes. Fixed data consists of data bytes that are present in every record. Variable data consists of one or more data bytes that may or may not be present in every record, so different records can have different lengths up to the maximum logical record length (LRECL) for the data set.

## Starting Positions

For FB data sets, the first data byte starts in position 1. However, for VB data sets, the RDW is in positions 1-4, so the first data byte starts in position 5. So when you code your control fields for sorting or merging VB data sets, remember to add 4 to the starting position to account for the 4-byte RDW. For example, the following SORT statement specifies a CH control field in the third through fifth data bytes of a VB record:

```
SORT FIELDS=(7,3,CH,A)
```

## Short Control Fields

Because VB records have a fixed part and a variable part, it is possible for part of a control field to be missing. Consider this SORT statement:

```
SORT FIELDS=(21,12,CH,A)
```

The control field is in positions 21-32. If your VB records have 25 fixed data bytes and LRECL=45, the records can vary in length from 29 bytes (4-byte RDW, 25 bytes of fixed data, and 0 bytes of variable data) to 45 bytes (4-byte RDW, 25 bytes of fixed data, and 16 bytes of variable data). Records 32 bytes or longer include the entire control field. But records less than 32 bytes have “short” control fields, that is, they are missing some of the bytes at the end of the control field. You cannot validly sort or merge on control fields with missing bytes because missing bytes have no values.

If you know you have VB records with short control fields, you can specify the VLSHRT option, if appropriate, to prevent DFSORT from terminating. For example:

```
OPTION VLSHRT
SORT FIELDS=(21,12,CH,A)
```

VLSHRT tells DFSORT that you want to temporarily replace any missing control field bytes with binary zeros (the zeros are not kept for the output record), thus allowing DFSORT to validly sort or merge on the short control fields.

**Attention:** If NOVLSHRT is in effect, DFSORT terminates if it finds a short control field in any VB record.

For more information on DFSORT's VLSHRT option, see *z/OS DFSORT Application Programming Guide*.

---

## Copying Data Sets

With DFSORT you can copy data sets directly without performing a sort or merge.

You can use COPY with all of the other DFSORT control statements except SUM. DFSORT can select and reformat the specific data sets you want to copy by using the control statements covered in later chapters.

You write a copy statement by specifying COPY on the SORT, MERGE, or OPTION statement.

### Specifying COPY on the SORT, MERGE, or OPTION Statement

The SORT and MERGE statements change very little when you specify COPY. Just replace the information you usually put in parentheses with the word COPY:

```
SORT FIELDS=COPY
MERGE FIELDS=COPY
```

You can also specify COPY on the OPTION statement:

```
OPTION COPY
```

All three of these statements have identical results.

### JCL for Copying Data Sets Directly

The JCL for a copy application is the same as for a sort, except that you do not need dynamic allocation of work data sets or SORTWKdd DD statements.

This sample JCL will copy the SORT.SAMPIN data set to a temporary output data set using the OPTION COPY statement:

```
//EXAMP   JOB   A492,PROGRAMMER
//COPY    EXEC  PGM=SORT
//SYSOUT  DD    SYSOUT=A
//SORTIN  DD    DSN=A123456.SORT.SAMPIN,DISP=SHR
//SORTOUT DD    DSN=&&TEMP,DISP=(,PASS),SPACE=(CYL,(5,5)),UNIT=SYSDA
//SYSIN   DD    *
           OPTION COPY
/*
```

You can use SORT FIELDS=COPY or MERGE FIELDS=COPY instead of OPTION COPY to produce the same results.

### **Summary**

In this chapter, you covered the following concepts:

- Writing the SORT, COPY, or MERGE program control statements
- Using JCL statements to process your sort, copy, or merge

As you continue with the tutorials, you will cover two methods of obtaining subsets of your input data set for your output data set. Chapter 3, “Including or Omitting Records,” on page 25 covers allowable comparison operators, various types of constants, substring search, and padding and truncation rules for INCLUDE and OMIT.

---

## Chapter 3. Including or Omitting Records

Often, you need only a subset of the records in a data set for an application. This chapter explains how to include or omit only specific records from the input data set for sorting, copying or merging to the output data set.

By removing unneeded records with an INCLUDE or OMIT statement **before sorting, copying or merging**, you can increase the speed of the sort, copy or merge. The fewer the records, the less time it takes to process them.

You select a subset of the records in an input data set by:

- Using an INCLUDE control statement to collect wanted records
- Using an OMIT control statement to exclude unwanted records
- Using an INCLUDE or OMIT parameter on an OUTFIL statement to collect wanted records or exclude unwanted records, respectively. Different INCLUDE and OMIT parameters can be used on different OUTFIL statements.

Your choice of an INCLUDE or OMIT statement depends on which is easier and more efficient to write for a given application. *You cannot use both statements together.*

The information presented in this chapter for the INCLUDE and OMIT statements also applies to the INCLUDE and OMIT parameters of the OUTFIL statement, except that:

- OUTFIL is processed **after** sorting, copying or merging
- The FORMAT=f parameter cannot be used for OUTFIL

OUTFIL is discussed later in Chapter 6, "Creating Multiple Output Data Sets and Reports," on page 65.

You select the records you want included or omitted by comparing the contents of a field with either:

### Another field

For example, you can select records for which the author's last name is the same as the instructor's last name.

### A constant

The constant can be a character string, a decimal number, a hexadecimal string, or the current date. For example, you can select records that have the character string " HIST" in the department field.

You can also combine two or more conditions with logical ANDs and ORs. For example, you can select records that have either "HIST" or "PSYCH" in the department field.

INCLUDE and OMIT both offer powerful substring search capabilities.

In addition, INCLUDE and OMIT allow you to select records based on the results of bit logic tests and two-digit year date comparisons. These two features are not discussed in this document, but details can be found in *z/OS DFSORT Application Programming Guide*.

### Writing the INCLUDE Statement

Suppose it is the end of the year and you want to sort, by title, only the books that you need to reorder for the coming year. If the number of copies sold this year for a particular book is greater than the number in stock, you can assume you need to order more copies.

An INCLUDE statement that selects only the books you need to order looks like this:

```
INCLUDE COND=(166,4,GT,162,4),FORMAT=BI
```

Here are the steps for writing this INCLUDE statement:

*Table 13. Steps to Create the INCLUDE Statement for Books You Need to Order*

Step	Action
1	Leave at least one blank and type <b>INCLUDE</b>
2	Leave at least one blank and type <b>COND=</b>
3	Type, in parentheses, and separated by commas: <ol style="list-style-type: none"> <li>1. The location, length, and data format of the number sold field</li> <li>2. The comparison operator <b>GT</b> (comparison operators are shown in Figure 1) for greater than</li> <li>3. The location, length, and data format of the number in stock field.</li> </ol>

You can select from the following comparison operators:

Comparison Operator	Meaning
<b>EQ</b>	Equal to
<b>NE</b>	Not equal to
<b>GT</b>	Greater than
<b>GE</b>	Greater than or equal to
<b>LT</b>	Less than
<b>LE</b>	Less than or equal to

*Figure 1. Comparison Operators*

You can place the SORT statement either before or after the INCLUDE statement. Control statements do not have to be in any specific order. However, it is good documentation practice to code them in the order in which they are processed. For a flowchart showing the order in which all the control statements are processed, see Appendix C, “Processing Order of Control Statements,” on page 159.

```
INCLUDE COND=(166,4,BI,GT,162,4,BI)
SORT FIELDS=(1,75,CH,A)
```



This sorts the selected subset of the input records by title in ascending order.  
Table 14 shows the sorted data set.

Table 14. Books for which Number Sold is greater than Number in Stock

Book Title	Number In Stock	Number Sold
1            75	162   165	166   169
ADVANCED TOPICS IN PSYCHOANALYSIS	1	12
COMPUTER LANGUAGES	5	29
COMPUTERS: AN INTRODUCTION	20	26
<b>CRISES OF THE MIDDLE AGES</b>	<b>14</b>	<b>17</b>
EDITING SOFTWARE MANUALS	13	32
<b>INKLINGS: AN ANTHOLOGY OF YOUNG POETS</b>	<b>2</b>	<b>32</b>
INTRODUCTION TO BIOLOGY	6	11
<b>MODERN ANTHOLOGY OF WOMEN POETS</b>	<b>1</b>	<b>26</b>
NUMBERING SYSTEMS	6	27
STRATEGIC MARKETING	3	35
<b>SUPPLYING THE DEMAND</b>	<b>0</b>	<b>32</b>
SYSTEM PROGRAMMING	4	23
THE COMPLETE PROOFREADER	7	19

Suppose you want to reduce the subset of input records even further, to sort only the books you need to order from COR publishers. In this case, two conditions must be true:

- The number sold is greater than the number in stock.
- The book is published by COR.

To add the second condition, expand the INCLUDE statement by adding a logical AND, and compare the contents of the publisher field to the character string "COR" (see "Writing Constants" on page 30 for details how to specify constants). Because the publisher field is 4 bytes long, "COR" will be padded on the right with one blank.

```
INCLUDE COND=(166,4,BI,GT,162,4,BI,AND,106,4,CH,EQ,C'COR')
SORT FIELDS=(1,75,CH,A)
```

Table 15 shows the result.

Table 15. COR Books for which Number Sold is greater than Number in Stock

Book Title	Publisher	Number In Stock	Number Sold
1            75	106   109	162   165	166   169
CRISES OF THE MIDDLE AGES	COR	14	17
INKLINGS: AN ANTHOLOGY OF YOUNG POETS	COR	2	32
MODERN ANTHOLOGY OF WOMEN POETS	COR	1	26
SUPPLYING THE DEMAND	COR	0	32

As another example, you might sort only the books for courses 00032 and 10347 by writing the INCLUDE and SORT statements as follows:

```
INCLUDE COND=(115,5,CH,EQ,C'00032',OR,115,5,CH,EQ,C'10347')
SORT FIELDS=(115,5,CH,A)
```

**Note:** In the previous example, you cannot substitute C'32' for C'00032', because character constants are padded on the right with blanks. DFSORT uses the following rules for padding and truncation:

## Including or Omitting Records

<b>Padding</b>	adds fillers in data, usually zeros or blanks
<b>Truncation</b>	deletes or omits a leading or trailing portion of a string

In comparisons, the following rules apply:

- In a field-to-field comparison, the shorter field is padded as appropriate (with blanks or zeros).
- In a field-to-constant comparison, the constant is padded or truncated to the length of the field. Decimal constants are padded or truncated on the left. Character and hexadecimal constants are padded or truncated on the right.

---

## Writing the OMIT Statement

Suppose that you want to sort, by title, all the books used for courses but not those for general reading. In this case, you can use an OMIT statement that excludes records containing a blank in the course department field.

The format of the OMIT statement is the same as that of the INCLUDE statement. To exclude the general reading books, write:

```
OMIT COND=(110,5,CH,EQ,C' ')  
SORT FIELDS=(1,75,CH,A)
```

Table 16 shows the sorted data set.

*Table 16. Sorted Data Set without Books Not Required for Classes*

Book Title		Course Department	
1	75	110	114
ADVANCED TOPICS IN topCHOANALYSIS		PSYCH	
COMPUTER LANGUAGES		COMP	
COMPUTERS: AN INTRODUCTION		COMP	
CRISES OF THE MIDDLE AGES		HIST	
EDITING SOFTWARE MANUALS		ENGL	
EIGHTEENTH CENTURY EUROPE		HIST	
INKLINGS: AN ANTHOLOGY OF YOUNG POETS		ENGL	
INTRODUCTION TO BIOLOGY		BIOL	
INTRODUCTION TO PSYCHOLOGY		PSYCH	
MODERN ANTHOLOGY OF WOMEN POETS		ENGL	
NUMBERING SYSTEMS		COMP	
SHORT STORIES AND TALL TALES		ENGL	
STRATEGIC MARKETING		BUSIN	
SUPPLYING THE DEMAND		BUSIN	
SYSTEM PROGRAMMING		COMP	
THE COMPLETE PROOFREADER		ENGL	
THE INDUSTRIAL REVOLUTION		HIST	
VIDEO GAME DESIGN		COMP	

---

## Allowable Comparisons for INCLUDE and OMIT

Table 17 on page 29 and Table 18 on page 29 show the allowable field-to-field and field-to-constant comparisons for the data formats most commonly used with INCLUDE and OMIT. Refer to *z/OS DFSORT Application Programming Guide* for complete details of all of the data formats you can use with INCLUDE and OMIT.

Table 17. Allowable Field-to-Field Comparisons

Field Format	BI	FI	CH	ZD	PD	FS	UFF	SFF
BI	✓		✓					
FI		✓						
CH	✓		✓					
ZD				✓	✓			
PD				✓	✓			
FS						✓	✓	✓
UFF						✓	✓	✓
SFF						✓	✓	✓

Table 18. Allowable Field-to-Constant Comparisons

Field Format	Character String	Hexadecimal String	Decimal Number
BI	✓	✓	✓
FI			✓
CH	✓	✓	
ZD			✓
PD			✓
FS			✓
UFF			✓
SFF			✓

For example, if you want to sort by author's name and include only those books whose author's last name begins with "M," you can compare the contents of byte 76 (the first byte of the author's last name), which is in character format, with either a character or hexadecimal string:

```
INCLUDE COND=(76,1,CH,EQ,C'M')
SORT FIELDS=(76,15,CH,A)
```

or

```
INCLUDE COND=(76,1,CH,EQ,X'D4')
SORT FIELDS=(76,15,CH,A)
```

Also, if you want to sort by number in stock only the books for which the number in stock is less than 10, you can compare the contents of the number in stock field, which is in binary format, to a decimal constant or a hexadecimal string:

```
INCLUDE COND=(162,4,BI,LT,10)
SORT FIELDS=(162,4,BI,A)
```

or

```
INCLUDE COND=(162,4,BI,LT,X'0000000A')
SORT FIELDS=(162,4,BI,A)
```

## Including or Omitting Records

For the hexadecimal constant, remember the padding and truncation rules. If you specify X'0A', the string is padded on the right instead of the left. For the decimal constant, you can use 10 or +10, and you do not have to worry about padding or truncation.

---

## Writing Constants

The formats for writing character strings, hexadecimal strings, and decimal numbers are shown below.

### Character Strings

The format for writing a character string is:

C'x...x'

where *x* is an EBCDIC character. For example, C'FERN'.

If you want to include a single apostrophe in the string, you must specify it as two single apostrophes. For example, O'NEILL must be specified as C'O"NEILL'.

You can use special keywords to specify a character string for the date of the run in various forms, as detailed in *z/OS DFSORT Application Programming Guide*. For example, if you want to select records in which a 10-character date in the form C'yyyy/mm/dd' starting in position 42 equals today's date, write:

```
INCLUDE COND=(42,10,CH,EQ,DATE1(/))
```

### Hexadecimal Strings

The format for writing a hexadecimal string is:

X'yy...yy'

where *yy* is a pair of hexadecimal digits. For example, X'7FB0'.

### Decimal Numbers

The format for writing a decimal number is:

n...n      or      ±n...n

where *n* is a decimal digit. Examples are 24, +24, and -24.

Decimal numbers must not contain commas or decimal points.

You can use special keywords to specify a decimal number for the date of the run in various forms, as detailed in *z/OS DFSORT Application Programming Guide*. For example, if you want to select records in which a 4-byte packed decimal date of P'yyyddd' (hex yyydddC) starting in position 28 equals today's date, write:

```
INCLUDE COND=(28,4,PD,EQ,DATE3P)
```

---

## Substring Search for INCLUDE and OMIT

Suppose you want to select only the books for the Biology, History, Business and Psychology departments. Based on what you learned earlier, you can select those books using this INCLUDE statement:

```
INCLUDE COND=(106,5,CH,EQ,C'BIOL',OR,
              106,5,CH,EQ,C'HIST',OR,
              106,5,CH,EQ,C'BUSIN',OR,
              106,5,CH,EQ,C'PSYCH')
```

But the more departments you want to include, the more typing you have to do. Instead, you can use one of the substring search capabilities of INCLUDE and OMIT to write the statement in a simpler form as:

```
INCLUDE COND=(106,5,SS,EQ,C'BIOL ,HIST ,BUSIN,PSYCH')
```

With substring search (SS format), you only write the field once and write the character constant so it includes all of the strings you want to search for. If the value in the field matches any of the strings (for example, "BUSIN"), the record is included. If the value in the field does not match any of the strings, the record is omitted.

The length of each string must match the length of the field. Because the Department field is 5 characters, you must add a blank at the end of "BIOL" and "HIST", which are each four characters, but not for "BUSIN" and "PSYCH", which are each five characters.

The other way to use substring search is by searching for a constant within a field. For example, if you wanted to select only the books with "INTRODUCTION" in their Title, you could use the following INCLUDE statement:

```
INCLUDE COND=(1,75,SS,EQ,C'INTRODUCTION')
```

The books selected for output would be:

```
COMPUTERS: AN INTRODUCTION
INTRODUCTION TO PSYCHOLOGY
INTRODUCTION TO BIOLOGY
```

---

## VB Data Set Considerations

The same VB data set considerations you learned about previously for the SORT and MERGE statements also apply to the INCLUDE and OMIT statements.

### Starting Positions

When you code your compare fields for including or omitting VB records, remember to add 4 to the starting position to account for the 4-byte RDW. For example, the following INCLUDE statement compares a PD field in the third through fifth data bytes of a VB record to a PD field in the sixth through eighth bytes of a VB record.

```
INCLUDE COND=(7,3,PD,EQ,10,3,PD)
```

### Short Control Fields

If you know you have VB records with short compare fields, you can specify the VLSCMP option, if appropriate, to prevent DFSORT from terminating. For example:

```
OPTION COPY,VLSCMP
INCLUDE COND=(21,8,CH,EQ,C'Type 200')
```

VLSCMP tells DFSORT that you want to temporarily replace any missing compare field bytes with binary zeros, thus allowing the short fields to be validly compared (the zeros are not kept for the output records). In the example above, records less

## Including or Omitting Records

than 28 bytes are not included because the binary zeros added for the missing bytes in the field prevent it from being equal to 'Type 200'.

Another way you can prevent DFSORT from terminating for VB records with short compare fields, if appropriate, is by specifying the VLSHRT option. For example:

```
OPTION COPY,VLSHRT
INCLUDE COND=(21,8,CH,EQ,C'Type 200')
```

VLSHRT tells DFSORT to treat any comparison involving a short field as false. In the example above, any records less than 28 bytes are not included.

**Attention:** If NOVLSCMP and NOVLSHRT are in effect, DFSORT terminates if it finds a short compare field in any VB record.

For more information on DFSORT's VLSCMP and VLSHRT options, see *z/OS DFSORT Application Programming Guide*.

### Summary

This chapter covered two ways to select only a subset of the input records to make processing more efficient. You wrote INCLUDE and OMIT statements and learned about allowable comparison operators, various types of constants, and substring search.

---

## Chapter 4. Summing Records

Suppose that the English department wants to know the total price of books for all its courses. You can include just the records for the English department by using the INCLUDE statement, and add the book prices together by using the SORT and SUM statements.

On the SUM control statement, you specify one or more **numeric** fields that are to be summed whenever records have equally collating control fields (control fields are specified on the SORT statement). The data formats you can specify on the SUM statement are binary (BI), fixed-point (FI), packed decimal (PD), zoned decimal (ZD) and floating-point (FL).

To sum the prices for just the records for the English department, specify the price field on the SUM statement and the department field on the SORT statement. The INCLUDE statement selects just the records for the English department before SUM and SORT are processed, making the department field equal for all of the included records, and allowing the prices to be summed. (For a flowchart showing the order in which the INCLUDE, SUM, and SORT statements are processed, see Appendix C, "Processing Order of Control Statements," on page 159.)

When you sum records, keep in mind that two types of fields are involved:

### Control fields

specified on the SORT statement

### Summary fields

specified on the SUM statement

The contents of the summary fields are summed for groups of records with the same control fields (often called "duplicate" records).

---

## Writing the SUM Statement

A SUM statement that sums the prices would look like this:

```
SUM  FIELDS=(170,4,BI)
      └──┬──> Price
```

Here are the steps for writing this SUM statement:

*Table 19. Steps to Create the SUM Statement for Prices*

Step	Action
1	Leave at least one blank and type <b>SUM</b>
2	Leave at least one blank and type <b>FIELDS=</b>
3	Type, in parentheses and separated by commas, the location, length, and data format of the price field.

The INCLUDE, SORT, and SUM statements are shown below:

## Summing Records

```
INCLUDE COND=(110,5,CH,EQ,C'ENGL')
SORT FIELDS=(110,5,CH,A)
SUM FIELDS=(170,4,BI)
```

When the prices are summed, the final sum appears in the price field of one record, and the other records are deleted. Therefore, the result (shown in Table 20) is only one record, containing the sum. You can control which record appears if you specify that records keep their original order. For the examples, the default is for records with equally collating control fields to appear in their original order (EQUALS in effect). When summing records keeping the original order, DFSORT chooses the first record to contain the sum.

Table 20. Sum of Prices for English Department

Book Title	Course Department	Price
1 75	110 114	170 173
INKLINGS: AN ANTHOLOGY OF YOUNG POETS <sup>1</sup>	ENGL <sup>2</sup>	4640 <sup>3</sup>

Note:

<sup>1</sup> Some of the fields in your summation record might not be meaningful, such as the book title field in Table 20. In the next chapter, you will learn two ways to leave out fields that are not meaningful.

<sup>2</sup> Specified as a control field.

<sup>3</sup> Specified as a summary field.

Suppose now that the English department wants to know the total price of books for *each* of its courses. In this case, you still select only the English department's records using INCLUDE, and specify the price field on the SUM statement, but you specify the *course number* on the SORT statement.

```
INCLUDE COND=(110,5,CH,EQ,C'ENGL')
SORT FIELDS=(115,5,CH,A)
SUM FIELDS=(170,4,BI)
```

→ Price

Table 21 shows the result, one record per course.

Table 21. Sum of Prices for English Department

Book Title	Course Number	Price
1 75	115 119	170 173
SHORT STORIES AND TALL TALES	10054	1520
EDITING SOFTWARE MANUALS	10347	2075
INKLINGS: AN ANTHOLOGY OF YOUNG POETS	10856	1045

For an example using two summary fields, assume that for inventory purposes you want to sum separately the number of books in stock and the number sold for each of the publishers.

For this application, specify the publisher as the control field on the SORT statement and the number in stock and number sold as summary fields on the SUM statement. You want to use all of the records in the input data set this time,



so you don't need to code an INCLUDE or OMIT statement. (SORT and SUM can be used with or without an INCLUDE or OMIT statement.)

```
SORT FIELDS=(106,4,CH,A)
SUM FIELDS=(162,4,166,4),FORMAT=BI
```

Table 22 shows the result, one record per publisher.

Table 22. Sum of Number in Stock and Number Sold for Each Publisher

Book Title		Publisher		Number In Stock		Number Sold	
1	75	106	109	162	165	166	169
LIVING WELL ON A SMALL BUDGET		COR		103		161	
COMPUTER LANGUAGES		FERN		19		87	
VIDEO GAME DESIGN		VALD		42		97	
COMPUTERS: AN INTRODUCTION		WETH		62		79	

## Suppressing Records with Duplicate Control Fields

Apart from summing values, you can also use SUM to delete records with duplicate control fields (often called "duplicate records").

For example, you might want to list the publishers in ascending order, with each publisher appearing only once. If you use only the SORT statement, COR appears seven times (because seven books in the file are published by COR), FERN appears four times, VALD five times, and WETH four times.

By specifying FIELDS=NONE on the SUM statement, as shown below, DFSORT writes only one record per publisher:

```
SORT FIELDS=(106,4,CH,A)
SUM FIELDS=NONE
```

Table 23 shows the result.

Table 23. List of Publishers, Deleting Duplicates

Book Title		Publisher
1	75	106 109
LIVING WELL ON A SMALL BUDGET		COR
COMPUTER LANGUAGES		FERN
VIDEO GAME DESIGN		VALD
COMPUTERS: AN INTRODUCTION		WETH

In Chapter 10, "Using the ICETOOL Utility," on page 105, you will learn how to use ICETOOL's powerful SELECT, OCCUR and SPLICE operators to perform many more functions involving duplicate and non-duplicate records.

---

### Handling Overflow

When a sum becomes larger than the space available for it, *overflow* occurs. For example, if a 2-byte binary field (unsigned) contains X'FFFF' and you add X'0001' to it, overflow occurs, because the sum requires more than two bytes.

```
FFFF
0001
----
10000
```

If overflow occurs, the summary fields in the two records involved are not added together. That is, the records are kept unchanged; neither record is deleted.

In some cases, you can correct overflow by padding the summary fields with zeros, using the INREC control statement. "Preventing Overflow When Summing Values" on page 57 shows you how to do this.

---

### VB Data Set Considerations

The same VB data set considerations you learned about previously for the SORT, MERGE, INCLUDE and OMIT statements also apply to the SUM statement.

#### Starting Positions

When you code your summary fields for VB records, remember to add 4 to the starting position to account for the 4-byte RDW. For example, the following SUM statement specifies a PD summary field in the third through fifth data bytes of a VB record:

```
SUM FIELDS=(7,3,PD)
```

#### Short Summary Fields

If you know you have VB records with short summary fields, you can specify the VLSHRT option, if appropriate, to prevent DFSORT from terminating. For example:

```
OPTION VLSHRT
SORT FIELDS=(6,2,CH,A)
SUM FIELDS=(21,8,ZD)
```

VLSHRT tells DFSORT to leave records with short summary fields unsummed. That is, when one of the two records involved in a summary operation has a short summary field, the records are kept unchanged; neither record is deleted.

**Attention:** If NOVLSHRT is in effect, DFSORT terminates if it finds a short summary field in any VB record.

For more information on DFSORT's VLSHRT option, see *z/OS DFSORT Application Programming Guide*.

#### Summary

This chapter covered summing records in your data set. It explained how to use the SUM statement to sum records with equal control fields, and how to suppress any records with duplicate control fields. Now, you continue with tutorials about using OUTREC and INREC to reformat your data sets.

---

## Chapter 5. Reformatting Records

You can reformat records in your data sets by using the INREC, OUTREC, and OUTFIL control statements. You can use these statements separately or together.

With INREC, OUTREC, and OUTFIL, you can perform a wide variety of tasks while sorting, copying, or merging, including the following:

- Delete fields.
- Reorder fields.
- Insert separators (blanks, zeros, strings, current date, and current time).
- Convert data to its hexadecimal representation.
- Convert lowercase characters to uppercase characters, and uppercase characters to lowercase characters.
- Convert numeric values to many different types of printable formats with or without thousands separators, decimal point, leading or suppressed zeros, and signs.
- Convert numeric values from one format to another format.
- Perform arithmetic using numeric values and decimal constants.
- Change values using a lookup table.
- Insert sequence numbers.

You can reformat records in one of the following three ways:

- **BUILD:** Reformat each record by specifying all of its items one by one. Build gives you complete control over the items you want in your reformatted records and the order in which they appear. You can delete, rearrange and insert fields and constants.

**Note:** For INREC and OUTREC, you can use either the BUILD parameter or the FIELDS parameter. For OUTFIL, you can use either the BUILD parameter or the OUTREC parameter.

- **OVERLAY:** Reformat each record by specifying just the items that overlay specific columns. Overlay lets you change specific existing columns without affecting the entire record.
- **IFTHEN clauses:** Reformat different records in different ways by specifying how build or overlay items are applied to records that meet given criteria. IFTHEN clauses let you use sophisticated conditional logic to choose how different record types are reformatted.

The INREC, OUTREC, and OUTFIL statements can all perform the same functions. However:

- The **INREC** statement reformats records **before** they are sorted, copied or merged. See “Using Other Statements with INREC” on page 56 for information about how INREC affects other control statements.
- The **OUTREC** statement reformats records **after** they are sorted, copied or merged.
- The **OUTFIL** statement can reformat records for OUTFIL output data sets **after** they are sorted, copied or merged. Different reformatting parameters can be used for different OUTFIL data sets. The information presented in this Chapter for the INREC and OUTREC statements also applies to the OUTFIL statement. OUTFIL is discussed later in Chapter 6, “Creating Multiple Output Data Sets and Reports,” on page 65.

## Reformatting Records After Sorting with BUILD or FIELDS

In the last chapter, you used the SUM statement to sum the price of the books in stock and the books sold for each publisher. Now, using the FIELDS or BUILD parameter of the OUTREC statement, you can delete all the fields that are not needed for the application; in other words, fields whose contents are not meaningful in a summation record. Only the publisher, number-in-stock, and number-sold fields are written, reducing the output record length to 12 bytes.

The OUTREC statement looks like this:

```
OUTREC FIELDS=(106,4,162,4,166,4)
```

Here are the steps for writing this OUTREC statement:

*Table 24. Steps to Create the OUTREC Statement for Reformatting Records*

Step	Action
1	Leave at least one blank, and type <b>OUTREC</b>
2	Leave at least one blank, and type <b>FIELDS=</b> (or <b>BUILD=</b> )
3	Type, in parentheses, and separated by commas: <ol style="list-style-type: none"> <li>1. The location and length of the publisher field</li> <li>2. The location and length of the number in stock field</li> <li>3. The location and length of the number sold field.</li> </ol>

The SORT, SUM and OUTREC statements are shown below:

```
SORT FIELDS=(106,4,CH,A)
SUM FIELDS=(162,4,BI,166,4,BI)
OUTREC FIELDS=(106,4,162,4,166,4)
```

Table 25 shows the output.

*Table 25. Writing Only Publisher, Number In Stock, and Number Sold Fields*

Publisher	Number In Stock	Number Sold
1 4	5 8	9 12
COR	103	161
FERN	19	87
VALD	42	97
WETH	62	79

The number in stock and number sold fields are binary values which would actually be unreadable if you printed or displayed the output records shown in Table 25. Later in this chapter, you'll learn how binary and other unreadable numeric values can be converted to various readable forms.

Suppose you use this SORTOUT DD statement for your output data set:

```
//SORTOUT DD DSN=MY.OUTPUT,DISP=(NEW,CATLG,DELETE),
// UNIT=SYSDA,SPACE=(CYL,(5,5))
```

DFSORT automatically sets the LRECL of your new output data set (MY.OUTPUT) to the reformatted output record length, so LRECL=12 would be set in this case. You do not need to specify the LRECL on your SORTOUT DD statement, because DFSORT will set it appropriately for you.

If your SORTOUT data set already has an LRECL value (OLD data set), or you choose to specify an LRECL value on the SORTOUT DD statement, that value overrides the value DFSORT would set for the LRECL. This can result, intentionally or unintentionally, in padding or truncating your output records if the calculated length of the reformatted record does not match your specified LRECL.

In general, it is best to let DFSORT set the RECFM, LRECL and BLKSIZE for your NEW SORTOUT data sets, unless you have a particular reason to override these values. For OLD SORTOUT data sets, ensure that the existing RECFM, LRECL and BLKSIZE values are appropriate for the control statements you use.

---

## Reordering Fields to Reserve Space

The fields always appear in the order in which you specify them. Therefore, if you want the number sold to appear before the number in stock, as shown in Table 26, you reverse their order on the OUTREC statement.

```
SORT FIELDS=(106,4,CH,A)
SUM FIELDS=(162,4,BI,166,4,BI)
OUTREC FIELDS=(106,4,166,4,162,4)
```

*Table 26. Reordering the Fields*

Publisher	Number Sold	Number In Stock
1 4	5 8	9 12
COR	161	103
FERN	87	19
VALD	97	42
WETH	79	62

---

## Inserting Binary Zeros

Building on the last example, assume you want to reformat the records to include a new 4-byte binary field after the number in stock (beginning at byte 13). In this case, you can insert binary zeros as place holders for the new field (to be filled in with data at a later date). You can use Z or 1Z to specify a single binary zero. You can use nZ to specify n binary zeros.

To insert four binary zeros, write 4Z after the last field:

```
SORT FIELDS=(106,4,CH,A)
SUM FIELDS=(162,4,BI,166,4,BI)
OUTREC FIELDS=(106,4,166,4,162,4,4Z)
```

## Reformatting Records

Table 27 shows the result.

Table 27. Inserting Binary Zeros

Publisher	Number Sold	Number In Stock	X'0...0'
1 4	5 8	9 12	13 16
COR	161	103	0...0
FERN	87	19	0...0
VALD	97	42	0...0
WETH	79	62	0...0

## Inserting Blanks

If an output data set contains *only character data*, you can print it by writing the SORTOUT DD statement as follows:

```
//SORTOUT DD SYSOUT=A
```

You can make the printout more readable by using the OUTREC statement to separate the fields with blanks and to create margins. You can insert blanks before, between, or after fields. You can use X or 1X to specify a single blank. You can use nX to specify n blanks.

For example, assume you want to print just the publisher and title fields, with the publisher field appearing first. Because most of the publishers' names fill up the entire 4-byte publisher field, the publishers' names will run into the titles if you do not separate the two fields with blanks. Also, without a margin, the publishers' names will begin at the edge of the paper.

The printout can be made more readable by creating a left margin of 20 blanks and by separating the fields with 10 blanks.

To insert 20 blanks, write 20X before the first field. To insert 10 blanks, write 10X between the two fields. The SORT statement sorts the records by title in ascending order (remember that SORT, COPY, or MERGE is always required).

```
|      SORT FIELDS=(1,75,CH,A)
|      OUTREC BUILD=(20X,106,4,10X,1,75)
```

Table 28 shows the result.

Table 28. Output After Inserting Blanks

Publisher				Book Title	
1	20	21 24	25 34	35	190

Table 28. Output After Inserting Blanks (continued)

Publisher		Book Title
(20 Blanks)	(10 Blanks)	
FERN		ADVANCED TOPICS IN PSYCHOANALYSIS
FERN		COMPUTER LANGUAGES
WETH		COMPUTERS: AN INTRODUCTION
COR		CRISES OF THE MIDDLE AGES
VALD		EDITING SOFTWARE MANUALS
WETH		EIGHTEENTH CENTURY EUROPE
COR		INKLINGS: AN ANTHOLOGY OF YOUNG POETS
VALD		INTRODUCTION TO BIOLOGY
COR		INTRODUCTION TO PSYCHOLOGY
COR		LIVING WELL ON A SMALL BUDGET
COR		MODERN ANTHOLOGY OF WOMEN POETS
FERN		NUMBERING SYSTEMS
COR		PICK'S POCKET DICTIONARY
VALD		SHORT STORIES AND TALL TALES
VALD		STRATEGIC MARKETING
COR		SUPPLYING THE DEMAND
WETH		SYSTEM PROGRAMMING
FERN		THE COMPLETE PROOFREADER
WETH		THE INDUSTRIAL REVOLUTION
VALD		VIDEO GAME DESIGN

If you know the columns you want your fields to start in, you can specify them directly instead of figuring out how many blanks to use. For example, if you want the publisher field to start in column 21 and the title field to start in column 35, as above, you can write the OUTREC statement as:

```
OUTREC BUILD=(21:106,4,35:1,75)
```

c: causes DFSORT to fill in blanks from the last field with data (or column 1) up to the column before c. So 21: puts blanks in columns 1-20 and 35: puts blanks in column 25-34.

Specifying c:X as your last field is an easy way to increase the record length of your output records to c bytes. For example, if you want to create 80-byte output records containing the first 30 bytes of your input records padded with blanks, you can use this OUTREC statement:

```
OUTREC BUILD=(1,30,80:X)
```

DFSORT automatically sets LRECL=80 for the SORTOUT data set if you do not override the LRECL.

## Inserting Strings

In addition to making the printout more readable, OUTREC can also be used to set up a very basic report format by inserting strings. ICETOOL's DISPLAY operator or the OUTFIL control statement can be used to create complex reports, as you will see later in this document. The formats for writing strings are shown below.

## Character Strings

The format for repeating a character string is:

```
C'x...x'
```

## Reformatting Records

where *x* is an EBCDIC character. For example, C'FERN'.

The format for repeating a character string is:

nC'x...x'

where *n* can be from 1 to 4095; *n* repetitions of the character string (C'x...x') are inserted into the reformatted records. If *n* is omitted, 1 is used instead.

If you want to include a single apostrophe in the string, you must specify it as two single apostrophes. For example, O'NEILL must be specified as C'O"NEILL'.

You can use special keywords to insert a character string for the date or time of the run in various forms, as detailed in *z/OS DFSORT Application Programming Guide*. For example, suppose you want to insert the following at the end of an 80 byte record:

- the string 'Timestamp: '
- the date of the run in the form C'yyyy/mm/dd',
- a blank, and
- the time of the run in the form C'hh:mm'

Here's the OUTREC statement:

```
OUTREC FIELDS=(1,80,C'Timestamp: ',DATE1(/),X,TIME2(:))
```

## Hexadecimal Strings

The format for writing a hexadecimal string is:

X'yy...yy'

where *yy* is a pair of hexadecimal digits. For example, X'7FB0'.

The format for repeating a hexadecimal string is:

X'yy...yy'

where *n* can be from 1 to 4095. *n* repetitions of the hexadecimal string (X'yy...yy') are inserted in the reformatted records. If *n* is omitted, 1 is used.

## Setting Up a Basic Report

To produce a very basic report of the publisher's names and author's names from the bookstore data set, you can use the following OUTREC statement to put in "Publisher is" and "Author is" as character separators.

```
OPTION COPY
OUTREC FIELDS=(11:C'Publisher is ',106,4,
31:C'Author is ',91,15,X,76,15)
```

The result is shown in Table 29.

Table 29. Output of a Report

Publisher								Author's First Name		Author's Last Name	
1	10	11	22	24	27	31	39	41	55	57	71



Table 29. Output of a Report (continued)

		Publisher		Author's First Name	Author's Last Name
(10 blanks)	Publisher is	FERN	Author is	ROBERT	MURRAY
	Publisher is	COR	Author is	FRANK	DEWAN
	Publisher is	COR	Author is	TOM	MILLER
	Publisher is	VALD	Author is	LORI	RASMUSSEN
	Publisher is	COR	Author is	KAREN	WILDE
	Publisher is	WETH	Author is	JOKHI	DINSHAW
	Publisher is	COR	Author is	CAROL	GUSTLIN
	Publisher is	VALD	Author is	VICTOR	OJALVO
	Publisher is	FERN	Author is	WILLIAM	BAYLESS
	Publisher is	VALD	Author is	MARK	YAEGER
	Publisher is	WETH	Author is	DON	GROSS
	Publisher is	COR	Author is	PETER	COWARD
	Publisher is	COR	Author is	LINDA	DUZET
	Publisher is	FERN	Author is	ANN	GREEN
	Publisher is	WETH	Author is	RAUL	CAUDILLO
	Publisher is	VALD	Author is	LILIANA	AVRIL
	Publisher is	VALD	Author is	CHIEN	WU
	Publisher is	FERN	Author is	DIANNE	OSTOICH
	Publisher is	WETH	Author is	ALICE	MUNGER
	Publisher is	COR	Author is	GREG	BENDER

**So Far**

So far this chapter has covered how the BUILD or FIELDS parameter of the OUTREC statement can reformat the records of your output data set to contain only the fields and constants you specify. This chapter also covered inserting binary zeros as place holders, and using blanks and strings to make a printout of the output data set more readable. In the following sections, you will learn how to use other reformatting features to change input fields in various ways for output.

## Changing Uppercase to Lowercase

You could use the following statements to show all of the authors for the books used in computer courses:

```
INCLUDE COND=(110,5,CH,EQ,C'COMP')
SORT FIELDS=(76,15,CH,A,91,15,CH,A)
OUTREC FIELDS=(91,15,X,76,15)
```

The results produced for these statements are:

```
WILLIAM      BAYLESS
RAUL         CAUDILLO
JOKHI        DINSHAW
ROBERT       MURRAY
LORI         RASMUSSEN
```

The author's first and last names are displayed as uppercase letters, because they are stored that way in the bookstore data set. If you wanted to display these names with an initial uppercase letter and subsequent lower case letters, you could use the following OUTREC statement:

```
OUTREC FIELDS=(91,1,92,14,TRAN=UTOL,X,76,1,77,14,TRAN=UTOL)
```

The results produced for this OUTREC statement are:

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William	Bayless
Raul	Caudillo
Jokhi	Dinshaw
Robert	Murray
Lori	Rasmussen

p,m,TRAN=UTOL changes each uppercase letter (A-Z) in the field to the equivalent lowercase letter (a-z). In our example, p,m,TRAN=UTOL changes uppercase letters to lowercase letters starting with the **second** letter of the author's first name and the **second** letter of the author's last name. The first letter of each name is not included in the TRAN=UTOL field; these uppercase letters are moved to the output record unchanged.

p,m,TRAN=LTOU is similar to p,m,TRAN=UTOL, but changes each lowercase letter (a-z) in a field to the equivalent uppercase letter (A-Z).

p,m,TRAN=ALTSEQ can be used to change characters in a field to other characters as specified by an ALTSEQ statement. For example, a "null" character (hex 00) can be changed to a blank character (hex 40).

For detailed information on all of the TRAN parameters, see *z/OS DFSORT Application Programming Guide*.

---

## Converting Numeric Fields to Different Formats

Suppose you want the summed binary values in Table 25 on page 38 be readable so you can print or display them. You can use the following statements to convert the BI values to readable ZD values:

```
OPTION COPY
OUTREC FIELDS=(1,4,X,
                5,4,BI,TO=ZD,LENGTH=6,X,
                9,4,BI,TO=ZD,LENGTH=6)
```

p,m,BI,TO=ZD converts the BI values to ZD values. By default, a 4-byte BI value produces a 10-byte ZD value, but LENGTH=6 overrides the default length to produce a 6-byte ZD value.

Table 30 shows the output, which is readable:

*Table 30. Converting from BI to ZD*

Publisher	Number In Stock	Number Sold
1 4	6 11	13 18
COR	000103	000161
FERN	000019	000087
VALD	000042	000097
WETH	000062	000079

Alternatively, you can use the following OUTREC statement to convert the BI values to readable FS values:

```
OUTREC FIELDS=(1,4,X,
                5,4,BI,TO=FS,LENGTH=6,X,
                9,4,BI,TO=FS,LENGTH=6)
```

p,m,BI,TO=FS converts the BI values to FS values. By default, a 4-byte BI value produces an 11-byte FS value, but LENGTH=6 overrides the default length to produce a 6-byte FS value.

Table 31 shows the output, which is readable:

*Table 31. Converting from BI to FS*

Publisher	Number In Stock	Number Sold
1 4	6 11	13 18
COR	103	161
FERN	19	87
VALD	42	97
WETH	62	79

You can use `p,m,f,TO=f` or `p,m,f,f` to convert from various numeric formats to various other numeric formats. You can use `LENGTH=n` to override the default output length.

For detailed information on DFSORT's numeric conversion parameters, see *z/OS DFSORT Application Programming Guide*.

## Editing Numeric Fields

Suppose you have input records with numeric values stored in PD format that you want to display or print so they can be easily interpreted. PD values are stored as integers in a compressed internal format that is actually unreadable if you print or display the values.

However, you know that:

- The first PD field represents a number with two decimal places.
- The second PD field represents a number with three decimal places.
- The third PD field represents a date in the form `mmddyyyy`.

You can use the edit features of the OUTREC statement to display the digits of the PD values as readable characters. Furthermore, you can use the edit features to insert signs, commas, decimal points and hyphens, as appropriate, to make the PD values easy to interpret.

Table 32 shows the relevant input fields in the records. The PD fields are represented as readable numbers in Table 32, but they are really stored in an unreadable format.

*Table 32. Input records with PD values*

CH field	First PD field	Second PD field	Third PD field
1 8	11 16	31 37	41 45
WEST	+1524900810	+0000000020000	+05122003
EAST	-0065781053	+0721500532006	+11292003
NORTH	+0000000000	-0000982630735	+02152004
SOUTH	-0000003562	-0003826254999	+12032003

You can use the following OUTREC statement to make the PD values meaningful:

```
OUTREC FIELDS=(1,8,
  5X,
  11,6,PD,M4,
  5X,
  31,7,PD,EDIT=(SI,III,III,IIT.TTT),SIGNS=(,-),
  5X,
  41,5,PD,EDIT=(TT-TT-TTTT))
```

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M4 is one of DFSORT's 27 pre-defined edit masks (see Table 33 below). It edits a numeric field according to the pattern SI,III,III,III,IIT.TT. EDIT=(SI,III,III,IIT.TTT) is a user-defined edit mask. It edits a numeric field according to the pattern SI,III,III,IIT.TTT. EDIT=(TT-TT-TTTT) is another user-defined edit mask. It edits a numeric field according to the pattern TT-TT-TTTT.

In the patterns:

- **I** indicates a leading insignificant digit to be displayed as 1-9, or as blank for a leading 0.
- **T** indicates a significant digit to be displayed as 0-9.
- **S** before the digits indicates a leading sign. **S** after the digits indicates a trailing sign. For M4, the leading sign is to be displayed as + for a positive value or as – for a negative value. For EDIT=(SI,III,III,IIT.TTT),SIGNS=(,–), the leading sign is to be displayed as blank for a positive value or as – for a negative value.
- Any other character (for example, comma, decimal point or hyphen) is just displayed as appropriate.

The results produced for the OUTREC statement are:

WEST	+15,249,008.10	20.000	05-12-2003
EAST	-657,810.53	3,721,500,532.006	11-29-2003
NORTH	+0.00	-982,630.735	02-15-2004
SOUTH	-35.62	-3,826,254.999	12-03-2003

Pre-defined and user-defined edit masks give you a great deal of flexibility in how you format your numeric fields for output. You can use p,m,f,Mnn or p,m,f,EDIT=(pattern) to edit various numeric fields according to various output patterns. You can use SIGNS=(a,b,c,d) to override or set the output signs (leading positive, leading negative, trailing positive and trailing negative). You can use LENGTH=n to override or set the output length.

See *z/OS DFSORT Application Programming Guide* for complete details about DFSORT's numeric editing parameters. For easy reference, Table 33 shows the patterns for the 27 pre-defined edit masks (M0-M26) as well as examples of the output for each mask.

Table 33. Edit Mask Patterns

Mask	Pattern	Examples	
		Value	Result
M0	IIIIIIIIIIIIIIIIIIIIIIITS	+01234	1234
		-00001	1-
M1	TTTTTTTTTTTTTTTTTTTTTTTTTTTS	-00123	00123-
		+00123	00123
M2	II,III,III,III,III,III,III,III,IIT.TTS	+123450	1,234.50
		-000020	0.20-
M3	II,III,III,III,III,III,III,III,IIT.TTCR	-001234	12.34CR
		+123456	1,234.56
M4	SII,III,III,III,III,III,III,III,IIT.TT	+0123456	+1,234.56
		-1234567	-12,345.67
M5	SII,III,III,III,III,III,III,III,IIT.TTS	-001234	(12.34)
		+123450	1,234.50

Table 33. Edit Mask Patterns (continued)

Mask	Pattern	Examples	
		Value	Result
M6	III-TTT-TTTT	00123456	012-3456
		12345678	1-234-56788
M7	TTT-TT-TTTT	00123456	000-12-3456
		12345678	012-34-5678
M8	IT:TT:TT	030553	3:05:53
		121736	12:17:36
M9	IT/TT/TT	123004	12/30/04
		083104	8/31/04
M10	IIIIIIIIIIIIIIIIIIIIIT	01234	1234
		00000	0
M11	TTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTT	00010	00010
		01234	01234
M12	SI,III,III,III,III,III,III,III,III,III,IT	+1234567	1,234,567
		-0012345	-12,345
M13	SI.III.III.III.III.III.III.III.III.III.IT	+1234567	1.234.567
		-0012345	-12.345
M14	SI III III III III III III III III III ITS	+1234567	1 234 567
		-0012345	(12 345)
M15	I III III III III III III III III III ITS	+1234567	1 234 567
		-0012345	12 345-
M16	SI III III III III III III III III III IT	+1234567	1 234 567
		-0012345	-12 345
M17	SI'III'III'III'III'III'III'III'III'III'IT	+1234567	1'234'567
		-0012345	-12'345
M18	SII,III,III,III,III,III,III,III,III,IT.TT	+0123456	1,234.56
		-1234567	-12,345.67
M19	SII.III.III.III.III.III.III.III.III.IT,TT	+0123456	1.234.56
		-1234567	-12.345.67
M20	SI III III III III III III III III IT,TTS	+0123456	1 234.56
		-1234567	(12 345,67)
M21	II III III III III III III III III IT,TTS	+0123456	1 234,567
		-1234567	12 345,67-
M22	SI III III III III III III III III IT,TT	+0123456	1 234.56
		-1234567	-12 345.67
M23	SII'III'III'III'III'III'III'III'III'IT.TT	+0123456	1'234.56
		-1234567	-12'345.67
M24	SII'III'III'III'III'III'III'III'III'IT,TT	+0123456	1'234.56
		-1234567	-12'345.67

## Reformatting Records

Table 33. Edit Mask Patterns (continued)

Mask	Pattern	Examples	
		Value	Result
M25	S	+01234	1234
		-00001	-1
M26	S	1234	+01234
		-1	-00001

## Displaying Data in Hexadecimal

If you are curious about how the CH and PD values in Table 32 on page 45 are actually stored, you can use this OUTREC statement to display hexadecimal representations of these fields:

```
OUTREC FIELDS=(1,8,HEX,
                2X,
                11,6,HEX,
                2X,
                31,7,HEX,
                2X,
                41,5,HEX)
```

The results produced for this OUTREC statement are:

```
E6C5E2E340404040 01524900810C 0000000020000C 005122003C
C5C1E2E340404040 00065781053D 3721500532006C 011292003C
D5D6D9E3C8404040 000000000000C 0000982630735D 002152004C
E2D6E4E3C8404040 00000003562D 0003826254999D 012032003C
```

## Performing Arithmetic with Numeric Fields and Constants

Suppose you want to display the results of subtracting the second PD field in Table 32 on page 45 from the first PD field in Table 32 on page 45. As discussed previously, the PD fields are stored as integers, but we know that:

- The first PD field is 6 bytes and represents a signed number with 11 digits including two decimal places.
- The second PD field is 7 bytes and represents a signed number with 13 digits including three decimal places.

In order to do arithmetic on these fields, you must ensure that the integer and decimal parts of the numbers match up correctly. For example, in the first record, the first PD value is +1524900810 representing +15249008.10 and the second PD value is +20000 representing +20.000. In order to subtract the second PD value from the first PD value, you need to put them in the following forms:

```
+15249008.100
+00000020.000
```

You could use the following OUTREC statement to handle the subtraction correctly:

```
OUTREC FIELDS=(1,8,
                5X,
                ((11,6,PD,MUL,+10),SUB,31,7,PD),
                EDIT=(SI,III,III,IIT.TTT),SIGNS=(,-))
```

11,6,PD,MUL,+10 multiplies the first PD field by 10 to match up the decimal places. SUB,31,7,PD subtracts the second PD field from the results of the 11,6,PD,MUL,+10 operation.

EDIT and SIGNS are used to make the results more meaningful.

The results produced for this OUTREC statement are:

WEST	15,248,988.100
EAST	-3,722,158,342.536
NORTH	982,630.735
SOUTH	3,826,219.379

You can do arithmetic with numeric fields and decimal constants (+n and -n) using the operators MIN (minimum), MAX (maximum), DIV (division), MUL (multiplication), MOD (modulus), ADD (addition) and SUB (subtraction). The order of evaluation precedence for the operators is as follows, but can be changed by using parentheses:

1. MIN and MAX
2. MUL, DIV and MOD
3. ADD and SUB

You can use p,m,f, MIN, MAX, MUL, DIV, MOD, ADD, SUB, +n, -n and parentheses to do a wide variety of arithmetic operations for various numeric formats. The result of an arithmetic operation is a 15-digit ZD value that can be converted to a different numeric format, or edited using pre-defined edit masks (M0-M26) or user-defined edit masks, as discussed earlier.

For complete details on arithmetic operations, see *z/OS DFSORT Application Programming Guide*.

---

## Doing Lookup and Change

You can use the following statements to show all of the course departments and the publishers whose books they use:

```
SORT FIELDS=(110,5,CH,A,106,4,CH,A)
SUM FIELDS=NONE
OUTREC FIELDS=(110,5,X,106,4)
```

The results produced for these statements are:

```
      COR
BIOL  VALD
BUSIN  COR
BUSIN  VALD
COMP  FERN
COMP  VALD
COMP  WETH
ENGL  COR
ENGL  FERN
ENGL  VALD
HIST  COR
HIST  WETH
PSYCH  COR
PSYCH  FERN
```

This list is rather cryptic as everything is abbreviated. You can use the following OUTREC statement to make the list more meaningful by substituting descriptive words for the abbreviations.

## Reformatting Records

```
OUTREC  FIELDS=(110,5,CHANGE=(16,
    C'HIST',C'History',
    C'BUSIN',C'Business',
    C'COMP',C'Computer Science',
    C'ENGL',C'English',
    C'BIOL',C'Biology',
    C'PSYCH',C'Psychology'),
    NOMATCH=(C'Unaffiliated'),
    C' | ',
    106,4,CHANGE=(20,
    C'FERN',C'Fernal Brothers',
    C'CORN',C'Cornish Limited',
    C'VALD',C'Valdern and Co.',
    C'WETH',C'Wethman, Inc.'))
```

The results produced for this OUTREC statement are:

Unaffiliated	Cornish Limited
Biology	Valdern and Co.
Business	Cornish Limited
Business	Valdern and Co.
Computer Science	Fernal Brothers
Computer Science	Valdern and Co.
Computer Science	Wethman, Inc.
English	Cornish Limited
English	Fernal Brothers
English	Valdern and Co.
History	Cornish Limited
History	Wethman, Inc.
Psychology	Cornish Limited
Psychology	Fernal Brothers

Table lookup and change allows you to find an input field value in a table of character, hexadecimal or bit constants, and set a corresponding character constant, hexadecimal constant, or input field in the output record.

You use `p, m, CHANGE=(v,find,set,...)` to give the position and length of the input field, the length of the output field, and the "table" consisting of pairs of find constants, and set constants or set fields. For example, for the first field in the OUTREC statement above:

- The input field starts in position 110.
- The length of the input field and find constants is 5.
- The length of the output field and set constants is 16.
- The first find constant is 'HIST' (padded with a blank at the end to 5 characters).
- The first set constant is 'History' (padded with blanks at the end to 16 characters).

Whenever the course department contains 'HIST', the output field is set to 'History'. Whenever the course department contains 'BUSIN', the output field is set to 'Business', and so on.

You can use `NOMATCH=(set)` to set the output value when an input field value does not match any of the find constants. `NOMATCH=(C'string')` sets a character string constant. `NOMATCH=(X'string')` sets a hexadecimal string constant. `NOMATCH=(q,n)` sets an input field value. For example, in the OUTREC statement above, an input field value of blanks results in an output field value of 'Unaffiliated' (padded with blanks at the end to 16 characters). If you do not specify `NOMATCH=(set)`, DFSORT terminates with an error message when an input field value does not match any of the find constants.



For complete details on lookup and change, see *z/OS DFSORT Application Programming Guide*.

### So Far

Now you know how to use the many features available with the BUILD or FIELDS parameter of the OUTREC statement to reformat your input records in many ways for output. Keep in mind that you can use all of these reformatting features with the BUILD or FIELDS parameter of the INREC statement and with the BUILD or OUTREC parameter of the OUTFIL statement, as well as with the OUTREC statement. In fact, you can use all of these statements together, when appropriate. Next, you will learn how to use the OVERLAY parameter of the OUTREC statement to change one or more fields without affecting the rest of your record.

## Reformatting Records with OVERLAY

With the BUILD or FIELDS parameter of the OUTREC statement, you build your reformatted output record one item at a time. You must specify each item (unedited, edited or converted input field, blanks, string, and so on) you want in the output record in the order in which you want it to appear.

But if you only want to change one or a few items and keep the rest of the record in its original form, there's an easier way: the OVERLAY parameter of the OUTREC statement. You can use the same items with the OVERLAY parameter we discussed earlier for the BUILD or FIELDS parameter.

Suppose you want to change the course department to lowercase and discount the price of each book by 10%. You can use the following statements to create an output data set with the new price instead of the old price in each output record:

```
OPTION COPY
OUTREC BUILD=(1,109,
              110:110,5,TRAN=UTOL,
              115:115,55,
              170:170,4,BI,SUB,(170,4,BI,DIV,+10),
              TO=BI,LENGTH=4)
```

The arithmetic expression in the OUTREC parameter gives you a new 4-byte BI price as follows:

new price = old price - (old price / 10)

With the BUILD parameter, you must build the entire record, so you must specify the following:

- 1,109 to keep the bytes before the course department
- 110,5,TRAN=UTOL to change the course department from uppercase to lowercase
- 115,55 to keep the bytes between the course department and the price
- 170:170,4,BI,SUB,(170,4,BI,DIV,+10),TO=BI,LENGTH=4 to replace price with price=price-(price/10)

But since you are not changing the bytes before the course department or between the course department and the price, it's easier to use the OVERLAY parameter to just overlay the bytes you want to change as follows:

## Reformatting Records

```
OPTION COPY
OUTREC OVERLAY=(110:110,5,TRAN=UTOL,
170:170,4,BI,SUB,(170,4,BI,DIV,+10),
TO=BI,LENGTH=4)
```

Table 34 shows the copied data set.

*Table 34. Books with Course Department and Price Changes*

Book Title	Department	Price
1 75	110 114	170 173
COMPUTER LANGUAGES	comp	2340
LIVING WELL ON A SMALL BUDGET		8910
SUPPLYING THE DEMAND	busin	1733
VIDEO GAME DESIGN	comp	1980
INKLINGS: AN ANTHOLOGY OF YOUNG POETS	engl	0536
COMPUTERS: AN INTRODUCTION	comp	1710
PICK'S POCKET DICTIONARY		0266
EDITING SOFTWARE MANUALS	engl	1305
NUMBERING SYSTEMS	comp	0324
STRATEGIC MARKETING	busin	2115
THE INDUSTRIAL REVOLUTION	hist	0716
MODERN ANTHOLOGY OF WOMEN POETS	engl	0405
INTRODUCTION TO PSYCHOLOGY	psych	1980
THE COMPLETE PROOFREADER	engl	0563
SYSTEM PROGRAMMING	comp	2876
SHORT STORIES AND TALL TALES	engl	1368
INTRODUCTION TO BIOLOGY	biol	2115
ADVANCED TOPICS IN PSYCHOANALYSIS	psych	2340
EIGHTEENTH CENTURY EUROPE	hist	1611
CRISES OF THE MIDDLE AGES	hist	1080

With the OVERLAY parameter, you don't have to figure out or specify 1,109 or 115,55. Instead you just specify each output starting column (110: and 170:) and its replacement item. Any column you don't overlay remains the same. In addition, in contrast to BUILD items, OVERLAY items can overlap each other and can be specified in any order. In our case, the following OUTREC statement would give the same results as the previous OUTREC statement:

```
OPTION COPY
OUTREC OVERLAY=(170:170,4,BI,SUB,(170,4,BI,DIV,+10),
TO=BI,LENGTH=4,
110:110,5,TRAN=UTOL)
```

## Extending Records with OVERLAY

You can also use the OVERLAY parameter to extend your output record without affecting the rest of the record.

Suppose you want to replace the old price with a new price discounted by 10%, but also extend the record with a new field containing the original price. You can use the following statements:

```
OPTION COPY
OUTREC OVERLAY=(174:170,4,
170:170,4,BI,SUB,(170,4,BI,DIV,+10),
TO=BI,LENGTH=4)
```

Table 35 shows the copied data set.

*Table 35. New and Old Prices*

New Price	Old Price
170 173	174 177
2340	2600
8910	9900
1733	1925
1980	2199
0536	0595
1710	1899
0266	0295
1305	1450
0324	0360
2115	2350
0716	0795
0405	0450
1980	2200
0563	0625
2876	3195
1368	1520
2115	2350
2340	2600
1611	1790
1080	1200

Since you added a new field at positions 174-177, DFSORT automatically increases the record length from 173 bytes to 177 bytes.

In this case, the order in which you specify the two overlay items is important because you are using the old price for both items. So you must make the copy of the old price before you modify it. Thus, in the OUTREC statement above, the first overlay item copies the old price to the new field, and the second overlay item replaces the old price with the new price. If you used this OUTREC statement:

```
OUTREC OVERLAY=(170:170,4,BI,SUB,(170,4,BI,DIV,+10),
                 TO=BI,LENGTH=4,
                 174:170,4)
```

you would inadvertently replace the old price with the new price and then copy the new price to the new field. Thus, you would have the new price in both fields instead of having the new price in one field and the old price in the other field. Since OVERLAY allows overlapping items, you must be careful not to destroy a field with an earlier overlay item that you want to use in a later overlay item.

#### So Far

Now you know how to use the OVERLAY parameter of the OUTREC statement to overlay specified columns with reformatting items, without affecting the rest of your reformatted record. Keep in mind that you can use all of these reformatting features with the OVERLAY parameter of the INREC statement and OUTFIL statement, as well as with the OUTREC statement. Next, you will learn how to use IFTHEN clauses with the OUTREC statement to reformat different records in different ways.

## Reformatting Records with IFTHEN

The OVERLAY and BUILD or FIELDS parameters discussed in previous sections let you use the same reformatting items for every output record. IFTHEN clauses for the OUTREC statement let you select subsets of the output records and apply different BUILD or OVERLAY items to them. So you can apply a set of BUILD items to "type 1" records, a set of OVERLAY items to "type 2" records, another set of BUILD items to "type 3" records, and a different set of OVERLAY items (or no items) to other types of records.

You can use four types of IFTHEN clauses as follows:

- **WHEN=INIT:** Use one or more WHEN=INIT clauses to apply BUILD or OVERLAY items to all of your input records. WHEN=INIT clauses are processed before any of the other IFTHEN clauses.
- **WHEN=(logexp):** Use one or more WHEN=(logexp) clauses to apply BUILD or OVERLAY items to the subset of your records that satisfy a specified logical expression. You can use any logical expression for WHEN=(logexp) that you can use for the COND=(logexp) parameter of an INCLUDE statement as previously discussed in Chapter 3, "Including or Omitting Records," on page 25. A WHEN=(logexp) clause is satisfied when the logical expression evaluates as true.
- **WHEN=ANY:** Use a WHEN=ANY clause after multiple WHEN=(logexp) clauses to apply additional BUILD or OVERLAY items to your records if they satisfied the criteria for any of the preceding WHEN=(logexp) clauses.
- **WHEN=NONE:** Use one or more WHEN=NONE clauses to apply BUILD or OVERLAY items to your records that did not meet the criteria for any of the WHEN=(logexp) clauses. WHEN=NONE clauses are processed after any of the other IFTHEN clauses. If you do not specify a WHEN=NONE clause, only the WHEN=INIT changes (if any) are applied to input records that do not meet the criteria for any of the WHEN=(logexp) clauses.

Suppose you want to produce a report showing the title, publisher, edited price and % discount if you:

- discount the price of books from publisher COR that cost more than \$20.00 by 20%
- discount the price of books from publisher COR that cost \$20.00 or less by 10%
- discount the price of all books from publisher VALD by 25%
- discount the price of all books from the other publishers by 15%

You can use the following statements:

```
OPTION COPY
OUTREC IFTHEN=(WHEN=INIT,
    BUILD=(1:1,40,50:106,4,60:170,4,BI,EDIT=(TT.TT),70:170,4)),
    IFTHEN=(WHEN=(50,4,CH,EQ,C'COR',AND,70,4,BI,GT,+2000),
    OVERLAY=(70:C'20%',X)),
    IFTHEN=(WHEN=(50,4,CH,EQ,C'COR',AND,70,4,BI,LE,+2000),
    OVERLAY=(70:C'10%',X)),
    IFTHEN=(WHEN=(50,4,CH,EQ,C'VALD'),OVERLAY=(70:C'25%',X)),
    IFTHEN=(WHEN=NONE,OVERLAY=(70:C'15%',X))
```

Table 36 shows the copied data set.

Table 36. Proposed discounts for books

Book Title	Publisher	Price	Discount
1 40	50 53	60 64	70 73

Table 36. Proposed discounts for books (continued)

Book Title	Publisher	Price	Discount
COMPUTER LANGUAGES	FERN	26.00	15%
LIVING WELL ON A SMALL BUDGET	COR	99.00	20%
SUPPLYING THE DEMAND	COR	19.25	10%
VIDEO GAME DESIGN	VALD	21.99	25%
INKLINGS: AN ANTHOLOGY OF YOUNG POETS	COR	05.95	10%
COMPUTERS: AN INTRODUCTION	WETH	18.99	15%
PICK'S POCKET DICTIONARY	COR	02.95	10%
EDITING SOFTWARE MANUALS	VALD	14.50	25%
NUMBERING SYSTEMS	FERN	03.60	15%
STRATEGIC MARKETING	VALD	23.50	25%
THE INDUSTRIAL REVOLUTION	WETH	07.95	15%
MODERN ANTHOLOGY OF WOMEN POETS	COR	04.50	10%
INTRODUCTION TO PSYCHOLOGY	COR	22.00	20%
THE COMPLETE PROOFREADER	FERN	06.25	15%
SYSTEM PROGRAMMING	WETH	31.95	15%
SHORT STORIES AND TALL TALES	VALD	15.20	25%
INTRODUCTION TO BIOLOGY	VALD	23.50	25%
ADVANCED TOPICS IN PSYCHOANALYSIS	FERN	26.00	15%
EIGHTEENTH CENTURY EUROPE	WETH	17.90	15%
CRISES OF THE MIDDLE AGES	COR	12.00	10%

The first IFTHEN clause is a WHEN=INIT clause that uses BUILD to initialize every record with the title, publisher, edited price and a placeholder for the discount. Notice that the publisher field is copied to positions 50-53 and the 4-byte BI price field is copied to positions 70-73. Subsequent IFTHEN clauses are processed for all records and must refer to these fields at their new positions.

The second IFTHEN clause is a WHEN=(logexp) clause that uses OVERLAY to set the discount field to '20%' for the subset of records with 'COR ' as the publisher and more than 2000 as the price. Subsequent IFTHEN clauses are not processed for records that satisfy this logical expression. Subsequent IFTHEN clauses are processed for records that do not satisfy this logical expression.

The third IFTHEN clause is a WHEN=(logexp) clause that uses OVERLAY to set the discount field to '10%' for the subset of records with 'COR ' as the publisher and 2000 or less as the price. Subsequent IFTHEN clauses are not processed for records that satisfy this logical expression. Subsequent IFTHEN clauses are processed for records that do not satisfy this logical expression.

The fourth IFTHEN clause is a WHEN=(logexp) clause that uses OVERLAY to set the discount field to '25%' for the subset of records with 'VALD' as the publisher. Subsequent IFTHEN clauses are not processed for records that satisfy this logical expression. Subsequent IFTHEN clauses are processed for records that do not satisfy this logical expression.

The fifth IFTHEN clause is a WHEN=NONE clause that uses OVERLAY to set the discount field to '15%' for the subset of records that did not satisfy the logical expression for the second, third and fourth IFTHEN clauses.

DFSORT determines an appropriate reformatted output record length from the IFTHEN clauses you specify. However, you can use the IFOUTLEN=n parameter to tell DFSORT the length you want it to use for the reformatted records. For example, suppose you had 80 byte input records, and this DFSORT statement:

```
OUTREC IFTHEN=(WHEN=INIT,OVERLAY=(81:SEQNUM,8,ZD)),
          IFTHEN=(WHEN=(81,8,ZD,EQ,+5),OVERLAY=(21:C'J82')),
          IFTHEN=(WHEN=(81,8,ZD,EQ,+10),OVERLAY=(21:C'M72'))
```

```

| OUTREC IFTHEN=(WHEN=INIT,OVERLAY=(81:SEQNUM,8,ZD)),
| IFTHEN=(WHEN=(81,8,ZD,EQ,+5),OVERLAY=(21:C'J82')),
| IFTHEN=(WHEN=(81,8,ZD,EQ,+10),OVERLAY=(21:C'M72')),
| TEQUITI EN=80

```

	<b>So Far</b>
	Now you know how to use IFTHEN clauses with the OUTREC statement to reformat different records in different ways. Keep in mind that you can use IFTHEN clauses with the INREC statement and OUTFIL statement, as well as with the OUTREC statement. Next, you will learn about some Special considerations for using the INREC statement.

The INREC statement has the same format as the OUTREC statement. Therefore, in the first example of “Reformatting Records After Sorting with BUILD or FIELDS” on page 38, where you used OUTREC to write only the publisher, number in stock, and number sold fields, you can use INREC instead.

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- \* Move input positions 106-109 to reformatted record positions 1-4.
- \* Move input positions 162-169 to reformatted record positions 5-12.  
INREC FIELDS=(106,4,162,8)
- \* Sort reformatted record positions 1-4.  
SORT FIELDS=(1,4,CH,A)
- \* Sum reformatted record positions 5-8 and 9-12.  
SUM FIELDS=(5,4,BI,9,4,BI)

Table 37 shows the result.

Table 37. Using INREC to Write Only Publisher, Number in Stock, and Number Sold

Publisher	Number In Stock	Number Sold
1 4	5 8	9 12
COR	103	161
FERN	19	87
VALD	42	97
WETH	62	79

As the flowchart in Appendix C, “Processing Order of Control Statements,” on page 159 shows, DFSORT processes the INREC statement *before* SORT, SUM, and OUTREC, but *after* INCLUDE and OMIT. Therefore, when used with the INREC statement, SORT, SUM, and OUTREC must refer to the *reformatted* records, and INCLUDE and OMIT must refer to the *original* records.

DFSORT processes the OUTFIL statements after the INREC and OUTREC statements. Therefore, OUTFIL must refer to the reformatted records produced by OUTREC if specified, or to the reformatted records produced by INREC if it is specified without OUTREC. You will learn about OUTFIL statements in Chapter 6, “Creating Multiple Output Data Sets and Reports,” on page 65.

The control statements below illustrate how the INREC and OUTREC statements affect the positions you specify for various other statements:

```
INCLUDE COND=(110,5,CH,EQ,C'ENGL',OR,110,5,CH,EQ,C'PSYCH')
INREC FIELDS=(1:1,75,76:170,4,80:110,5)
SORT FIELDS=(76,4,BI,D)
OUTREC FIELDS=(1:1,75,85:76,4,BI,EDIT=($IT.TT),95:80,5)
OUTFIL FNames=ENGL,INCLUDE=(95,5,CH,EQ,C'ENGL')
OUTFIL FNames=PSYCH,INCLUDE=(95,5,CH,EQ,C'PSYCH')
```

The INCLUDE and INREC statements refer to fields as they appear in the input records. The SORT and OUTREC statements refer to fields as they appear in the reformatted INREC records. The OUTFIL statements refer to fields as they appear in the reformatted OUTREC records.

## Preventing Overflow When Summing Values

In some cases, you can prevent overflow by using INREC to pad summary fields with zeros. However, this method cannot be used for negative fixed-point binary data, because padding with zeros rather than with ones would change the sign.

If the summary fields in Table 37 were overflowing, you could pad each of them on the *left* with 4 bytes (binary fields must be 2, 4, or 8 bytes long), as shown in Table 38.



## Reformatting Records

Table 38. Padding Summary Fields

Publisher	X'0...0'	Number In Stock	X'0...0'	Number Sold
1 4	5 8	9 12	13 16	17 20
COR		103		161
FERN		19		87
VALD		42		97
WETH		62		79

```
INREC FIELDS=(106,4,4Z,162,4,4Z,166,4)
```

```
SORT FIELDS=(1,4,CH,A)
```

```
SUM FIELDS=(5,8,BI,13,8,BI)
```

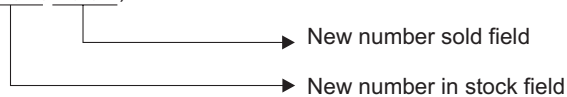


Table 39 shows the output records, each 20 bytes long.

Table 39. Padding Summary Fields

Publisher	Number In Stock	Number Sold
1 4	5 12	13 20
COR	103	161
FERN	19	87
VALD	42	97
WETH	62	79

**Attention:** You cannot use the OUTREC statement to prevent overflow, because it is processed *after* summarization.

## Inserting Sequence Numbers

Suppose you want to show the total price for all of the books associated with each course department, but you need the list in its original course department order rather than sorted by course department. In order to get the totals, you need to SORT by the department field, and SUM the price field, using the following statements:

```
INREC FIELDS=(110,5,170,4)
```

```
SORT FIELDS=(1,5,CH,A)
```

```
SUM FIELDS=(6,4,BI)
```

Table 40 shows the result of these statements.

Table 40. Total book prices by course

Department	Total Price
1 5	6 9



Table 40. Total book prices by course (continued)

Department	Total Price
	10195
BIOL	2350
BUSIN	4275
COMP	10253
ENGL	4640
HIST	3785
PSYCH	4800

Because you had to SORT in order to SUM (remember that you cannot SUM with COPY), the list is in sorted order by course department instead of the original order of COMP, blank, BUSIN, ENGL, HIST, PSYCH, and BIOL you need. To get back the original order, you can add a sequence number to each record **before** the records are sorted, and use a **second step** to sort the records back into their original order by that sequence number. You can remove the sequence numbers at the end of the second step.

You can use the previous statements with a slightly modified INREC statement to add the sequence number for the first step:

```
INREC FIELDS=(110,5,170,4,SEQNUM,8,ZD)
SORT FIELDS=(1,5,CH,A)
SUM FIELDS=(6,4,BI)
```

The sequence numbers start at 00000001 for the first record and are incremented by 00000001 for each subsequent record. This allows you to sort the summed records back into their original course department order by the sequence number.

Table 41 shows the result of this first step. The output records are stored in a temporary data set.

Table 41. Total Book Prices by Course with Sequence Numbers

Department	Total Price	Sequence Number
1 5	6 9	10 17
	10195	00000002
BIOL	2350	00000017
BUSIN	4275	00000003
COMP	10253	00000001
ENGL	4640	00000005
HIST	3785	00000011
PSYCH	4800	00000013

You can use the following statements for the second step to sort by the sequence number, display the data in a meaningful way, and remove the sequence numbers. The input for this second step is the temporary data set you created in the first step.

```
SORT FIELDS=(10,8,CH,A)
OUTREC FIELDS=(1,5,CHANGE=(16,
    C'HIST',C'History',
    C'BUSIN',C'Business',
    C'COMP',C'Computer Science',
    C'ENGL',C'English',
    C'BIOL',C'Biology',
```

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```
C'PSYCH',C'Psychology'),  
NOMATCH=(C'Unaffiliated'),  
C' | ',  
6,4,BI,EDIT=($III,IIT.TT))
```

The output records from this second step are:

Computer Science	\$102.53
Unaffiliated	\$101.95
Business	\$42.75
English	\$46.40
History	\$37.85
Psychology	\$48.00
Biology	\$23.50

You can use SEQNUM,m,f to create sequence numbers of various lengths in various formats. You can use START=j to start the sequence numbers at j instead of 1. You can use INCR=i to increment each sequence number by i instead of 1. You can use RESTART=(p,m) to start the sequence number at the starting value again each time the value in a particular field changes.

Suppose you have the following input records:

New York	Albany
California	Morgan Hill
New York	Buffalo
Arizona	Tuscon
California	San Jose
New York	Poughkeepsie
Arizona	Phoenix
California	Davis
New York	Armonk

If you wanted to sort the records by the State field in positions 1-15 and by the City field in positions 16-30, and add a third field with a sequence number starting from 1000 and incrementing by 10, you could use START=1000 and INCR=10 as shown in the following statements:

```
SORT FIELDS=(1,30,CH,A)  
OUTREC OVERLAY=(32:SEQNUM,5,ZD,START=1000,INCR=10)
```

The output records would look like this:

Arizona	Phoenix	01000
Arizona	Tuscon	01010
California	Davis	01020
California	Morgan Hill	01030
California	San Jose	01040
New York	Albany	01050
New York	Armonk	01060
New York	Buffalo	01070
New York	Poughkeepsie	01080

Note that each record has a different sequence number.

If you wanted to start the sequence number over at 1000 again each time the State changed, you could add RESTART=(1,15) as shown in the following statements:

```
SORT FIELDS=(1,30,CH,A)  
OUTREC OVERLAY=(32:SEQNUM,5,ZD,START=1000,INCR=10,  
RESTART=(1,15))
```

The output records would look like this:

```

|      Arizona      Phoenix      01000
|      Arizona      Tuscon       01010
|      California   Davis        01000
|      California   Morgan Hill  01010
|      California   San Jose     01020
|      New York     Albany       01000
|      New York     Armonk       01010
|      New York     Buffalo      01020
|      New York     Poughkeepsie 01030

```

Note that the sequence number starts over at 1000 again each time the State changes.

If you specify an IFTHEN clause with a sequence number, the sequence number is only incremented for the subset of records selected by that IFTHEN clause. For example, if you specified the following statements for the input records shown above:

```

|      OPTION COPY
|      OUTREC IFTHEN=(WHEN=(1,15,CH,EQ,C'Arizona'),
|                  OVERLAY=(32:SEQNUM,2,ZD)),
|                  IFTHEN=(WHEN=(1,15,CH,EQ,C'California'),
|                  OVERLAY=(32:SEQNUM,4,ZD)),
|                  IFTHEN=(WHEN=(1,15,CH,EQ,C'New York'),
|                  OVERLAY=(32:SEQNUM,3,ZD))

```

The output records would look like this:

```

|      New York     Albany       001
|      California   Morgan Hill  0001
|      New York     Buffalo      002
|      Arizona      Tuscon       01
|      California   San Jose     0002
|      New York     Poughkeepsie 003
|      Arizona      Phoenix      02
|      California   Davis        0003
|      New York     Armonk       004

```

For complete details about creating sequence numbers with INREC, OUTREC and OUTFIL OUTREC, see *z/OS DFSORT Application Programming Guide*.

---

## VB Data Set Considerations

Some of the same VB data set considerations you learned about previously for the SORT, MERGE, INCLUDE, OMIT and SUM statements also apply to the INREC and OUTREC statements, but some additional considerations apply as well

### RDW

If you use the BUILD, FIELDS, or IFTHEN BUILD parameter, you must begin your INREC or OUTREC statement fields by specifying 1,4 (starting position is 1 and length is 4) to represent the RDW in your VB records. For example:

```
INREC FIELDS=(1,4,8,25)
```

If you want your first field to include input data bytes immediately after the RDW (that is, starting with position 5), you can use 1,n (starting position is 1 and length is n, with n greater than 4) instead of 1,4. For example:

```
OUTREC BUILD=(1,10,21,30)
```

If you want to display the record length (from positions 1-2 in the RDW), you can use 1,4 to represent the RDW followed by 1,2 for the record length. For example:

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```
INREC FIELDS=(1,4,C'Record length is ',1,2,BI,M11)
```

If you use the OVERLAY or IFTHEN OVERLAY parameter of INREC or OUTREC, you must not overlay the RDW in positions 1-4. So all of your items must start at or after position 5. For example:

```
INREC OVERLAY=(5:5,3,TRAN=UTOL,21:18,2,11:C'***')
```

converts the input field at positions 5-7 to lowercase. If you forget to specify c: for the first item, c will default to 1 which will result in an error message because you would be overlaying the RDW. For example:

```
INREC OVERLAY=(5,3,TRAN=UTOL) Results in an error message
```

is interpreted as overlaying output positions 1-3 with the lowercase conversion of input positions 5-7. Since you cannot overlay positions 1-4, you will get an error message .

Be careful not to use 1:, 2:, 3: or 4: for any OVERLAY item. For example, the following will also result in an error message, since the second item would overlay the RDW:

```
OUTREC OVERLAY=(8:5,3,TRAN=UTOL, ok
2:18,2) Results in an error message
```

## Starting Positions and Columns

When you code your input fields for the BUILD, FIELDS, OVERLAY, IFTHEN BUILD, or IFTHEN OVERLAY parameters, remember to add 4 to the starting position to account for the 4-byte RDW. Likewise, when you code your output columns. For example, the following OUTREC statement puts the field in the first through sixth data byte of the VB input record into positions 21-26 of the VB output record.

```
OUTREC FIELDS=(1,4,21:5,6)
```

## Variable Data

If you want to include the variable data at the end of each VB input record in the VB output record with the BUILD, FIELDS, or IFTHEN BUILD parameter, specify the starting position of the variable input data without the length. For example:

```
OUTREC FIELDS=(1,4,C'Fixed data ',5,10,C' Variable data ',15)
```

You can also use the following for the variable data at the end of each VB record:

- p,HEX - hexadecimal display
- p,TRAN=UTOL - uppercase to lowercase
- p,TRAN=LTOU - lowercase to uppercase
- p,TRAN=ALTSEQ - conversion using the ALTSEQ table

For example, the following OUTREC statement displays the entire contents of the VB record in hexadecimal:

```
OUTREC FIELDS=(1,4,1,4,HEX,5,HEX)
```

You must not specify a starting positions without a length with the OVERLAY or IFTHEN parameters. DFSORT will issue an error message if you specify any of the following with OVERLAY or IFTHEN OVERLAY:

- p
- p,HEX
- p,TRAN=UTOL

- p,TRAN=LTOU
- p,TRAN=ALTSEQ .

For example:

```
INREC OVERLAY=(5:C'***',
  21:21,HEX) Results in an error message
```

### Summary

This chapter covered using the BUILD, FIELDS, OVERLAY, and IFTHEN parameters of the OUTREC statement and INREC statement to reformat input records in a variety of ways for output. It explained how you can delete fields, reorder fields, overlay fields, insert separators and sequence numbers, convert character and numeric data to various forms, perform arithmetic operations, and change different records in different ways, with the OUTREC and INREC statements, as well as with the OUTFIL statement.

## Reformatting Records

---

## Chapter 6. Creating Multiple Output Data Sets and Reports

You can create one or more output data sets and reports from a single pass over sorted, merged, or copied input using OUTFIL control statements. You can use different OUTFIL parameters on different OUTFIL statements, so the output data sets you create in a single DFSORT application can be identical or very different. You can perform a wide variety of tasks with each OUTFIL statement, including the following:

- Select a sequential subset of records with the STARTREC and ENDREC parameters.
- Select a sample of records with the SAMPLE parameter.
- Select a subset of records with the INCLUDE and OMIT parameters. These parameters have all of the capabilities of the INCLUDE and OMIT statements.
- Select "discarded" records with the SAVE parameter. This parameter saves any records that are not selected as a result of STARTREC, ENDREC, SAMPLE, INCLUDE or OMIT parameters.
- Reformat records using the BUILD, OUTREC, OVERLAY, or IFTHEN parameters. These parameters have all of the capabilities of the BUILD, FIELDS, OVERLAY, or IFTHEN parameters on the OUTREC statement, and also allow you to create multiple output records and blank output records from each input record.
- Repeat records with the REPEAT parameter.
- Split records between output data sets using the SPLIT and SPLITBY parameters.
- Create detailed reports with up to three levels (report, page, and section) using the BUILD, OUTREC, OVERLAY, IFTHEN, HEADERn, TRAILERn, SECTIONS, LINES, NODETAIL, and REMOVECC parameters. Your reports can contain elements such as headers, data, blank lines, trailers, statistics, sections, timestamps, page numbers, and counts.
- Convert FB records to VB records with the FTOV parameter, or convert VB records to FB records with the VTOF parameter.

You can use OUTFIL statements with any of the other DFSORT statements (for example, INCLUDE, OMIT, INREC, SORT, MERGE, OPTION, SUM and OUTREC). OUTFIL processing is performed last, after all of the processing for the other statements, as shown in Appendix C, "Processing Order of Control Statements," on page 159. Thus, the output records created by the processing for the other statements are the input records for OUTFIL processing. For example, OUTFIL processes the sorted records if the SORT statement is specified, or the copied records if the OPTION COPY statement is specified.

Combining the various DFSORT statements in different ways gives you a lot of flexibility. You can actually use an INREC statement, an OUTREC statement, and an OUTFIL statement to reformat your input records three times. You can also use an INCLUDE or OMIT statement to keep a subset of the input records, and use OUTFIL statements with different INCLUDE or OMIT and OUTREC, OVERLAY, or IFTHEN parameters to write different subsets of the remaining records into different OUTFIL data sets reformatted in different ways

## Creating Multiple Identical Copies

Suppose you want to create backups for your data set; on disk for the local site and on tapes for the remote sites. You can do this by using OUTFIL and the FNames parameter with an OPTION COPY statement. The FNames parameter identifies the DD statements in your JCL for your output data sets by their DD names. Sample JCL and DFSORT control statements are shown below.

```
//COPY JOB A492,PROGRAMMER
//S1 EXEC PGM=SORT
//SYSOUT DD SYSOUT=A
//SORTIN DD DSN=A123456.SORT.SAMPIN,DISP=SHR
//BACKUP DD DSN=A123456.BOOKS.BACKUP,DISP=OLD
//NEWYORK DD DSN=BOOKS,UNIT=3490,DISP=(,KEEP),VOL=SER=REMOT1,LABEL=(,SL)
//SANJOSE DD DSN=BOOKS,UNIT=3490,DISP=(,KEEP),VOL=SER=REMOT2,LABEL=(,SL)
//SYSIN DD *
        OPTION COPY
        OUTFIL FNames=(BACKUP,NEWYORK,SANJOSE)
/*
```

**Note:** The JCL above includes two tape data sets. Substitute your own tape data set information if you want to run this example.

Here are the steps for writing the OUTFIL statement:

*Table 42. Creating the OUTFIL Statement for the Multiple Output Data Set Job*

Step	Action
1	Leave at least one blank and type <b>OUTFIL</b>
2	Leave at least one blank and type <b>FNames=</b>
3	Type, in parentheses and separated by commas, each output data set DD name. In this example, they are <b>BACKUP</b> , <b>NEWYORK</b> , and <b>SANJOSE</b> .

This OUTFIL statement creates three backup copies of your data set: one on-site disk data set, and two tapes that can be sent to remote sites.

You can also complete this task using the FILES parameter of OUTFIL. With FILES, you assign SORTOFd or SORTOFdd DD statements instead of naming unique DD statements. Sample JCL and DFSORT control statements using FILES are shown below.

```
//COPY JOB A492,PROGRAMMER
//S1 EXEC PGM=SORT
//SYSOUT DD SYSOUT=A
//SORTIN DD DSN=A123456.SORT.SAMPIN,DISP=SHR
//SORTOF1 DD DSN=A123456.BOOKS.BACKUP,DISP=OLD
//SORTOF2 DD DSN=BOOKS,UNIT=3490,DISP=(,KEEP),VOL=SER=REMOT1
//SORTOF3 DD DSN=BOOKS,UNIT=3490,DISP=(,KEEP),VOL=SER=REMOT2
//SYSIN DD *
        OPTION COPY
        OUTFIL FILES=(1,2,3)
/*
```

Both FNames and FILES create the same output, but FNames lets you use descriptive names of up to 8 characters for your OUTFIL DD statements instead of one or two cryptic suffix characters. FNames is recommended and is used in all of the multiple output examples in the rest of this chapter.



**Note:** If you do not specify a FNMES or FILES parameter for an OUTFIL statement, the OUTFIL ddname is SORTOUT by default.

## Selecting and Sampling by Relative Record Number

When you copy, sort or merge input records, the resulting output records have implicit relative record numbers starting from 1 for the first record and ending at n (the total number of copied, sorted or merged records) for the last record.

Table 43 shows the City field of the output records created by copying the SORT.BRANCH data set, along with the relative record number (abbreviated RRN) for each record (the relative record numbers **do not** actually appear in the output data set).

*Table 43. Relative Records Numbers for Copy*

City	RRN
1      15	
Los Angeles	1
San Francisco	2
Fort Collins	3
Sacramento	4
Sunnyvale	5
Denver	6
Boulder	7
Morgan Hill	8
Vail	9
San Jose	10
San Diego	11
Aspen	12

Table 44 shows the City field of the output records created by sorting the SORT.BRANCH data set on the City field, along with the RRN for each record. Note that the RRNs for the copied output data set and the sorted output data set are different because the order of the output records is different (for example, the record containing 'Denver' has a relative record number of 6 for the copied data set and 3 for the sorted data set).

*Table 44. Relative Records Numbers for Sort*

City	RRN
1      15	
Aspen	1
Boulder	2
Denver	3
Fort Collins	4
Los Angeles	5
Morgan Hill	6
Sacramento	7
San Diego	8
San Francisco	9
San Jose	10
Sunnyvale	11
Vail	12

You can use these relative record numbers to select groups of sequential records to be written to different OUTFIL data sets. STARTREC=n tells DFSORT to start

## Using OUTFIL

OUTFIL processing at relative record n. ENDREC=m tells DFSORT to end OUTFIL processing at relative record m. The following statements show how this works:

```
SORT FIELDS=(1,15,CH,A)
OUTFIL FNames=OUT1,ENDREC=4
OUTFIL FNames=OUT2,STARTREC=2,ENDREC=6
OUTFIL FNames=OUT3,STARTREC=7,ENDREC=9
OUTFIL FNames=OUT4,STARTREC=10
```

Because STARTREC is not specified for OUT1, DFSORT starts at RRN 1 and ends at RRN 4. For OUT2, DFSORT starts at RRN 2 and ends at RRN 6. (Note that RRNs 2, 3 and 4 are written to both OUT1 and OUT2.) For OUT3, DFSORT starts at RRN 7 and ends at RRN 9. Because ENDREC is not specified for OUT4, DFSORT starts at RRN 10 and ends at the last record (RRN 12). The RRNs in each OUTFIL data set are as follows:

```
OUT1:  1, 2, 3, 4
OUT2:  2, 3, 4, 5, 6
OUT3:  7, 8, 9
OUT4: 10, 11, 12
```

You can also use relative record numbers to take a "sample" of your records. SAMPLE=n tells DFSORT to process every nth record, starting at the record indicated by STARTREC=x and ending at or before the record indicated by ENDREC=y. SAMPLE=(n,m) tells DFSORT to process m records every nth record, starting at the record indicated by STARTREC=x and ending at or before the record indicated by ENDREC=y. The following statements show how this works:

```
OPTION COPY
OUTFIL FNames=OUT1,SAMPLE=3
OUTFIL FNames=OUT2,STARTREC=4,SAMPLE=2,ENDREC=10
OUTFIL FNames=OUT3,STARTREC=2,SAMPLE=(5,3)
```

For OUT1, DFSORT starts at RRN 1 and writes every third record up to RRN 10 (RRN 13 would be the next record, but there are only 12 records). For OUT2, DFSORT starts at RRN 4 and writes every other record up to RRN 10. For OUT3, DFSORT writes 3 records starting at RRN 2, and writes three records starting at every fifth record after record 2, up to RRN 12. The records in each OUTFIL data set are as follows:

```
OUT1:  1, 4, 7, 10
OUT2:  4, 6, 8, 10
OUT3:  2, 3, 4, 7, 8, 9, 12
```

---

## Including, Omitting, and Saving Discards

In Chapter 3, "Including or Omitting Records," on page 25, you learned how to use the INCLUDE and OMIT statements to select only a subset of the input records for sorting, copying or merging. You can also select subsets of records for your individual OUTFIL output data sets in the same way using the INCLUDE and OMIT parameters. Different INCLUDE or OMIT parameters can be used for different OUTFIL statements.

All of the logical expressions that are valid for the COND parameter of the INCLUDE and OMIT statements are also valid for the INCLUDE and OMIT parameters of OUTFIL. However, you cannot specify the FORMAT parameter with the OUTFIL statement as you can with the INCLUDE and OMIT statements. VB data set considerations for the INCLUDE and OMIT statements also apply to the INCLUDE and OMIT parameters.

Suppose you wanted to sort the bookstore data set by title, and create separate output data sets for the English, History and Psychology departments. You could use the following OUTFIL statements to create these three output data sets:

```

SORT  FIELDS=(1,75,CH,A)
OUTFIL FNames=ENGLOUT,INCLUDE=(110,5,CH,EQ,C'ENGL')
OUTFIL FNames=HISTOUT,INCLUDE=(110,5,CH,EQ,C'HIST')
OUTFIL FNames=PSYCHOUT,INCLUDE=(110,5,CH,EQ,C'PSYCH')

```

The SORT statement sorts the input records by the title field.

The first OUTFIL statement writes the records for the English department to the ENGLOUT data set. The result is shown in Table 45.

*Table 45. Output records in ENGLOUT data set*

Book Title	Course Department
1 75	110 114
EDITING SOFTWARE MANUALS	ENGL
INKLINGS: AN ANTHOLOGY OF YOUNG POETS	ENGL
MODERN ANTHOLOGY OF WOMEN POETS	ENGL
SHORT STORIES AND TALL TALES	ENGL
THE COMPLETE PROOFREADER	ENGL

The second OUTFIL statement writes the records for the History department to the HISTOUT data set. The result is shown in Table 46.

*Table 46. Output records in HISTOUT data set*

Book Title	Course Department
1 75	110 114
CRISES OF THE MIDDLE AGES	HIST
EIGHTEENTH CENTURY EUROPE	HIST
THE INDUSTRIAL REVOLUTION	HIST

The third OUTFIL statement writes the records for the Psychology department to the PSYCHOUT data set. The result is shown in Table 47.

*Table 47. Output records in PSYCHOUT data set*

Book Title	Course Department
1 75	110 114
ADVANCED TOPICS IN PSYCHOANALYSIS	PSYCH
INTRODUCTION TO PSYCHOLOGY	PSYCH

The previous example creates output data sets for the English, History and Psychology department's books. If you wanted to create an additional output data set (RESTOUT) containing the rest of the books, you could use the following statements:

```

SORT  FIELDS=(1,75,CH,A)
OUTFIL FNames=ENGLOUT,INCLUDE=(110,5,CH,EQ,C'ENGL')
OUTFIL FNames=HISTOUT,INCLUDE=(110,5,CH,EQ,C'HIST')
OUTFIL FNames=PSYCHOUT,INCLUDE=(110,5,CH,EQ,C'PSYCH')
OUTFIL FNames=RESTOUT,
      INCLUDE=(110,5,CH,NE,C'ENGL',AND,
               110,5,CH,NE,C'HIST',AND,
               110,5,CH,NE,C'PSYCH')

```

## Using OUTFIL

This is not too bad for only three departments, but the INCLUDE statement for RESTOUT would get more involved as the number of departments increased.

DFSORT's SAVE parameter gives you an easy way to keep the records discarded by a group of OUTFIL statements. The SAVE parameter selects records for its OUTFIL data set that are not selected for any other OUTFIL data set as a result of the INCLUDE, OMIT, STARTREC, ENDREC or SAMPLE parameters. So instead of the preceding statements, you could use the following statements to accomplish the same thing

```
SORT FIELDS=(1,75,CH,A)
OUTFIL FNames=ENGLOUT,INCLUDE=(110,5,CH,EQ,C'ENGL')
OUTFIL FNames=HISTOUT,INCLUDE=(110,5,CH,EQ,C'HIST')
OUTFIL FNames=PSYCHOUT,INCLUDE=(110,5,CH,EQ,C'PSYCH')
OUTFIL FNames=RESTOUT,SAVE
```

The fourth OUTFIL statement writes the records not used for English, History or Psychology to the RESTOUT data set. The result is shown in Table 48.

*Table 48. Output records in RESTOUT data set*

Book Title		Course Department	
1	75	110	114
COMPUTER LANGUAGES		COMP	
COMPUTERS: AN INTRODUCTION		COMP	
INTRODUCTION TO BIOLOGY		BIOL	
LIVING WELL ON A SMALL BUDGET			
NUMBERING SYSTEMS		COMP	
PICK'S POCKET DICTIONARY			
STRATEGIC MARKETING		BUSIN	
SUPPLYING THE DEMAND		BUSIN	
SYSTEM PROGRAMMING		COMP	
VIDEO GAME DESIGN		COMP	

### So far

So far, you have learned how to create multiple identical copies of an input data set; select and sample input records by relative record number for output; and include, omit or save selected input records for output. Next, you will learn about reformatting records with OUTFIL.

## Reformatting

In Chapter 5, "Reformatting Records," on page 37, you learned how to use the INREC and OUTREC statements to reformat your input records in various ways while sorting, copying or merging. You can also reformat your individual OUTFIL output data sets in the same ways using the BUILD, OUTREC, OVERLAY, or IFTHEN parameters. VB data set considerations for the INREC and OUTREC statements also apply to the BUILD, OUTREC, OVERLAY and IFTHEN parameters of OUTFIL statements.

Different BUILD, OUTREC, OVERLAY or IFTHEN parameters can be used for different OUTFIL statements. You can use these parameters to perform the same wide variety of tasks as for the INREC and OUTREC statements, as described in Chapter 5, "Reformatting Records," on page 37.

In addition, you can use the BUILD, OUTREC, or IFTHEN BUILD parameters to create one, two or more output records from each input record, and insert blank lines before, between or after your records.

Suppose you wanted to create separate data sets for publishers FERN and WETH. For WETH, you want the number of copies sold and the instructor's name on one line. For FERN, you want the course number on one line and the price on another line. You also want two blank lines to separate the information for each book. You can use the following statements to create these two output data sets:

```
OPTION COPY
OUTFIL FNames=WETHBKS,
      INCLUDE=(106,4,CH,EQ,C'WETH'),
      OUTREC=(C'Sold ',166,4,BI,EDIT=(IIT),
              C' copies of Wethman, Inc. book for instructor ',
              160,2,X,145,15)
OUTFIL FNames=FERNBKS,
      INCLUDE=(106,4,CH,EQ,C'FERN'),
      OUTREC=(3:C'Fernal Brothers book #',SEQNUM,2,ZD,
              C' for course ',115,5,/,
              5:C'costs ',170,4,BI,EDIT=($IIT.TT),2/)
```

The first OUTFIL statement uses an INCLUDE parameter to select the books for publisher WETH, and an OUTREC parameter to create the output records for each book with the needed information. The second OUTFIL statement uses an INCLUDE parameter to select the books for publisher FERN, and a different OUTREC parameter to create the output records for each book, with the needed information. Fields, constants, sequence numbers, and numeric editing are used in the OUTREC parameters as previously explained for the INREC and OUTREC statements.

/, n/ and /.../ can be used in the BUILD, OUTREC, or IFTHEN BUILD parameters of the OUTFIL statement, but not in the OVERLAY or IFTHEN OVERLAY parameters of the OUTFIL statement, or in any parameters of the INREC and OUTREC statements. If n/ is used at the start or end of the BUILD, OUTREC or IFTHEN BUILD parameters, n blank lines are inserted. If n/ is used in the middle of the BUILD, OUTREC or IFTHEN parameters, n-1 blank lines are inserted.

Thus, in the OUTREC parameter for FERNBKS, the / (0 blank lines) in the middle after 115,5 is used to create two output records from each FERN input record, and the 2/ (two blank lines) at the end is used to insert two blank lines after the information for each FERN book.

The results produced for WETHBKS are:

```
Sold 26 copies of Wethman, Inc. book for instructor CL CHATTERJEE
Sold  9 copies of Wethman, Inc. book for instructor ST GOODGOLD
Sold 23 copies of Wethman, Inc. book for instructor DC SMITH
Sold 21 copies of Wethman, Inc. Book for instructor HR BISCARDI
```

The results produced for FERNBKS are:

```
Fernal Brothers book #01 for course 00032
costs $26.00
```

```
Fernal Brothers book #02 for course 00032
costs $3.60
```

```
Fernal Brothers book #03 for course 10347
```

## Using OUTFIL

```
costs    $6.25
```

```
Fernal1 Brothers book #04 for course 30975
costs    $26.00
```

DFSORT automatically sets the LRECL of each OUTFIL data set to the reformatted output record length. If n/ is used to create multiple output records from each input record, the LRECL is set to the longest output record.

For WETHBKS, the output record is 71 bytes long, so DFSORT sets the LRECL to 71. For FERNBKS, the first output record is 44 bytes long and the second output record is 17 bytes long, so DFSORT sets the LRECL to 44. If your reformatted length is shorter than you want for the LRECL, you can use c:X to increase the LRECL to c. For example, if you want the LRECL for FERNBKS to be 80 instead of 44, you can change the last line of the OUTREC parameter for FERNBKS to:

```
5:C'costs ',170,4,BI,EDIT=($IIT.TT),80:X,2/)
```

---

## Repeating

OUTFIL's REPEAT=n parameter lets you repeat each output record n times. If you specify the BUILD, OUTREC, OVERLAY, or IFTHEN parameters with a sequence number, the sequence numbers are incremented for each repeated record, but otherwise the repeated records are identical. For example, you could use the following statements to create two output data sets with repeated records; one with just the course name and the other with the course name and a sequence number.

```
OPTION COPY
INCLUDE COND=(110,5,CH,EQ,C'PSYCH')
OUTFIL FNames=OUT1,
      REPEAT=3,
      BUILD=(120,25)
OUTFIL FNames=OUT2,
      REPEAT=3,
      BUILD=(120,25,X,SEQNUM,4,ZD)
```

The results produced for OUT1 are:

```
PSYCHOLOGY I
PSYCHOLOGY I
PSYCHOLOGY I
PSYCHOANALYSIS
PSYCHOANALYSIS
PSYCHOANALYSIS
```

The results produced for OUT2 are:

```
PSYCHOLOGY I          0001
PSYCHOLOGY I          0002
PSYCHOLOGY I          0003
PSYCHOANALYSIS        0004
PSYCHOANALYSIS        0005
PSYCHOANALYSIS        0006
```

If you specify an IFTHEN clause with a sequence number, the sequence number is only incremented for the subset of records selected by the IFTHEN clause. For example, if you specified the following statements:

```
OPTION COPY
INCLUDE COND=(110,5,CH,EQ,C'PSYCH')
OUTFIL REPEAT=3,
```

```

|           IFTHEN=(WHEN=(120,7,CH,EQ,C'PSYCHOL'),
|                   BUILD=(120,25,X,SEQNUM,4,ZD)),
|           IFTHEN=(WHEN=NONE,BUILD=(120,25,X,SEQNUM,2,ZD))

```

The results produced for SORTOUT are:

```

| PSYCHOLOGY I           0001
| PSYCHOLOGY I           0002
| PSYCHOLOGY I           0003
| PSYCHOANALYSIS         01
| PSYCHOANALYSIS         02
| PSYCHOANALYSIS         03

```

## Splitting

Suppose you don't know how many records are in a data set, but you want to divide the records as equally as possible between two output data sets. You can use OUTFIL's SPLIT parameter to put the first record into OUTPUT1, the second record into OUTPUT2, the third record into OUTPUT1, the fourth record into OUTPUT2, and so on until you run out of records. SPLIT splits the records one at a time among the data sets specified by FNAMES. The following statements split the records between two OUTFIL data sets:

```

OPTION COPY
OUTFIL FNAMES=(OUTPUT1,OUTPUT2),SPLIT

```

With 17 input records, the results produced for OUTPUT1 are:

```

Record 01
Record 03
Record 05
Record 07
Record 09
Record 11
Record 13
Record 15
Record 17

```

The results produced for OUTPUT2 are:

```

Record 02
Record 04
Record 06
Record 08
Record 10
Record 12
Record 14
Record 16

```

Similarly, OUTFIL's SPLITBY=n parameter splits the records n at a time among the data sets specified by FNAMES. The following statements split the records four at a time between three OUTFIL data sets:

```

OPTION COPY
OUTFIL FNAMES=(OUT1,OUT2,OUT3),SPLITBY=4

```

With 17 input records, the results produced for OUT1 are:

```

Record 01
Record 02
Record 03
Record 04
Record 13
Record 14
Record 15
Record 16

```

The results produced for OUT2 are:

Record 05  
Record 06  
Record 07  
Record 08  
Record 17

The results produced for OUT3 are:

Record 09  
Record 10  
Record 11  
Record 12

### So far

So far, you have learned how to create multiple identical copies of an input data set; select and sample input records by relative record number for output; include, omit or save selected input records for output; and reformat, repeat and split input records for output. Next, you will learn about creating various types of reports.

---

## Creating Reports: OUTFIL vs ICETOOL

Both the OUTFIL statement and ICETOOL's DISPLAY operator can be used to create reports. While each performs some reporting functions that the other does not, in general the difference between them is one of control and effort. With OUTFIL, you have more control over the appearance of reports, but considerable effort may be required on your part to specify in detail where every piece of information is to appear in the report and how it is to look. With ICETOOL, much of the work of determining where information is to appear in the report and how it is to look is done for you, but you have somewhat less control over the appearance of the reports.

ICETOOL should be your primary choice for creating reports, because it is easier to use than OUTFIL. But remember that OUTFIL is available if you need any of its specific reporting features, or more control of the appearance of reports than ICETOOL gives you. Next, you will learn about using OUTFIL to create reports. See Chapter 10, "Using the ICETOOL Utility," on page 105 for tutorials on using ICETOOL's DISPLAY operator to create reports.

---

## Creating Reports with OUTFIL

You can use OUTFIL to create one or more detailed reports using the OUTFIL parameters BUILD, OUTREC, OVERLAY, IFTHEN, HEADERn, TRAILERn, SECTIONS, LINES, NODETAIL and REMOVECC. You can include any or all of these in your reports:

- A cover sheet (report header)
- A header at the top of each page (page header)
- A trailer at the bottom of each page (page trailer)
- A header at the start of each section (section header)
- A trailer at the end of each section (section trailer)
- A summary sheet (report trailer)



Your reports can contain a variety of elements you specify such as current date, current time, edited or converted page numbers, character strings, and blank lines. Your reports can also contain a variety of elements you derive from the input records such as character fields, unedited, edited, or converted numeric input fields, edited or converted record counts, and edited or converted totals, maximums, minimums, and averages for numeric input fields.

## Data

The data for your report consists of the OUTFIL output records. You can use the INCLUDE, OMIT, INREC, SUM and OUTREC statements, and the OUTFIL parameters STARTREC, SAMPLE, ENDREC, INCLUDE, OMIT, SAVE, BUILD, OUTREC, OVERLAY, and IFTHEN to determine which data records appear in your report and what they look like.

The following statements show the simplest possible type of OUTFIL report you can produce:

```
OPTION COPY
OUTFIL FNames=RPT1,LINES=10
```

LINES=10 indicates you want a report with 10 lines per page. These statements might produce the following two page result for RPT1:

```
1Data line 01
Data line 02
Data line 03
Data line 04
Data line 05
Data line 06
Data line 07
Data line 08
Data line 09
Data line 10
1Data line 11
Data line 12
Data line 13
Data line 14
Data line 15
```

**Note:** In some of the examples below, small LINES values are used to illustrate a point. However, the default for LINES is 60 and you would generally want to use either that value or one close to it.

For reports, OUTFIL places an ANSI carriage control character in the first byte of each output line to tell a printer what action to take for that line. The '1' for Data line 01 and Data line 11 tells the printer that these lines each start on a new page. This is the way DFSORT translates LINES=10 into 10 lines per page for the printer. Other ANSI carriage control characters that DFSORT uses for OUTFIL reports are: blank for single space (no blank lines before the output line), '0' for double space (one blank line before the output line), and '-' for triple space (two blank lines before the output line).

When you view a report on your display, the ANSI carriage control is not meaningful, and is usually not displayed even though it's actually in the record. If you don't want ANSI carriage control characters in your output records, you can use OUTFIL's REMOVECC parameter to remove them (more on this later).

In general, you will want to use the BUILD, OUTREC, OVERLAY, or IFTHEN parameters to reformat the data records for your report. Suppose you want to print a report from the SORT.BRANCH data set showing each branch's revenue and

profit or loss, with 9 lines per page. You can use the following statements to show the branches in sorted order, along with their revenue and profit fields in readable form:

```

SORT FIELDS=(1,15,CH,A)
UTFIL FAMES=RPT2,LINES=9,
      OUTREC=(1,15,X,
               22,6,PD,EDIT=(SIII,IIT),SIGNS=(,-),X,
               28,6,PD,EDIT=(SIII,IIT),SIGNS=(,-))

```

The two page result produced for RPT2 is:

1Aspen	25,800	5,200
Boulder	33,866	7,351
Denver	31,876	6,288
Fort Collins	12,300	-2,863
Los Angeles	22,530	-4,278
Morgan Hill	18,200	3,271
Sacramento	42,726	8,276
San Diego	32,940	8,275
San Francisco	42,820	6,832
1San Jose	27,225	8,264
Sunnyvale	16,152	-978
Vail	23,202	5,027

## Headers

The preceding output for RPT2 does not look much like a report, but you can fix that by adding page headings with UTFIL's HEADER2 parameter. This parameter (as well as the HEADER1 and HEADER3 parameters discussed later), lets you specify multi-line headings with character strings, hexadecimal strings, input fields, the current date, the current time, page numbers and blank lines.

The following statements create a report with page headings:

```

SORT FIELDS=(1,15,CH,A)
UTFIL FAMES=RPT3,LINES=15,
      HEADER2=(/,3:'Branch Revenue Report',
               30:'Page',PAGE,45:DATE=(MD4-),2/,
               3:'Branch',25:'Revenue',50:'Profit',/,
               3:'-----',25:'-----',50:'-----'),
      OUTREC=(3:1,15,X,
               25:22,6,PD,EDIT=(SIII,IIT),SIGNS=(,-),X,
               50:28,6,PD,EDIT=(SIII,IIT),SIGNS=(,-))

```

All of the elements in the HEADER2 parameter should be familiar from the previous discussions of the OUTREC statement, except for the PAGE and DATE=(MD4-) parameters.

PAGE tells DFSORT to print a 6-character page number with leading blanks starting at 1 for the first page and incrementing by 1 for each subsequent page. For page 3, PAGE would give you ' 3'. If you wanted to print a 3-character page number with leading zeros, you could use PAGE=(EDIT=(TTT)) or PAGE=(M11,LENGTH=3) or PAGE=(TO=ZD,LENGTH=3). For page 10, these would all give you '010'. See "Converting Numeric Fields to Different Formats" on page 44 and "Editing Numeric Fields" on page 45, for more information on conversion and editing.

DATE=(MD4-) tells DFSORT to print the date in the form mm-dd-yyyy. See *z/OS DFSORT Application Programming Guide* for more information on the different forms of the date you can print in headers and trailers.

You do not need to start character strings in headers (HEADERn parameters) or trailers (TRAILERn parameters) with C as you do for the BUILD, OUTREC, OVERLAY, or IFTHE parameters, although you can if you want to.

If n/ is used at the start or end of a header or trailer, n blank lines are printed. If n/ is used in the middle of a header or trailer, n-1 blanks lines are printed.

The two-page result produced for RPT3 is shown below:

```

1      Branch Revenue Report      Page      1      07-16-2004
0      Branch      Revenue      Profit
-----
Aspen      25,800      5,200
Boulder    33,866      7,351
Denver     31,876      6,288
Fort Collins 12,300     -2,863
Los Angeles 22,530     -4,278
Morgan Hill 18,200      3,271
Sacramento 42,726      8,276
San Diego  32,940      8,275
San Francisco 42,820     6,832
San Jose   27,225     8,264

1      Branch Revenue Report      Page      2      07-16-2004
0      Branch      Revenue      Profit
-----
Sunnyvale  16,152     -978
Vail       23,202     5,027

```

If you print this report, the ANSI carriage control characters tell the printer to eject a page when it sees '1' in the first byte, and to insert a blank line before the lines with '0' in the first byte. So you get a blank line between the 'Branch Revenue Report' line and the 'Branch' line in your headers, corresponding to the 2/ in your OUTREC parameter. However, if you view this report on a display, the ANSI carriage control characters are ignored, so the '0' line does not have a blank line before it on the display. To force the blank line to appear whether you print the report or view it on a display, you can change the second line of HEADER2 to:

```
30: 'Page',PAGE,45:DATE=(MD4-),/,X,/,
```

This forces DFSORT to write an additional blank output line instead of using the '0' ANSI carriage control character to insert a blank line for the printer. The blank line appears on the printer or display.

OUTFIL's HEADER1 parameter is very similar to the HEADER2 parameter, except that it produces a report heading on a separate page before the first page of data. You can add the following HEADER1 parameter to your OUTFIL statement:

```
HEADER1=(20:'Cover sheet for Branch Revenue Report',3/,
20:'Printed on ',DATE=(MD4/),' at ',TIME),
```

This separate page is printed at the beginning of the report for RPT3, before the other two pages shown previously:

```

1      Cover sheet for Branch Revenue Report
-      Printed on 07/16/2004 at 16:42:20

```

Here are sample JCL statements and control statements for the report using HEADER1 and HEADER2:

```
//HDRPT JOB A492,PROGRAMMER
//S1 EXEC PGM=SORT
//SYSOUT DD SYSOUT=A
```

```
//SORTIN DD DSN=A123456.SORT.BRANCH,DISP=SHR
//RPT3 DD SYSOUT=A
//SYSIN DD *
  SORT FIELDS=(1,15,CH,A)
  OUTFIL FNMES=RPT3,LINES=15,
    HEADER1=(20:'Cover sheet for Branch Revenue Report',3/,
      20:'Printed on ',DATE=(MD4/),' at ',TIME),
    HEADER2=(/3:'Branch Revenue Report',
      30:'Page',PAGE,45:DATE=(MD4-),2/,
      3:'Branch',25:'Revenue',50:'Profit',/,
      3:'-----',25:'-----',50:'-----'),
    OUTREC=(3:1,15,X,
      25:22,6,PD,EDIT=(SIII,IIT),SIGNS=(,-),X,
      50:28,6,PD,EDIT=(SIII,IIT),SIGNS=(,-))
/*
```

Of course, you could use a temporary or permanent data set for RPT3 instead of SYSOUT=A. For example:

```
//RPT3 DD DSN=88&MYRPT,DISP=(,PASS),SPACE=(CYL,(2,2)),UNIT=SYSDA
```

## Trailers and Statistics

You can add trailers to your report with OUTFIL's TRAILER1 (report trailer) and TRAILER2 (page trailer) parameters. You can use any combination of headers and trailers you need.

Like the HEADERn parameters, the TRAILER1 and TRAILER2 parameters (as well as the TRAILER3 parameter discussed later), let you specify multi-line headings with character strings, hexadecimal strings, input fields, the current date, the current time, page numbers and blank lines. In addition, you can include edited or converted record counts, and edited or converted totals, maximums, minimums, and averages for numeric fields, in your trailers.

The following statements create a report with a separate report trailer page containing the overall record count and various overall statistics for the revenue brought in by the branches.

```
SORT FIELDS=(1,15,CH,A)
OUTFIL FNMES=RPT4,
  HEADER2=(1:'BRANCH',18:'REVENUE',28:'PROFIT'),
  OUTREC=(1,15,X,
    22,6,PD,EDIT=(SIII,IIT),SIGNS=(,-),X,
    28,6,PD,EDIT=(SIII,IIT),SIGNS=(,-),
    50:X),
  TRAILER1=(2/,
    3:'Overall results for branches on ',DATE=(MD4/),' :',2/,
    3:COUNT=(EDIT=(IIT)), ' branches are included',2/,
    5:'Total revenue = ',
    TOT=(22,6,PD,M12,LENGTH=10),/,
    5:'Average revenue = ',
    AVG=(22,6,PD,M12,LENGTH=10),/,
    5:'Lowest revenue = ',
    MIN=(22,6,PD,M12,LENGTH=10),/,
    5:'Highest revenue = ',
    MAX=(22,6,PD,M12,LENGTH=10))
```

For OUTFIL reports, DFSORT terminates if any header or trailer record is longer than the data records. In this case, the TRAILER1 line with DATE=(MD4/) is 46 bytes long, so the data records must be at least 46 bytes long. To increase the data length set by the OUTREC parameter from 42 bytes to 50 bytes, you can put 50:X at the end of the OUTREC parameter as shown.

COUNT=(EDIT=(IIT)) shows the count of data records as three digits with leading zeros suppressed. TOT=(22,6,PD,M12,LENGTH=10) shows the total revenue as ten bytes of the M12 pattern (that is, SI,III,IIT). Similarly, AVG, MIN and MAX show the average, minimum and maximum, respectively, as ten bytes of the M12 pattern. See “Converting Numeric Fields to Different Formats” on page 44 and “Editing Numeric Fields” on page 45, for more information on conversion and editing.

Because LINES=n is not specified, the default of 60 lines per page is used.

The two page result produced for RPT4 is:

1BRANCH	REVENUE	PROFIT
Aspen	25,800	5,200
Boulder	33,866	7,351
Denver	31,876	6,288
Fort Collins	12,300	-2,863
Los Angeles	22,530	-4,278
Morgan Hill	18,200	3,271
Sacramento	42,726	8,276
San Diego	32,940	8,275
San Francisco	42,820	6,832
San Jose	27,225	8,264
Sunnyvale	16,152	-978
Vail	23,202	5,027

1  
0 Overall results for branches on 07/16/2004:  
0 12 branches are included  
0 Total revenue = 329,637  
Average revenue = 27,469  
Lowest revenue = 12,300  
Highest revenue = 42,820

The second page is the report trailer page produced for TRAILER1, which always starts on a new page.

## No Data or Carriage Control Characters

If you want your report to contain the overall statistics page, but not the actual data lines, you can add OUTFIL's NODETAIL parameter to your OUTFIL statement. NODETAIL tells DFSORT to process the data records in the usual way, but not to write them to the report data set.

If you do not want the ANSI carriage control characters in your report, you can add OUTFIL's REMOVECC parameter to your OUTFIL statement. REMOVECC tells DFSORT to remove the carriage control character from the first byte of each record. As a result, the data starts in column 1 of the report rather than in column 2.

Suppose you want to produce two output data sets. The first data set should have a single output record with the total count of records in your input data set. The second data set should have a single output record with today's date in the form ddmmyyyy. The following statements would produce these two output data sets:

```
OPTION COPY
OUTFIL FNames=BRANCHCT,NODETAIL,REMOVECC,
      TRAILER1=(COUNT=(TO=ZD,LENGTH=10))
OUTFIL FNames=CURDT,NODETAIL,REMOVECC,
      HEADER1=(DATENS=(DM4))
```

If the input data set has 12 records, the single record produced for BRANCHCT with the count in columns 1-10 is:

0000000012

If the job is run on July 15th, 2004, the single record produced for CURDT with the ddmmyyyy date in columns 1-8 is:

15072004

### VB Data Set Considerations for Headers and Trailers

When you specify an output column in a HEADERn or TRAILERn parameter, you must not add 4 for the RDW to the column, as you must for the BUILD, OUTREC, or IFTHEN OUTREC parameters. Consider this OUTFIL statement:

```
OUTFIL REMOVECC,  
  HEADER2=(1:C'PAGE HEADER'),  
  OUTREC=(1,4,5:C'OUTREC FOR DATA')
```

Both the 'PAGE HEADER' string and the 'OUTREC FOR DATA' string start in position 5 of their respective output records. For HEADER2, you use 1: because 4 must not be added to the output column for the RDW, even though the RDW appears in the header record. For OUTREC, you use 5: because 4 must be added to the output column for the RDW. Just be aware of this difference and specify your output columns accordingly.

When you specify an input field in a HEADERn or TRAILERn parameter, you must add 4 for the RDW to the starting position as you do for a BUILD, OUTREC, OVERLAY, or IFTHEN parameter. However, you cannot specify the variable part of the input record (that is, position without length) in a HEADERn or TRAILERn parameter, as you can for a BUILD, OUTREC, OVERLAY, or IFTHEN parameter.

### Sections

Suppose you want to print one page with information about the Computer department's books, one page with information about the English department's books, and one page about the History department's books. For each department's books, you want to show their course numbers, number in stock, number sold year to date, and price, as well as totals by department for each of the three numeric (BI) fields. The following statements create a report with all of this information:

```
INCLUDE COND=(110,4,SS,EQ,C'COMP,ENGL,HIST')  
INREC FIELDS=(1:110,4, Course Department  
  CHANGE=(16,  
    C'COMP',C'Computer Science',  
    C'ENGL',C'English',  
    C'HIST',C'History'),  
  17:115,5, Course Number  
  22:162,4, Number in Stock  
  26:166,4, Number Sold Y-to-D  
  30:170,4, Price  
  50:X) Ensure data length greater than header/trailer length  
SORT FIELDS=(1,16,CH,A,17,5,CH,A)  
OUTFIL FNAMES=RPT5,  
  SECTIONS=(1,16,SKIP=P,  
    HEADER3=(3:X,/,  
      3:'Department: ',1,16,/,X,/,  
      3:'Number',12:'In Stock',23:'Sold YTD',34:' Price',/,  
      3:'-----',12:'-----',23:'-----',34:'-----'),  
    TRAILER3=(3:'=====',12:'=====',23:'=====',34:'=====',/,  
      3:'Totals',  
      15:TOT=(22,4,BI,EDIT=(IIII)),  
      26:TOT=(26,4,BI,EDIT=(IIII)),  
      34:TOT=(30,4,BI,EDIT=(IIIT.TT))),  
    OUTREC=(3:17,5,  
      15:22,4,BI,EDIT=(IIII),  
      26:26,4,BI,EDIT=(IIII),  
      34:30,4,BI,EDIT=(IIIT.TT))
```

The INCLUDE statement and INREC statement remove the unneeded records and fields before sorting. The INREC statement also changes department identifiers (COMP, ENGL, HIST) to more readable strings. As you learned previously, the INREC statement changes the starting positions of various fields, so you must use those new positions for the statements that are processed after INREC (SORT and OUTFIL in this case).

OUTFIL's SECTION parameter is used to divide the report up into sections by the course department. 1,16 tells DFSORT to start a new section every time the department value in columns 1-16 changes. The SORT statement sorts on the department field to bring all of the records for each department value together, so only one section is produced for each department value. If your records are not already sorted by the section field, use the SORT statement to sort them that way. You can sort by other fields as well, but the first sort field must be the section field.

SKIP=P tells DFSORT to start each section on a new page. Alternatively, you can use SKIP=nL if you want your sections to appear on the same page, when possible, with n lines between them.

HEADER3 creates section headers in the same way that HEADER1 and HEADER2 create report and page headers, respectively. TRAILER3 creates section trailers in the same way that TRAILER 1 and TRAILER2 create report and page trailers, respectively.

OUTFIL's OUTREC parameter is used to reformat the data records for the report.

The three page result produced for RPT5 is:

1	Department: Computer Science			
	Number	In Stock	Sold YTD	Price
	-----	-----	-----	-----
	00032	5	29	26.00
	00032	6	27	3.60
	00032	20	26	18.99
	00103	4	23	31.95
	00205	10	10	21.99
	=====	=====	=====	=====
	Totals	45	115	102.53
1	Department: English			
	Number	In Stock	Sold YTD	Price
	-----	-----	-----	-----
	10054	10	9	15.20
	10347	7	19	6.25
	10347	13	32	14.50
	10856	1	26	4.50
	10856	2	32	5.95
	=====	=====	=====	=====
	Totals	33	118	46.40
1	Department: History			
	Number	In Stock	Sold YTD	Price
	-----	-----	-----	-----
	50420	15	9	7.95

## Using OUTFIL

50521	14	17	12.00
50632	23	21	17.90
=====	=====	=====	=====
Totals	52	47	37.85

Suppose you want to create a second report showing the totals for each department, but not the data lines. To accomplish this, you can use a second OUTFIL statement with the NODETAIL (no data), HEADER2 (page headers), SECTIONS (sections) and TRAILER3 (section trailers) parameters. In this case, because the data lines are not printed, you do not need to reformat them with the OUTREC parameter. The JCL and control statements for the complete job to produce your two reports is:

```
//SCTNRPT JOB A492,PROGRAMMER
//S1 EXEC PGM=SORT
//SYSOUT DD SYSOUT=A
//SORTIN DD DSN=A123456.SORT.SAMPIN,DISP=SHR
//RPT5 DD SYSOUT=A
//RPT6 DD SYSOUT=A
//SYSIN DD *
INCLUDE COND=(110,4,SS,EQ,C'COMP,ENGL,HIST')
INREC FIELDS=(1:110,4, Course Department
              CHANGE=(16,
                C'COMP',C'Computer Science',
                C'ENGL',C'English',
                C'HIST',C'History'),
              17:115,5, Course Number
              22:162,4, Number in Stock
              26:166,4, Number Sold Y-to-D
              30:170,4, Price
              50:X) Ensure data length greater than header/trailer length
SORT FIELDS=(1,16,CH,A,17,5,CH,A)
OUTFIL FNAME=RPT5,
SECTIONS=(1,16,SKIP=P,
          HEADER3=(3:X,/,
            3:'Department: ',1,16,/,X,/,
            3:'Number',12:'In Stock',23:'Sold YTD',34:' Price',/,
            3:'-----',12:'-----',23:'-----',34:'-----'),
          TRAILER3=(3:'=====',12:'=====',23:'=====',34:'=====',/,
            3:'Totals',
            15:TOT=(22,4,BI,EDIT=(IIIIIT)),
            26:TOT=(26,4,BI,EDIT=(IIIIIT)),
            34:TOT=(30,4,BI,EDIT=(IIIT.TT)))),
OUTREC=(3:17,5,
          15:22,4,BI,EDIT=(IIIIIT),
          26:26,4,BI,EDIT=(IIIIIT),
          34:30,4,BI,EDIT=(IIIT.TT))
OUTFIL FNAME=RPT6,
NODETAIL,
HEADER2=(3:'Department ',22:'In Stock',
          31:'Sold YTD',42:' Price',/,
          3:'-----',22:'-----',
          31:'-----',42:'-----'),
SECTIONS=(1,16,SKIP=0L,
          TRAILER3=(3:1,16,
            25:TOT=(22,4,BI,EDIT=(IIIIIT)),
            34:TOT=(26,4,BI,EDIT=(IIIIIT)),
            42:TOT=(30,4,BI,EDIT=(IIIT.TT))))
/*
```

The three page report produced for RPT5 is the same as shown previously. The one page result produced for RPT6 is:



1 Department	In Stock	Sold YTD	Price
-----	-----	-----	-----
Computer Science	45	115	102.53
English	33	118	46.40
History	52	47	37.85

**So Far**

So far, you have learned how to create multiple identical copies of an input data set; select and sample input records by relative record number for output; include, omit or save selected input records for output; reformat, repeat and split input records for output; and create various types of reports. Next, you will learn about converting between fixed and variable records.

## Converting FB to VB

You can convert an FB data set to a VB data set with OUTFIL's FTOV parameter. Each VB output record has a 4-byte RDW followed by the corresponding data from the FB input record, and the length in the RDW is the length of the FB record plus 4.

The following JCL and DFSORT control statements convert the bookstore data set records from FB to VB.

```
//FBVB JOB A92,PROGRAMMER
//S1 EXEC PGM=SORT
//SYSOUT DD SYSOUT=*
//SORTIN DD DSN=A123456.SORT.SAMPIN,DISP=SHR
//VBOUT DD DSN=A123456.SORT.VSAMP,DISP=(NEW,CATLG,DELETE),
// UNIT=3390,SPACE=(CYL,(5,5))
//SYSIN DD *
OPTION COPY
OUTFIL FNAMES=VBOUT,FTOV
/*
```

Because the LRECL of SORT.SAMPIN is 173 bytes, each VB record in SORT.VSAMP is 177 bytes (the FB record length of 173 plus 4 for the RDW) and SORT.VSAMP is given an LRECL of 177.

You can also use BUILD, OUTREC, OVERLAY or IFTHEN parameters with FTOV on the OUTFIL statement. All of the reformatting features are available (input fields, strings, editing, and so on). With FTOV, you specify the input positions, and output columns, for the BUILD, OUTREC, OVERLAY or IFTHEN parameters as you would for an FB record (without the RDW). DFSORT adds the RDW after the FB record is reformatted

Here is an example of using FTOV with BUILD:

```
OUTFIL FTOV,BUILD=(1:120,25,32:C'in ',110,5)
```

The VB output records look like this:

```
Positions 1-2: Length (in RDW) = hex 002B = 43
Positions 3-4: Zeros (in RDW) = hex 0000 = 0
Positions 5-29: Input positions 120-144
Positions 30-35: Blanks
Positions 36-38: 'in '
Positions 39-43: Input positions 110-114
```

Each VB output record is 43 bytes long and the output data set is given an LRECL of 43.

## Using OUTFIL

For the previous examples, the VB output records are all the same length. You can use OUTFIL'S VLTRIM parameter to create VB output records of different lengths from FB input records. Suppose you have an FB input data set with LRECL=20 and 20-byte records like this:

```
ABC
ABCDEF
AC
ABCDEFGHI
```

These statements change each 20-byte FB input record to a 24-byte VB output record and set LRECL=24 for the VB output data set:

```
OPTION COPY
OUTFIL FTOV
```

The VB output records look like this:

Length		X'0000'	Data	
1	2	3	4	5
-----				
				24
-----				
	24	0	ABC	
	24	0	ABCDEF	
	24	0	AC	
	24	0	ABCDEFGHI	
-----				

To remove the trailing blanks from the end of each VB output record, use VLTRIM=C' ' (or VLTRIM=X'40') like this:

```
OUTFIL FTOV,VLTRIM=C' '
```

LRECL=24 is still set for the resulting VB output data set, indicating that the maximum record length is 24, but the VB output records are not padded on the right with blanks; they now have different record lengths like this.

Length		X'0000'	Data	
1	2	3	4	5
-----				
				24
-----				
	7	0	ABC	
	10	0	ABCDEF	
	6	0	AC	
	13	0	ABCDEFGHI	
-----				

You can use any character or hexadecimal byte value for VLTRIM. For example, VLTRIM=C'\*' removes trailing asterisks, and VLTRIM=X'00' removes trailing binary zeros.

---

## Converting VB to FB

You can convert a VB data set to an FB data set with OUTFIL'S VTOF and BUILD or OUTREC parameters. All of the BUILD or OUTREC features are available (input fields, strings, editing, and so on). For VTOF, you specify the input positions of the VB input record (with the RDW), and the output columns of the FB output record (without the RDW). DFSORT does not include the RDW in the FB output records.

**Attention:** You cannot specify OVERLAY or IFTHEN with VTOF.

The following JCL and DFSORT control statements convert a VB data set with LRECL=104 to an FB data set with LRECL=100:

```
//VBFB JOB A92,PROGRAMMER
//S1 EXEC PGM=SORT
//SYSOUT DD SYSOUT=*
//SORTIN DD DSN=A123456.VBIN,DISP=SHR
//FBOU DD DSN=A123456.FBOU,DISP=(NEW,CATLG,DELETE),
// UNIT=3390,SPACE=(CYL,(5,5))
//SYSIN DD *
OPTION COPY
OUTFIL FNames=FBOU,VTOF,OUTREC=(5,100)
/*
```

Up to 100 bytes of data starting at position 5 (after the RDW) of the VB input record appears in the FB output record starting at position 1. The FB output records are all 100 bytes long. By default, if a VB input record has less than 100 data bytes, DFSORT pads the output data with blanks on the right to 100 bytes. However, you can change the padding character to anything you like with OUTFIL's VLFILL parameter. For example, VLFILL=C'\*' pads with asterisks and VLFILL=X'00' pads with binary zeros:

```
SORT FIELDS=(25,10,CH,A)
* Pad short fields on the right with blanks (default is VLFILL=C' ')
OUTFIL FNames=PADB,VTOF,
OUTREC=(41,40,C'Blank padding',11,20)
* Pad short fields on the right with asterisks
OUTFIL FNames=PADA,VTOF,
OUTREC=(5,60,C'Asterisk padding',61,40),VLFILL=C'*'.
* Pad short fields on the right with binary zeros
OUTFIL FNames=PADZ,VTOF,
OUTREC=(21,60,C'Binary zero padding'),VLFILL=X'00'
```

LRECL=73 is set for the PADB output data set, which has 73 byte FB records. Short input fields are padded with blanks on the right as needed.

LRECL=116 is set for the PADA output data set, which has 116 byte FB records. Short input fields are padded with asterisks on the right as needed.

LRECL=79 is set for the PADZ output data set, which has 79 byte FB records. Short input fields are padded with binary zeros on the right as needed.

### Summary

This chapter covered the many ways you can use the OUTFIL statement and its various parameters to create multiple output data sets and reports.

The next chapter will cover methods of calling DFSORT from a program.

## Using UTFIL

---

## Chapter 7. Calling DFSORT from a Program

This chapter contains Programming Interface information.

In addition to processing your DFSORT program control statements directly with PGM=SORT or PGM=ICEMAN, you can call DFSORT from COBOL, PL/I, Assembler, or other programs. In this chapter, you will concentrate on sorting and merging using COBOL and sorting using PL/I. The examples in this chapter assume that the COBOL environment is available.

For information on restrictions when using these languages and on calling DFSORT from an assembler program, see *z/OS DFSORT Application Programming Guide*.

---

### Passing Control Statements

When you use COBOL or PL/I to call DFSORT, these program products create and pass a SORT or MERGE control statement and a RECORD control statement for you. You can use other DFSORT control statements, such as INCLUDE, OMIT, SUM, INREC, OUTREC and OUTFIL with your COBOL or PL/I programs. Use a SORTCNTL or DFSPARM data set for these DFSORT statements in the same way you would use a SYSIN data set. For example, you can use the SORTCNTL DD statement to pass the INCLUDE control statement that selects only the English department books:

```
//EXAMP    JOB A492,PROGRAMMER
.
.
.
//SORTCNTL DD *
            INCLUDE COND=(110,5,CH,EQ,C'ENGL')
/*
```

Either a SYSIN data set or a DFSPARM data set, or both, can be used for DFSORT control statements when DFSORT is invoked directly, that is, by PGM=SORT or PGM=ICEMAN. Either a SORTCNTL data set or a DFSPARM data set, or both, can be used for DFSORT control statements when DFSORT is called from a program.

If you use DFSORT with COBOL, you should be familiar with the SORT-CONTROL and SORT-RETURN special registers. For complete details, see the COBOL Programmer's Guide that describes the compiler version available at your site.

---

### Calling DFSORT from a COBOL Program

To call DFSORT from a COBOL program, use the COBOL statements SORT and MERGE. This section shows sample programs that use the COBOL SORT and MERGE statements. For complete information, see the COBOL Programmer's Guide describing the compiler version available at your site.

### Sorting Records

The sample COBOL program in Figure 2 on page 89 calls DFSORT to sort the bookstore master file (MASTER-FILE) by title in ascending order. The sorted master file is written to SORTED-MASTER-FILE.

Following is the JCL that calls the sample COBOL program:

```
//EXAMP   JOB   A492,PROGRAMMER
//BOOKS   EXEC  PGM=COBOLPGM
//STEPLIB DD   DSN=USER.PGMLIB,DISP=SHR
//SYSOUT  DD   SYSOUT=A
//MASTIN  DD   DSN=A123456.MASTER,DISP=OLD
//MASTOUT DD   DSN=A123456.OUTB,DISP=(NEW,CATLG,DELETE),
//          SPACE=(CYL,(1,1)),UNIT=SYSDA
//PRINTFL DD   SYSOUT=A
```

In contrast to the JCL for executing DFSORT by using a JCL EXEC statement with PGM=SORT or PGM=ICEMAN (see “JCL for Sorting Data Sets Directly” on page 17) the above JCL has these differences:

- The program name on the EXEC statement is that of the COBOL program.
- The STEPLIB DD statement defines the library containing the COBOL program.
- The name of the DD statement for the input file need not be SORTIN.
- The name of the DD statement for the output file need not be SORTOUT.

Notice that the control field and order for the sort are specified in the COBOL program itself rather than with a SORT control statement. Figure 2 on page 89 shows the sample COBOL program.

---

```

IDENTIFICATION DIVISION.
PROGRAM-ID.
    COBOLPGM.
ENVIRONMENT DIVISION.
INPUT-OUTPUT SECTION.
FILE-CONTROL.
    SELECT SD-FILE ASSIGN TO
    DUMMYNM.
    SELECT MASTER-FILE ASSIGN TO
    MASTIN.
    SELECT SORTED-MASTER-FILE ASSIGN TO
    MASTOUT.
    SELECT PRINT-FILE ASSIGN TO
    PRINTFL.
DATA DIVISION.
FILE SECTION.
SD SD-FILE
    DATA RECORD IS SD-RECORD.
01 SD-RECORD.
    05 TITLE-IN    PICTURE X(75).
    05 AUTH-LN-IN  PICTURE X(15).
    05 AUTH-FN-IN  PICTURE X(15).
    05 PUB-IN      PICTURE X(4).
    05 COUR-DEPT-IN PICTURE X(5).
    05 COUR-NO-IN  PICTURE X(5).
    05 COUR-NAM-IN PICTURE X(25).
    05 INST-LN-IN  PICTURE X(15).
    05 INST-INIT-IN PICTURE X(2).
    05 NO-STOCK-IN  PICTURE 9(8) BINARY.
    05 NO-SOLD-IN  PICTURE 9(8) BINARY.
    05 PRICE-IN    PICTURE 9(8) BINARY.

```

---

*Figure 2. Sample COBOL Program with SORT Commands (Part 1 of 2)*

## Calling DFSORT from a Program

---

```
FD MASTER-FILE
  DATA RECORD IS MASTER-RECORD.
01 MASTER-RECORD.
05 FILLER    PICTURE X(173).

FD SORTED-MASTER-FILE
  DATA RECORD IS SORTED-MASTER-RECORD.
01 SORTED-MASTER-RECORD.
05 FILLER    PICTURE X(173).

FD PRINT-FILE
  DATA RECORD IS OUTPUT-REPORT-RECORD.
01 OUTPUT-REPORT-RECORD.
05 REPORT-OUT PICTURE X(120).
.
.
.

PROCEDURE DIVISION.
.
.
.

SORT-ROUTINE SECTION.
  SORT SD-FILE
  ASCENDING KEY TITLE-IN
  USING MASTER-FILE
  GIVING SORTED-MASTER-FILE.
  IF SORT-RETURN > 0
  DISPLAY "SORT FAILED".
.
.
.

SORT-REPORT SECTION.
  print a report on PRINT-FILE using SORTED-MASTER-FILE.
.
.
.
  STOP RUN.
```

---

*Figure 2. Sample COBOL Program with SORT Commands (Part 2 of 2)*

## Merging Records

The sample COBOL program in Figure 3 on page 92 calls DFSORT to merge the presorted bookstore master file (MASTER-FILE) with another presorted file (NEW-BOOKS-FILE) to create a new master file (MERGED-FILE).

The JCL for the program is as follows:



---

```
//EXAMP    JOB  A492,PROGRAMMER
//BOOKS    EXEC PGM=COBOLP
//STEPLIB  DD   DSN=USER.PGMLIB,DISP=SHR
//SYSOUT   DD   SYSOUT=A
//MASTERFL DD   DSN=A123456.MASTER,DISP=OLD
//NEWBOOKS DD   DSN=A123456.NEW,DISP=OLD
//MERGEDFL DD   DSN=A123456.OUTC,DISP=(NEW,CATLG,DELETE),
//          SPACE=(CYL,(1,1)),UNIT=SYSDA
```

---

Figure 3 on page 92 shows the sample COBOL program.

## Calling DFSORT from a Program

---

```
IDENTIFICATION DIVISION.  
PROGRAM-ID.  
    COBOLP.  
ENVIRONMENT DIVISION.  
INPUT-OUTPUT SECTION.  
FILE-CONTROL.  
    SELECT SD-FILE ASSIGN TO  
        DUMMYNM.  
    SELECT MASTER-FILE ASSIGN TO  
        MASTERFL.  
    SELECT NEW-BOOKS-FILE ASSIGN TO  
        NEWBOOKS.  
    SELECT MERGED-FILE ASSIGN TO  
        MERGEDFL.  
DATA DIVISION.  
FILE SECTION.  
SD  SD-FILE  
    DATA RECORD IS SD-RECORD.  
01  SD-RECORD.  
    05 TITLE-KEY  PICTURE X(75).  
    05 FILLER     PICTURE X(98).  
  
FD  MASTER-FILE  
    DATA RECORD IS MASTER-RECORD.  
01  MASTER-RECORD.  
    05 FILLER     PICTURE X(173).  
  
FD  NEW-BOOKS-FILE  
    DATA RECORD IS NEW-BOOKS-RECORD.  
01  NEW-BOOKS-RECORD.  
    05 FILLER     PICTURE X(173).  
  
FD  MERGED-FILE  
    DATA RECORD IS MERGED-RECORD.  
01  MERGED-RECORD.  
    05 FILLER     PICTURE X(173).  
.  
.  
.  
  
PROCEDURE DIVISION.  
.  
.  
.  
  
MERGE-ROUTINE SECTION.  
    MERGE SD-FILE  
        ASCENDING KEY TITLE-KEY  
        USING MASTER-FILE NEW-BOOKS-FILE  
        GIVING MERGED-FILE.  
    IF SORT-RETURN > 0  
        DISPLAY "MERGE FAILED".  
    STOP RUN.
```

---

Figure 3. Sample COBOL Program with MERGE Commands

## Sorting with COBOL FASTSRT

With the COBOL program for sorting records in Figure 2 on page 89, the input (from MASTER-FILE) and the output (to SORTED-MASTER-FILE) qualify for the COBOL FASTSRT option. With this compile-time FASTSRT option, your sort runs considerably faster, because DFSORT does the input and output processing, rather than COBOL. For complete details on FASTSRT, refer to *z/OS DFSORT Application Programming Guide* and the COBOL Programmer's Guide that describes the compiler version available at your site.

**Note:** COBOL evaluates sort input and output independently to see if it qualifies for FASTSRT. If either the input or the output of your sort does not qualify because of the presence of an input or output procedure, you might be able to replace such a procedure and use DFSORT control statements to accomplish the same thing. For example, you can use a control statement (OUTREC) to indicate how records will be reformatted before being written to the output data set.

## Calling DFSORT from a PL/I Program

When calling DFSORT, a PL/I program must pass a SORT control statement, a RECORD control statement, and the amount of main storage to be available to DFSORT. On the RECORD control statement, you specify the record type and length for the input data set. Following the RECORD control statement, you specify the main storage value for DFSORT either as MAX, or as a value in bytes. (DFSORT performs best when MAX is specified as the main storage value.)

You can also specify DFSORT control statements in a SORTCNTL or DFSPARM data set.

This JCL is for the program shown in Figure 4 on page 94. A SORTCNTL data set is used to specify an INCLUDE control statement that selects only the English department books.

```
//EXAMP   JOB   A492,PROGRAMMER
//BOOKS   EXEC  PGM=PLIPGM
//STEPLIB DD   DSN=USER.PGMLIB,DISP=SHR
//SYSOUT  DD   SYSOUT=A
//SORTIN  DD   DSN=A123456.SORT.SAMPIN,DISP=SHR
//SORTOUT DD   DSN=A123456.SORT.SAMPOUT,DISP=OLD
//SORTCNTL DD *
            INCLUDE COND=(110,5,CH,EQ,C'ENGL')
/*
//SYSPRINT DD   SYSOUT=A
```

The sample PL/I program shown in Figure 4 on page 94 calls DFSORT to sort the bookstore file by title. It specifies appropriate SORT and RECORD control statements, and a DFSORT main storage value of MAX.

## Calling DFSORT from a Program

---

```
PLIPGM:  PROC OPTIONS(MAIN);

          DCL 1 MASTER_RECORD,
              5 TITLE_IN    CHAR(75),
              5 AUTH_LN_IN  CHAR(20),
              .
              .
              .
              5 PRICE_IN    BIN FIXED(31);

          DCL RETURN_CODE FIXED BIN(31,0);
          DCL MAXSTOR FIXED BIN(31,0);
          UNSPEC(MAXSTOR)='00000000'B||UNSPEC('MAX');
          .
          .
          .
          CALL PLISRTA (' SORT FIELDS=(1,75,CH,A) ',
                        ' RECORD TYPE=F,LENGTH=(173) ',
                        MAXSTOR,
                        RETURN_CODE);
          IF RETURN_CODE ^= 0 THEN DO;
              PUT SKIP EDIT ('SORT FAILED')(A);
              CALL PLIRETC(RETURN_CODE);
          END;
          .
          .
          .
          CALL OUTPUT;
          .
          .
          .
          OUTPUT: PROCEDURE;
          .
          .
          .
          . Print a report from the sorted master file (SORTOUT)
          .
          .
          .
          END;
END PLIPGM;
```

---

*Figure 4. Sample PL/I Program with SORT Commands*

### Summary

This chapter covered methods of calling DFSORT from COBOL, and PL/I.

---

## Chapter 8. Overriding Installation Defaults

IBM ships DFSORT with pre-set defaults. During installation, your system programmer can change these defaults. For example, one IBM-supplied default is to list DFSORT control statements in the DFSORT message data set. However, at your site, the default might be to not list DFSORT control statements.

Furthermore, your system programmer can establish separate defaults for jobs with DFSORT executed directly and for jobs with DFSORT called from a program. So, when you execute DFSORT directly, the default might be to list DFSORT control statements, and when you call DFSORT from a program, the default might be to not list DFSORT control statements.

In many cases, if a particular installation default is not appropriate for your job, you can temporarily override it in one of several ways:

- as a PARM parameter in a DFSPARM data set
- as an OPTION, ALTSEQ or DEBUG parameter in a DFSPARM data set
- as a PARM parameter on the JCL EXEC statement
- as an OPTION, ALTSEQ or DEBUG parameter in a SYSIN or SORTCNTL data set
- as an OPTION, ALTSEQ or DEBUG parameter in a parameter list passed from a calling program

OPTION, ALTSEQ and DEBUG parameters in a DFSPARM data set are a good way to override installation defaults regardless of whether you execute DFSORT directly or call it from a program.

In this chapter, you will learn how to override some of the many available defaults, concentrating on PARM parameters in the JCL EXEC statement, and the OPTION control statement in a DFSPARM data set.

You can list all of the installation defaults selected at your site using an ICETOOL DEFAULTS job like the following:

```
//S1 EXEC PGM=ICETOOL
//TOOLMSG DD SYSOUT=A
//DFSMSG DD SYSOUT=A
//DFLT DD SYSOUT=A
//TOOLIN DD *
        DEFAULTS LIST(DFLT)
/*
```

You'll learn more about ICETOOL in Chapter 10, "Using the ICETOOL Utility".

For detailed information on all of the parameters you can override and the various ways in which you can override them, refer to *z/OS DFSORT Application Programming Guide*. In particular, see Appendix C, "Specification/Override of DFSORT Options".

---

### Specifying PARM Parameters on a JCL EXEC Statement

When you execute DFSORT directly, you can use the PARM parameter in the JCL EXEC statement to override certain defaults for your job. For example, if the default at your site is to list DFSORT statements (installation parameter LIST=YES), but you do not want them listed for your job, you can specify NOLIST in the PARM field

```
//S1 EXEC PGM=SORT,PARM='NOLIST'
```

On the other hand, if the default is not to list the DFSORT statements (installation parameter LIST=NO), but you do want them listed, you can specify LIST in the PARM field:

```
//S1 EXEC PGM=SORT,PARM='LIST'
```

You can also specify more than one PARM parameter. For example, if you want to list the DFSORT statements, have DFSORT set a return code of 4 if SUM fields overflow, use six dynamically allocated SYSDA work data sets, and have DFSORT ABEND if it detects an error, you can specify:

```
//S1 EXEC PGM=SORT,PARM='LIST,OVFL0=RC4,DYNALOC=(SYSDA,6),ABEND'
```

---

### Specifying an OPTION Control Statement in DFSPARM

Whether you execute DFSORT directly or call it from a program, you can use an OPTION statement in a DFSPARM data set to override certain defaults for your job. To do so, you can place the OPTION statement after a //DFSPARM DD \* statement, either by itself or with other DFSORT control statements.

A particular default that you may want to override with the OPTION statement is the EQUALS=NO installation option that specifies whether equally collating records are to be written in their original order.

If your site has EQUALS=NO as the default (recommended) and you want to temporarily override it (so that equally collating records are written in their original order for **your** job), you can specify EQUALS on the OPTION statement:

```
//DFSPARM DD *  
  OPTION EQUALS  
/*
```

Or, if your site has established EQUALS=YES as the installation default and you want to temporarily override it (so that equally collating records can be written in random order for your job), you can specify NOEQUALS on the OPTION statement:

```
//DFSPARM DD *  
  OPTION NOEQUALS  
/*
```

You can also specify more than one parameter on the OPTION statement, as well as additional control statements, in a DFSPARM data set. For example, if you want to list the DFSORT statements, have DFSORT set a return code of 4 if SUM fields overflow, use six dynamically allocated SYSDA work data sets, and have DFSORT ABEND if it detects an error, you can specify:

```
//DFSPARM DD *  
  OPTION LIST,OVFLO=RC4,DYNALLOC=(SYSDA,6)  
  DEBUG ABEND  
/*
```

### Summary

This chapter covered methods of overriding selected DFSORT installation defaults using PARM parameters on the JCL EXEC statement, or an OPTION control statement.





---

## Chapter 9. Using DFSORT Efficiently

You will get the best performance from DFSORT if you follow these guidelines:

- Be generous with main storage.
- Allow memory object sorting, hipersorting and dataspace sorting.
- Use high-speed disks for work space.
- Eliminate unnecessary fields with INREC.
- Eliminate unnecessary records with INCLUDE or OMIT.
- Eliminate unnecessary records with STOPAFT and SKIPREC.
- Consolidate records with SUM.
- Create multiple output data sets with OUTFIL
- Replace program logic with DFSORT control statements.
- Use FASTSORT with COBOL.
- Avoid options that might degrade performance.

Additional suggestions can be found in *z/OS DFSORT Application Programming Guide* and *z/OS DFSORT Tuning Guide*.

---

### Be Generous with Main Storage

By default, DFSORT can use 6 megabytes of main memory for sort, merge and copy applications, or even more when appropriate. If your site does not have an installation default of SIZE=MAX, we recommend setting the MAINSIZE=MAX parameter for your job. As an example, you can set MAINSIZE=MAX like this:

```
//DFSORT DD *  
        OPTION MAINSIZE=MAX  
/*
```

Alternatively, you can specify the MAINSIZE=*n*M parameter (*n* megabytes) to give DFSORT more or less storage for your job, but we do not recommend this unless you have a specific reason for using MAINSIZE=*n*M rather than MAINSIZE=MAX. As an example, you can set MAINSIZE=2M like this:

```
//DFSORT DD *  
        OPTION MAINSIZE=2M  
/*
```

---

### Allow Memory Object Sorting, Hipersorting and Dataspace Sorting

By default, DFSORT can use memory objects, hiperspaces or data spaces, when appropriate, instead of or along with disk work data sets, to improve the performance of sort applications. If your site has an installation default of MOSIZE=0, HIPRMAX=0 or DSPSIZE=0, you might want to specify the MOSIZE=MAX, HIPRMAX=OPTIMAL and DSPSIZE=MAX parameters when you sort large data sets. As an example, you can set these parameters like this:

```
//DFSORT DD *  
        OPTION MOSIZE=MAX,HIPRMAX=OPTIMAL,DSPSIZE=MAX  
/*
```

---

### Use High-Speed Disks for Work Data Sets

Using high-speed disks, such as the IBM 3390, for work data sets offers the best performance. You should avoid using tapes for work data sets whenever possible.

## Eliminate Unnecessary Fields with INREC

If you need to reformat your records, using INREC to significantly shorten them can result in faster processing.

Remember that INREC reformats records *before* they are processed, and OUTREC reformats them *after* they are processed. Therefore, you should use INREC to shorten records and OUTREC to lengthen records. For a summary of the control statements and the corresponding record positions to refer to when using INREC, see Table 49.

Table 49. Control Statement and Corresponding Records with INREC

Control Statement	Original Records	Reformatted Records
SORT		✓
MERGE		✓
SUM		✓
OUTREC		✓
OUTFIL		✓
INCLUDE	✓	
OMIT	✓	

For details on INREC, see Chapter 5, “Reformatting Records,” on page 37.

## Eliminate Unnecessary Records with INCLUDE or OMIT

Naturally, the number of input records affects the amount of time processing will take. The fewer the records, the faster the DFSORT application. You can improve performance by using INCLUDE or OMIT whenever possible to select only the records pertaining to your application.

For details on INCLUDE and OMIT, see Chapter 3, “Including or Omitting Records,” on page 25.

## Eliminate Unnecessary Records with STOPAFT and SKIPREC

You can also use the STOPAFT and SKIPREC options to reduce the number of input records you process.

- Use STOPAFT to specify the maximum number of records to be accepted for sorting or copying.
- Use SKIPREC to specify the number of records to be skipped before sorting or copying begins.

For information on how to use these options, see *z/OS DFSORT Application Programming Guide*.

## Consolidate Records with SUM

You can improve performance for sorting or merging by using the SUM statement, if appropriate for your job, to:

- add the contents of fields whenever two records with equal control fields are found. DFSORT places the result in one record and deletes the other, reducing the number of output records, or
- delete records with duplicate control fields by specifying `FIELDS=NONE`.

For details on SUM, see Chapter 4, “Summing Records,” on page 33.

---

## Create Multiple Output Data Sets with OUTFIL

If you need to create multiple output data sets from the same input data set, you can use OUTFIL to read the input data set only once, thus improving performance. OUTFIL can be used for sort, merge, and copy applications to provide sophisticated filtering, editing, conversion, lookup and replace, and report features.

For details on OUTFIL, see Chapter 6, “Creating Multiple Output Data Sets and Reports,” on page 65.

---

## Replace Program Logic with DFSORT Control Statements

As a rule, using appropriate DFSORT control statements is more efficient than program logic. Whenever possible, use DFSORT control statements INCLUDE, OMIT, INREC, OUTREC, SUM and OUTFIL instead of doing the same functions with program code.

---

## Use FASTSRT with COBOL

With COBOL, you can enhance DFSORT performance by using the FASTSRT compile-time option. With FASTSRT, DFSORT does the input and output processing, rather than COBOL. For more information on the FASTSRT option, see the COBOL Programmer’s Guide that describes the compiler version available at your site.

---

## Avoid Options That Might Degrade Performance

The parameters and options listed below might adversely affect DFSORT performance. Use them only when necessary. For a complete description of what these parameters and options are and how they affect performance, see *z/OS DFSORT Application Programming Guide* and *z/OS DFSORT Tuning Guide*.

- VERIFY parameter
- EQUALS parameter
- NOBLKSET parameter
- CKPT parameter
- EQUCOUNT parameter
- NOCINV parameter
- LOCALE parameter
- BSAM parameter
- NOASSIST parameter
- NOCFW parameter
- Tape work data sets
- User exit routines
- EFS program
- Dynamic link-edit of user exit routines
- Small values for the MOSIZE, HIPRMAX, DSPSIZE, or MAINSIZE parameters

### Summary

This chapter covered methods for improving DFSORT performance, including the effective use of various control statements and parameters.



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## Part 3. Learning to Use ICETOOL

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## Chapter 10. Using the ICETOOL Utility

ICETOOL is a multipurpose DFSORT utility that uses the capabilities of DFSORT to perform multiple operations on one or more data sets in a single step.

This chapter introduces you to ICETOOL's thirteen "operators", which allow you to do a wide variety of tasks. You will learn about ICETOOL's JCL and control statements while writing a large "main" ICETOOL job that uses many of the ICETOOL operators, as well as several additional smaller ICETOOL jobs that illustrate specific points. To fully use the capabilities of ICETOOL, you should become familiar with all of its operators, operands, and methods of invocation, as described in *z/OS DFSORT Application Programming Guide*.

**Note:** Most likely, you would do unrelated tasks in different ICETOOL jobs. But you can do unrelated tasks in the same ICETOOL job. The ICETOOL jobs constructed in this chapter take both approaches as a convenient way to illustrate the use of various ICETOOL operators.

---

### ICETOOL Operators

The thirteen ICETOOL operators listed below can be used to perform a variety of functions. By using various combinations of the thirteen ICETOOL operators, you can easily create applications that perform many complex tasks.

#### **COPY**

Copies a data set to one or more output data sets.

#### **COUNT**

Prints a message containing the count of records in a data set. COUNT can also be used to set RC=12, RC=4, or RC=0 based on meeting criteria for the number of records in a data set (for example, empty, not empty, less than, equal to, or greater than 5000 records, and so on).

#### **DEFAULTS**

Prints the DFSORT installation defaults in a separate list data set.

#### **DISPLAY**

Prints the values or characters of specified numeric or character fields in a separate list data set. Simple, tailored, or sectioned reports can be produced.

#### **MODE**

Three modes are available, which can be set or reset for groups of operators:

- STOP mode (the default) stops subsequent operations if an error is detected.
- CONTINUE mode continues with subsequent operations if an error is detected.
- SCAN mode allows ICETOOL statement checking without actually performing any operations.

#### **OCCUR**

Prints each unique value for specified numeric or character fields and how many times it occurs in a separate list data set. Simple or tailored reports can be produced. The values printed can be limited to those for which the value count meets specified criteria (for example, only duplicate values or only non-duplicate values).

**RANGE**

Prints a message containing the count of values in a specified range for a specified numeric field in a data set.

**SELECT**

Selects records from a data set for inclusion in an output data set based on meeting criteria for the number of times specified numeric or character field values occur (for example, only duplicate values or only non-duplicate values). Records that are not selected can be saved in a separate output data set.

**SORT**

Sorts a data set to one or more output data sets.

**SPLICE**

Splices together specified fields from records that have the same specified numeric or character field values (that is, duplicate values), but different information. Specified fields from two or more records can be combined to create an output record. The fields to be spliced can originate from records in different data sets, so you can use SPLICE to do various "join" and "match" operations.

**STATS**

Prints messages containing the minimum, maximum, average, and total for specified numeric fields in a data set.

**UNIQUE**

Prints a message containing the count of unique values for a specified numeric or character field.

**VERIFY**

Examines specified decimal fields in a data set and prints a message identifying each invalid value found for each field.

---

## Sample Input Data Sets

Each ICETOOL operator (except DEFAULTS and MODE) requires an input data set. The input data set used by one operator can be the same or different from the input data set used by another operator. Thus, ICETOOL can process many data sets in a single step.

This chapter uses the branch data set SORT.BRANCH, the bookstore data set SORT.SAMPIN, and the additional bookstore data set SORT.SAMPADD as input data sets. See Appendix A, "Creating the Sample Data Sets," on page 153 and Appendix B, "Descriptions of the Sample Data Sets," on page 155 for additional information about these sample data sets. Two temporary data sets created by ICETOOL from SORT.BRANCH are also used as input.

**Note:** This chapter also uses data sets other than SORT.BRANCH, SORT.SAMPIN and SORT.SAMPADD. You can either create data sets from scratch to match the ones used in the text, or else perform a similar exercise on data sets you already have.

---

## Writing Required JCL Statements

An ICETOOL job consists of:

1. The JCL statements that are required for every ICETOOL job.
2. The operator statements indicating the operations to be performed by the ICETOOL job.



3. The JCL statements that are required as a result of the specified operator statements.

The first step in creating any ICETOOL job is to write the JCL that is always required. Here is a skeleton of the JCL for an ICETOOL job:

```
//EXAMP JOB A492,PROGRAMMER
//TOOL EXEC PGM=ICETOOL
//TOOLMSG DD SYSOUT=A
//DFSMSG DD SYSOUT=A
//TOOLIN DD *
<ICETOOL statements go here>
/*
<Additional JCL statements go here>
```

- The JOB statement signals the beginning of the job.
- The EXEC statement signals the beginning of the job step and tells the operating system to run the ICETOOL program.
- The TOOLMSG statement defines the output data set for ICETOOL messages.
- The DFSMSG statement defines the output data set for DFSORT messages.
- The TOOLIN statement precedes the ICETOOL statements (comment, blank, and operator statements). The ICETOOL statements you write must appear after TOOLIN. The additional JCL statements you write can appear before the TOOLIN statement or after the ICETOOL statements. In the main ICETOOL job, the additional JCL statements will be placed after the ICETOOL statements.

---

## ICETOOL Comment and Blank Statements

Comment statements and blank statements can be placed anywhere among the ICETOOL operator statements.

- Comment statements start with an asterisk (\*) in column 1 and are printed along with the ICETOOL operator statements.
- Blank statements contain blanks in columns 1-72 and are ignored because ICETOOL prints blank lines where appropriate.

A blank statement and a comment statement for our example looks like this:

```
* Statistics from all branches
```

Here are the steps for writing these statements:

*Table 50. Steps to Create a Blank Statement and a Comment Statement*

Step	Action
1	After the TOOLIN DD statement, skip one line.
2	Type an asterisk (*) in column 1 followed by the comment.

When complete, the TOOLIN statements look like this:

```
//TOOLIN DD *
* Statistics from all branches
/*
```

For the main ICETOOL job, a comment statement will be placed before each operator to describe its function. Although not required, this is a good practice to follow.

### So Far

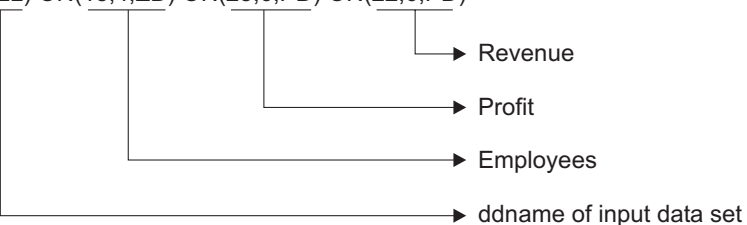
So far, you have been introduced to the basics of the ICETOOL utility. Now, using the following tutorials, you can learn about many of the ICETOOL operators. The following sections contain parts of the main ICETOOL job, so that by the end of the chapter, you will have created the complete main ICETOOL job. At the end of the chapter, there is a section that contains the complete main ICETOOL job and its resulting messages.

## Printing Statistics For Numeric Fields

When working with data sets containing numeric fields, you may want statistical information about one or more of those fields. You can use the STATS operator to find the minimum, maximum, average, and total values of up to 10 specific numeric fields.

A STATS operator that prints statistics for the employees, profit, and revenue fields of the branch office data set looks like this:

```
STATS FROM(ALL) ON(18,4,ZD) ON(28,6,PD) ON(22,6,PD)
```



Here are the steps for writing this STATS operator.

*Table 51. Steps to Create the STATS Operator*

Step	Action
1	Type <b>STATS</b> after the comment statement (you can leave one or more blanks before STATS if you like).
2	Leave at least one blank and type <b>FROM(ALL)</b>  FROM specifies the ddname (that is, the name of the DD statement) for the input data set from which you want to print statistics. In this case ALL is the ddname chosen, but you can use any valid 1-8 character ddname you like.
3	Leave at least one blank and type <b>ON</b>  ON defines a field for which you want to print statistics.
4	Type in parentheses, and separated by commas: <ol style="list-style-type: none"><li>1. Where the employees field begins relative to the beginning of the input record (the first position is byte 1). The employees field begins at byte <b>18</b>.</li><li>2. The length of the employees field in bytes. The employees field is <b>4</b> bytes long.</li><li>3. A code for the data format. The employees field contains zoned decimal data, which you specify as <b>ZD</b>.</li></ol>

Table 51. Steps to Create the STATS Operator (continued)

Step	Action
5	Leave at least one blank and type <b>ON</b>  ON defines another field for which you want to print statistics. You can print statistics for up to 10 fields with one STATS statement. Specify the ON fields in the same order in which you want their statistics to be printed.
6	Type in parentheses, and separated by commas the location ( <b>28</b> ), length ( <b>6</b> ), and format ( <b>PD</b> for packed decimal) of the profit field.
7	Leave at least one blank and type <b>ON</b> . Type in parentheses and separated by commas, the location ( <b>22</b> ), length ( <b>6</b> ), and format ( <b>PD</b> ) of the revenue field.  Make sure that the statement is coded between columns 1 and 72.

You must also write a DD statement for the A123456.SORT.BRANCH data set using the ddname ALL and place it at the end of the job:

```
//ALL DD DSN=A123456.SORT.BRANCH,DISP=SHR
```

When complete the TOOLIN statements and ALL statement look like this:

```
//TOOLIN DD *
* Statistics from all branches
STATS FROM(ALL) ON(18,4,ZD) ON(28,6,PD) ON(22,6,PD)
/*
//ALL DD DSN=A123456.SORT.BRANCH,DISP=SHR
```

When this STATS operation is run, the results are placed in the TOOLMSG data set. If you ran the ICETOOL job you created so far, the TOOLMSG output would look like this:

```
ICE600I 0 DFSORT ICETOOL UTILITY RUN STARTED
ICE650I 0 VISIT http://www.ibm.com/storage/dfsor FOR ICETOOL PAPERS, EXAMPLES AND MORE
ICE632I 0 SOURCE FOR ICETOOL STATEMENTS: TOOLIN
ICE630I 0 MODE IN EFFECT: STOP
      * Statistics from all branches
      STATS FROM(ALL) ON(18,4,ZD) ON(28,6,PD) ON(22,6,PD)
ICE627I 0 DFSORT CALL 0001 FOR COPY FROM ALL TO E35 EXIT COMPLETED
ICE628I 0 RECORD COUNT: 000000000000012
ICE607I 0 STATISTICS FOR (18,4,ZD) :
ICE608I 0 MINIMUM: +000000000000015, MAXIMUM: +000000000000035
ICE609I 0 AVERAGE: +000000000000024, TOTAL : +0000000000000298
ICE607I 0 STATISTICS FOR (28,6,PD) :
ICE608I 0 MINIMUM: -000000000004278, MAXIMUM: +0000000000008276
ICE609I 0 AVERAGE: +000000000004222, TOTAL : +0000000000050665
ICE607I 0 STATISTICS FOR (22,6,PD) :
ICE608I 0 MINIMUM: +0000000000012300, MAXIMUM: +0000000000042820
ICE609I 0 AVERAGE: +0000000000027469, TOTAL : +00000000000329637
ICE602I 0 OPERATION RETURN CODE: 00
ICE601I 0 DFSORT ICETOOL UTILITY RUN ENDED - RETURN CODE: 00
```

Looking at the output, you will notice that:

- Message ICE628I gives the count of records processed.
- Messages ICE607I, ICE608I, and ICE609I give the numerical statistics for each ON field specified in the order in which they were specified.
- A return code for each operator is given in message ICE602I and the highest operator return code is given in message ICE601I.

## Continuing an Operator Statement

If you cannot fit your STATS statement (or any other ICETOOL operator statement) between columns 1 and 72 of a single line, you can continue it across multiple lines. If you end a line with a hyphen (-) after the operator or any operand, the next line is treated as a continuation. Any characters specified after the hyphen are ignored.

Note that the operator and each operand must be completely specified on one line (between columns 1 and 72).

For example:

```
STATS      - this is the operator
FROM(ALL) - ALL is the ddname for SORT.BRANCH
ON(18,4,ZD)-
ON(28,6,PD)-
ON(22,6,PD)
```

## Statistics For VB Data Set Record Lengths

When working with variable length record data sets, you can use the STATS operator to easily obtain the following information:

- The shortest record in the data set (minimum)
- The longest record in the data set (maximum)
- The average length of records in the data set (average)
- The total number of bytes in the data set (total)

ICETOOL provides the special ON(VLEN) field for printing these statistics. Specify ON(VLEN) as you would any other ON field.

When you code ON(p,m,f) fields for VB records, remember to add 4 to the starting position to account for the 4-byte RDW, in the same way discussed earlier for DFSORT control statement fields.

The following STATS operator reports the minimum, maximum, total and average values for the record length and for a PD field in the first two data bytes:

```
STATS FROM(VBIN) ON(VLEN) ON(5,2,PD)
```

### So far

Now you know how to use ICETOOL's STATS operator to print statistics for numeric fields and VB record lengths. In the next section, you will learn how to use ICETOOL's SORT operator.

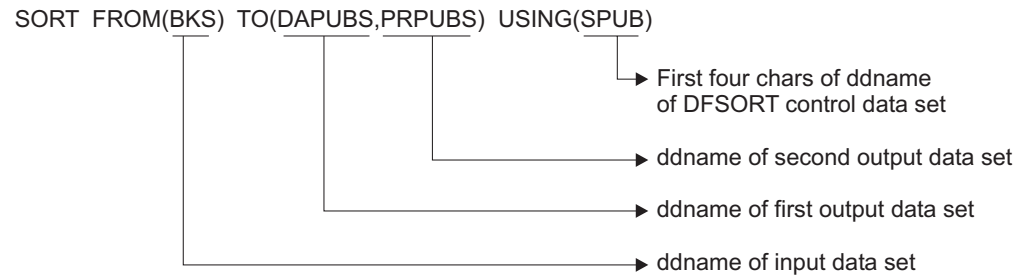
---

## Creating Identical Sorted Data Sets

You can use ICETOOL's SORT operator to create sorted output data sets. A single SORT operator can be used to create one output data set or up to 10 identical output data sets. Using INCLUDE or OMIT statements, you can select a subset of the input records. Using INREC or OUTREC statements, you can rearrange the fields of the input records. Using OUTFIL statements, you can create any number of output data sets with different subsets of records or arrangements of fields.

For this example, we will use both the sample bookstore data set (SORT.SAMPIN) and the additional bookstore data set (SORT.SAMPADD) as input.

A SORT operator that selects the books from publishers VALD and WETH, sorts them by publisher and title, and writes them to disk and print data sets, looks like this:



Here are the steps for writing this SORT operator:

*Table 52. Steps to Create the SORT Operator*

Step	Action
1	Write a comment statement (optional):  * Books from VALD and WETH
2	Type <b>SORT</b> after the comment statement
3	Leave at least one blank and type <b>FROM(BKS)</b>  BKS specifies the ddname for the input data sets you want to sort.
4	Leave at least one blank and type <b>TO(DAPUBS,PRPUBS)</b>  TO specifies the ddnames for the output data sets to contain the sorted subset of records. You can create up to 10 identical output data sets of any type that DFSORT allows (permanent, temporary, disk, tape, print, etc).  In this case, DAPUBS is the ddname chosen for the temporary disk data set and PRPUBS is the ddname chosen for the print data set. You can use any valid 1-8 character ddnames you like.  ICETOOL will automatically use OUTFIL to create both output data sets from a single pass over the input data set.
5	Leave at least one blank and type <b>USING(SPUB)</b>  USING specifies the first four characters of the ddname for the data set containing the DFSORT control statements. In this case, the four characters chosen are SPUB, but you can use any four characters you like as long as they are valid for a ddname. The last four characters of the ddname are always CNTL, so in this case the full ddname is SPUBCNTL.  For the SORT operator, you must specify a SORT control statement in the DFSORT control statement data set (SPUBCNTL) in order to tell DFSORT how to sort the input data set. You can also specify additional DFSORT control statements, like INCLUDE, OMIT, INREC, OUTREC and OUTFIL, as appropriate.

To write the JCL statements that go with the SORT operator:

*Table 53. Steps to Create JCL Statements for the SORT Operator*

Step	Action
1	Write DD statements for the input data sets and place them at the end of the job. In order to "concatenate" the two input data sets together, you must leave the ddname field blank in the second DD statement:  //BKS DD DSN=A123456.SORT.SAMPIN,DISP=SHR // DD DSN=A123456.SORT.SAMPADD,DISP=SHR
2	Write DD statements for the disk and print output data sets and place them at the end of the job:  //DAPUBS DD DSN=&&DSRT,DISP=(,PASS),SPACE=(CYL,(2,2)),UNIT=SYSDA //PRPUBS DD SYSOUT=A
3	Write a DD statement for the DFSORT control statement data set and place it at the end of the job:  //SPUBCNTL DD *
4	Write the SORT control statement to sort the input data sets by publisher and title, and the INCLUDE statement to select only the books by publishers VALD and WETH, and place them after the SPUBCNTL statement:  SORT FIELDS=(106,4,A,1,75,A),FORMAT=CH INCLUDE COND=(106,4,EQ,C'VALD',OR,106,4,EQ,C'WETH'), FORMAT=CH

When complete, the TOOLIN statements and DD statements for this SORT operator look like this:

```
* Books from VALD and WETH
SORT FROM(BKS) TO(DAPUBS,PRPUBS) USING(SPUB)
/*
//BKS DD DSN=A123456.SORT.SAMPIN,DISP=SHR
// DD DSN=A123456.SORT.SAMPADD,DISP=SHR
//DAPUBS DD DSN=&&DSRT,DISP=(,PASS),SPACE=(CYL,(2,2)),UNIT=SYSDA
//PRPUBS DD SYSOUT=A
//SPUBCNTL DD *
SORT FIELDS=(106,4,A,1,75,A),FORMAT=CH
INCLUDE COND=(106,4,EQ,C'VALD',OR,106,4,EQ,C'WETH'),
FORMAT=CH
/*
```

**Tip:** Instead of writing the INCLUDE statement above using two conditions joined by OR, you could write it with one condition using INCLUDE's substring search feature, as you learned in "Substring Search for INCLUDE and OMIT" on page 30, like this:

```
INCLUDE COND=(106,4,SS,EQ,C'VALD,WETH')
```

Table 54 shows the Book Title and Publisher fields for the records as they would appear in the resulting output data sets. The actual records contain all of the fields.

*Table 54. Books from publishers VALD and WETH*

Book Title	Publisher
1 75	106 109

Table 54. Books from publishers VALD and WETH (continued)

Book Title	Publisher
CELLS AND HOW THEY WORK	VALD
COMPLETE SPANISH DICTIONARY	VALD
EDITING SOFTWARE MANUALS	VALD
FREUD'S THEORIES	VALD
INTRODUCTION TO BIOLOGY	VALD
NOVEL IDEAS	VALD
SHORT STORIES AND TALL TALES	VALD
STRATEGIC MARKETING	VALD
VIDEO GAME DESIGN	VALD
ZEN BUSINESS	VALD
ANTICIPATING THE MARKET	WETH
CIVILIZATION SINCE ROME FELL	WETH
COMPUTERS: AN INTRODUCTION	WETH
EIGHTEENTH CENTURY EUROPE	WETH
GUIDE TO COLLEGE LIFE	WETH
GUNTHER'S GERMAN DICTIONARY	WETH
REBIRTH FROM ITALY	WETH
SYSTEM PROGRAMMING	WETH
THE INDUSTRIAL REVOLUTION	WETH

## Creating Different Subsets of a Sorted Data Set

If you want to create subsets of records from the same input data set, you can use OUTFIL statements with a SORT or COPY operator. The OUTFIL statements specify the ddnames of the output data sets, so the TO operand is not needed. All of the features of OUTFIL are available through the SORT and COPY operators.

A SORT operator that creates separate disk and tape data sets for the branch offices in California, and those in Colorado, sorted by city looks like this:

```
SORT FROM(ALL) USING(CACO)
```

First four chars of ddname of DFSORT control data set

ddname of input data set

Here are the steps for writing this SORT operator:

Table 55. Steps to Create the SORT Operator

Step	Action
1	Write a comment statement (optional):  * Separate output for California and Colorado branches
2	Type <b>SORT</b> after the comment statement
3	Leave at least one blank and type <b>FROM(ALL)</b>  ALL specifies the ddname for the input data set you want to sort. You can use the same ddname that you used for A123456.SORT.BRANCH in the STATS operator.
4	Leave at least one blank and type <b>USING(CACO)</b>  The CACOCNTL data set contains the SORT and OUTFIL statements.

To write the JCL statements that go with the SORT operator follow these steps:

*Table 56. Steps to Create JCL Statements for the SORT Operator*

Step	Action
1	Write a DD statement for the DFSORT control statement data set and place it at the end of the job: //CACOCNTL DD *
2	Write the SORT control statement to sort the input data set by city, the OUTFIL statement to select only the California branches, and the OUTFIL statement to select only the Colorado branches, and place them after the CACOCNTL statement: SORT FIELDS=(1,15,CH,A) OUTFIL FNames=(CADASD,CATAPE),INCLUDE=(16,2,CH,EQ,C'CA') OUTFIL FNames=(CODASD,COTAPE),INCLUDE=(16,2,CH,EQ,C'CO')
3	Write DD statements for the disk and tape output data sets and place them at the end of the job: //CADASD DD DSN=&&CA,DISP=(,PASS),SPACE=(CYL,(2,2)),UNIT=3390 //CATAPE DD DSN=CA.BRANCH,UNIT=3480,VOL=SER=111111, // DISP=(NEW,KEEP),LABEL=(,SL) //CODASD DD DSN=&&CO,DISP=(,PASS),SPACE=(CYL,(2,2)),UNIT=3390 //COTAPE DD DSN=CO.BRANCH,UNIT=3480,VOL=SER=222222, // DISP=(NEW,KEEP),LABEL=(,SL)

When complete, the TOOLIN statements and DD statements for this SORT operator look like this:

```
* Separate output for California and Colorado branches
SORT FROM(ALL) USING(CACO)
/*
//CACOCNTL DD *
  SORT FIELDS=(1,15,CH,A)
  OUTFIL FNames=(CADASD,CATAPE),INCLUDE=(16,2,CH,EQ,C'CA')
  OUTFIL FNames=(CODASD,COTAPE),INCLUDE=(16,2,CH,EQ,C'CO')
/*
//CADASD DD DSN=&&CA,DISP=(,PASS),SPACE=(CYL,(2,2)),UNIT=3390
//CATAPE DD DSN=CA.BRANCH,UNIT=3480,VOL=SER=111111,
// DISP=(NEW,KEEP),LABEL=(,SL)
//CODASD DD DSN=&&CO,DISP=(,PASS),SPACE=(CYL,(2,2)),UNIT=3390
//COTAPE DD DSN=CO.BRANCH,UNIT=3480,VOL=SER=222222,
// DISP=(NEW,KEEP),LABEL=(,SL)
```

Table 57 shows the records as they would appear in the CADASD data set (&&CA) and the CATAPE data set (CA.BRANCH) as a result of using the first OUTFIL statement.

*Table 57. Records for California Sorted by City*

City	State	Employees	Revenue	Profit
1 15	16 17	18 21	22 27	28 33
Los Angeles	CA	32	22530	-4278
Morgan Hill	CA	15	18200	3271
Sacramento	CA	29	42726	8276
San Diego	CA	22	32940	8275
San Francisco	CA	35	42820	6832
San Jose	CA	21	27225	8264
Sunnyvale	CA	18	16152	-978



Table 58 shows the records as they would appear in the CODASD data set (&&CO) and the COTAPE data set (CO.BRANCH) as a result of using the second OUTFIL statement.

*Table 58. Records for Colorado Sorted by City*

City	State	Employees	Revenue	Profit
<b>1 15</b>	<b>16 17</b>	<b>18 21</b>	<b>22 27</b>	<b>28 33</b>
Aspen	CO	20	25800	5200
Boulder	CO	32	33866	7351
Denver	CO	33	31876	6288
Fort Collins	CO	22	12300	-2863
Vail	CO	19	23202	5027

Figure 6 on page 139 shows the complete TOOLMSG output.

#### So Far

So far in this tutorial, you have learned how to print statistics for numeric fields using ICETOOL's STATS operator, and how to sort an input data set and create multiple output data sets using ICETOOL's SORT operator. Next, you will learn about ICETOOL's COPY operator.

## Creating Multiple Unsorted Data Sets

If you want to create unsorted copies of an input data set, you can use ICETOOL's COPY operator. The COPY operator does not require any DFSORT statements. However, you can supply DFSORT statements (for example, INCLUDE, OMIT, INREC, OUTREC, or OUTFIL) if appropriate.

Here are a couple of examples of COPY operator statements with their accompanying JCL statements:

```
//TOOLIN DD *
  COPY FROM(ALL) TO(D1,D2,D3)
  COPY FROM(ALL) TO(P1) USING(COPY)
/*
//ALL DD DSN=A123456.SORT.BRANCH,DISP=SHR
//D1 DD DSN=A123456.SORT.COPY1,DISP=OLD
//D2 DD DSN=A123456.SORT.COPY2,DISP=OLD
//D3 DD DSN=A123456.SORT.COPY3,DISP=OLD
//P1 DD SYSOUT=*
//COPYCNTL DD *
  INCLUDE COND=(16,2,CH,EQ,C'CA')
/*
```

The first COPY operator creates identical copies of A123456.SORT.BRANCH in A123456.SORT.COPY1, A123456.SORT.COPY2, and A123456.SORT.COPY3.

The second COPY operator prints the A123456.SORT.BRANCH records for the branches in California. Note that only the character fields in the resulting printed output will be readable. You will learn how to display numeric fields in readable format later in this chapter.

Because copying is more efficient than sorting, you should use the COPY operator rather than the SORT operator when possible.

### So Far

So far in this chapter you have learned about STATS, SORT, and COPY, three important ICETOOL operators. The next tutorial shows you how to use ICETOOL's RANGE operator.

## Counting Values in a Range

You can use ICETOOL's RANGE operator to count the number of values for a particular numeric field that fall within a range you define. The range can be defined with:

Operand	Comparison
EQUAL	Equal to a value
NOTEQUAL	Not equal to a value
LOWER	Less than a value
HIGHER	Greater than a value
HIGHER and LOWER	Greater than a value, but less than another value

To print a count of the number of California branches with profit greater than -1500, but less than +8000, write the following RANGE statement:

```
RANGE FROM(CADASD) ON(28,6,PD) HIGHER(-1500) LOWER(+8000)
```

Diagram illustrating the components of the RANGE statement:

- CADASD: ddname of input data set
- 28,6,PD: Profit
- 1500: Lower limit for range
- +8000: Upper limit for range

The input data set defined by CADASD is the same data set you created earlier (with the SORT operator) for the California branches. HIGHER(-1500) indicates that you want to count values in the profit field that are greater than -1500, while LOWER(+8000) indicates that you want to count values in the profit field that are less than +8000. For a negative limit, you must specify a minus (-) sign before the number. For a positive limit, you either specify a plus (+) sign before the number or leave it out, therefore, HIGHER(8000) is the same as HIGHER(+8000).

To print a count of the number of branches (in California and Colorado) with less than 32 employees, write the following RANGE statement:

```
RANGE FROM(ALL) ON(18,4,ZD) LOWER(32)
```

Diagram illustrating the components of the RANGE statement:

- ALL: ddname of input data set
- 18,4,ZD: Employees
- 32: Upper limit for range

Because CADASD and ALL were previously defined, you don't need to add any new JCL statements to the ICETOOL job.

When these RANGE operators are run, the results are placed in the TOOLMSG data set. The TOOLMSG output produced for these RANGE operators would look like this:

```
      * California branches profit analysis
      RANGE FROM(CADASD) ON(28,6,PD) HIGHER(-1500) LOWER(+8000)
ICE627I 0 DFSORT CALL 0004 FOR COPY FROM CADASD   TO E35  EXIT COMPLETED
ICE628I 0 RECORD COUNT: 0000000000000007
ICE631I 0 NUMBER OF VALUES IN RANGE FOR (28,6,PD)      : 0000000000000003
ICE602I 0 OPERATION RETURN CODE: 00

      * Branches with less than 32 employees
      RANGE FROM(ALL) ON(18,4,ZD) LOWER(32)
ICE627I 0 DFSORT CALL 0005 FOR COPY FROM ALL       TO E35  EXIT COMPLETED
ICE628I 0 RECORD COUNT: 0000000000000012
ICE631I 0 NUMBER OF VALUES IN RANGE FOR (18,4,ZD)    : 0000000000000008
ICE602I 0 OPERATION RETURN CODE: 00
```

Looking at the output, you will notice that:

- Message ICE628I gives the count of records processed.
- Message ICE631I gives the count of values in the specified range. There were 3 California branches with profit greater than -1500, but less than +8000, and 8 branches in all with less than 32 employees.
- A return code for each operator is given in message ICE602I.

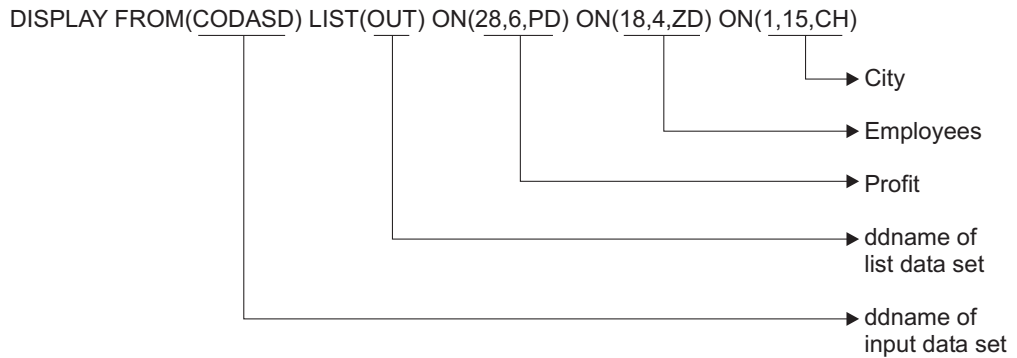
#### So Far

You have now learned how to count the number of values in a range for a particular field using ICETOOL's RANGE operator. Next, you will learn about ICETOOL's DISPLAY operator.

## Printing Simple Reports

Numeric fields are often in a format (binary, fixed-point, or decimal) that is not readable when printed. You can use ICETOOL's DISPLAY operator to print simple reports showing up to 20 numeric and character fields from an input data set in readable form. The specified fields are printed in a list data set that you define. For numeric fields, appropriate plus (+) and minus (-) signs are printed along with the decimal value of each number.

To print a list data set showing the profit, employees, and city fields for the Colorado branches, write the following DISPLAY operator:



The input data set defined by CODASD is the same data set you created earlier (with the SORT operator) for the Colorado branches. LIST specifies the ddname for the list data set you want the fields to be printed in. In this case, OUT is the ddname chosen for the list data set, but you can use any valid 1-8 character ddname you like. Specify the ON fields in the same order in which you want their values to be printed in the list data set.

Because OUT has not been defined previously, you must add a JCL statement for it to the end of the job:

```
//OUT DD SYSOUT=A
```

When this DISPLAY operator is run, the OUT data set looks like this:

(28,6,PD)	(18,4,ZD)	(1,15,CH)
+0000000000005200	+000000000000020	Aspen
+0000000000007351	+000000000000032	Boulder
+0000000000006288	+000000000000033	Denver
-0000000000002863	+000000000000022	Fort Collins
+0000000000005027	+000000000000019	Vail

**Note:** The output actually contains ANSI carriage control characters in the first byte of the report, as explained previously in “Creating Reports with OUTFIL” on page 74. However, ICETOOL always inserts actual blank lines in your report rather than using the '0' and '-' ANSI carriage control characters to print blank lines. So you do not have to do anything to force blank lines to be displayed when you view an ICETOOL report, as you do for an OUTFIL report. The ANSI carriage control characters are not shown in this section, although they are present in the reports.

The values for profit, employees, and city are printed in separate columns across the page with a header for each column at the top. If more than one page is printed, DISPLAY puts the header at the top of each page. If you do not want the header printed, you can use DISPLAY’s NOHEADER operand to suppress it.

DISPLAY also has two special ON fields you can use:

- **ON(VLEN)** can be used for variable length record data sets to print the length of each record.
- **ON(NUM)** can be used to print a relative record number for each record (starting with 1).

Use the ON(VLEN) or ON(NUM) field just as you would any other ON field.

---

## Printing Tailored Reports

The previous tutorial showed you how to print a simple listing of numeric and character fields using the DISPLAY operator. By using additional operands of DISPLAY, you can create list data sets showing character and numeric fields in a variety of tailored report formats. You can specify:

- title elements (TITLE, DATE, PAGE, and TIME operands)
- one, two or three line field headings (HEADER operand)
- spacing for columns (INDENT, BETWEEN, and STATLEFT operands)
- field formatting (BLANK and PLUS operands), and formatting items for individual ON fields
- statistics (TOTAL, AVERAGE, MAXIMUM and MINIMUM operands)
- lines per page (LINES operand)

Refer to *z/OS DFSORT Application Programming Guide* for complete details on these and other operands you can use with DISPLAY.

To print a report for the Colorado branches showing the city, profit and employee fields with a title line, field headings, totals, averages and minimums, write the following DISPLAY operator:

```
* Print a report for the Colorado branches
DISPLAY FROM(CODASD) LIST(RPT) -
                                     ddnames of data sets
DATE TITLE('Colorado Branches Report') PAGE -
                                     Title line elements
HEADER('City') HEADER('Profit') HEADER('Employees') -
                                     Field headings
ON(1,15,CH) ON(28,6,PD) ON(18,4,ZD) BLANK BETWEEN(5) -
                                     Spaces between columns
                                     Alternate print format
                                     Fields
TOTAL('Total') AVERAGE('Average') MINIMUM ('Lowest')
                                     Statistics
```

CODASD is the ddname for the previously created Colorado branches data set. RPT is the ddname for the list data set in which you want the report to be printed.

DATE, TITLE and PAGE indicate the elements to be included in the title line and their placement. Specify these operands in the same order in which you want them to be printed in the list data set.

Each HEADER indicates a heading to be used for the corresponding field. Specify the ON fields and their corresponding HEADER strings in the same order in which you want their values to be printed in the list data set.

BLANK specifies that numeric values are printed with blank for plus sign, - for minus sign and no leading zeros. BETWEEN specifies the number of spaces between columns (overriding the default of 3). HEADER, BLANK and BETWEEN

change the justification and column width for the fields, and the spacing between them, to produce a more report-like format.

TOTAL, AVERAGE and MINIMUM cause the indicated statistics to be produced at the end of the report, identified by the specified strings.

Because RPT has not been defined previously, you must add a JCL statement for it at the end of the job:

```
//RPT DD SYSOUT=A
```

When this DISPLAY operator is run, the RPT data set that results looks like:

```
10/21/03          Colorado Branches Report          - 1 -

City              Profit              Employees
-----
Aspen              5200              20
Boulder            7351              32
Denver             6288              33
Fort Collins       -2863              22
Vail               5027              19

Total              21003             126

Average            4200              25

Lowest             -2863              19
```

The title line and heading line are printed at the top of each page. The character data is left-justified and the numeric data is right-justified with zeros suppressed. The statistics are printed after the columns of data.

---

## Using Formatting Items

The previous tutorial used the BLANK operand to change the way all numeric values in the report are displayed. You can use formatting items to change the appearance of individual numeric fields and their related statistics in the report, with respect to separators, number of digits, decimal point, decimal places, signs, leading zeros, division, leading strings, floating strings, and trailing strings. Formatting items can also be used to insert leading strings or trailing strings for character fields.

Formatting items are written as part of the ON operand, separated by commas, as follows: ON(p,m,f,formatting), ON(VLEN,formatting) and ON(NUM,formatting).

## Edit Masks

You can select from thirty-three pre-defined edit masks. The table below describes the available masks and shows how the values 12345678 and -1234567 would be printed for each mask. In the pattern:

- **d** is used to represent a decimal digit (0-9)
- **w** is used to represent a leading sign that will be blank for a positive value or - for a negative value
- **x** is used to represent a trailing sign that will be blank for a positive value or - for a negative value
- **y** is used to represent a leading sign that will be blank for a positive value or ( for a negative value

- z is used to represent a trailing sign that will be blank for a positive value or ) for a negative value

Table 59. Edit Mask Patterns

Mask	Pattern	12345678	-1234567
A0	wdddddddddddddddddddddddddddd	12345678	-1234567
A1	wd,ddd,ddd,ddd,ddd,ddd,ddd,ddd,ddd,ddd	12,345,678	-1,234,567
A2	wd.ddd.ddd.ddd.ddd.ddd.ddd.ddd.ddd.ddd	12.345.678	-1.234.567
A3	wd ddd ddd ddd ddd ddd ddd ddd ddd ddd	12 345 678	-1 234 567
A4	wd'ddd'ddd'ddd'ddd'ddd'ddd'ddd'ddd'ddd	12'345'678	-1'234'567
A5	d ddd ddd ddd ddd ddd ddd ddd ddd dddx	12 345 678	1 234 567-
B1	wddd,ddd,ddd,ddd,ddd,ddd,ddd,ddd,ddd,d	1,234,567.8	-123,456.7
B2	wddd.ddd.ddd.ddd.ddd.ddd.ddd.ddd.ddd,d	1.234.567,8	-123.456,7
B3	wddd ddd ddd ddd ddd ddd ddd ddd ddd ddd,d	1 234 567,8	-123 456,7
B4	wddd'ddd'ddd'ddd'ddd'ddd'ddd'ddd'ddd'd	1'234'567.8	-123'456.7
B5	wddd'ddd'ddd'ddd'ddd'ddd'ddd'ddd'ddd,d	1'234'567,8	-123'456,7
B6	ddd ddd ddd ddd ddd ddd ddd ddd ddd ddx	1 234 567,8	123 456,7-
C1	wdd,ddd,ddd,ddd,ddd,ddd,ddd,ddd,ddd,dd	123,456.78	-12,345.67
C2	wdd.ddd.ddd.ddd.ddd.ddd.ddd.ddd.ddd,dd	123.456,78	-12.345,67
C3	wdd ddd ddd ddd ddd ddd ddd ddd ddd ddd,dd	123 456,78	-12 345,67
C4	wdd'ddd'ddd'ddd'ddd'ddd'ddd'ddd'ddd,dd	123'456.78	-12'345.67
C5	wdd'ddd'ddd'ddd'ddd'ddd'ddd'ddd'ddd,dd	123'456,78	-12'345,67
C6	dd ddd ddd ddd ddd d ddd ddd ddd ddd,ddx	123 456,78	12 345,67-
D1	wd,ddd,ddd,ddd,ddd,ddd,ddd,ddd,ddd,ddd	12,345.678	-1,234.567
D2	wd.ddd.ddd.ddd.ddd.ddd.ddd.ddd.ddd,ddd	12.345,678	-1.234,567
D3	wd ddd ddd ddd ddd ddd ddd ddd ddd ddd,ddd	12 345,678	-1 234,567
D4	wd'ddd'ddd'ddd'ddd'ddd'ddd'ddd'ddd,ddd	12'345.678	-1'234.567
D5	wd'ddd'ddd'ddd'ddd'ddd'ddd'ddd'ddd,ddd	12'345,678	-1'234,567
D6	d ddd ddd ddd ddd ddd ddd ddd ddd dddx	12 345,678	1 234,567-
E1	yd,ddd,ddd,ddd,ddd,ddd,ddd,ddd,ddd,dddz	12,345,678	(1,234,567)
E2	yd.ddd.ddd.ddd.ddd.ddd.ddd.ddd.ddd,dddz	12.345.678	(1.234.567)
E3	yd ddd ddd ddd ddd ddd ddd ddd ddd dddz	12 345 678	(1 234 567)
E4	yd'ddd'ddd'ddd'ddd'ddd'ddd'ddd'ddd,dddz	12'345'678	(1'234'567)
F1	ydd,ddd,ddd,ddd,ddd,ddd,ddd,ddd,ddd,dddz	123,456.78	(12,345.67)
F2	ydd.ddd.ddd.ddd.ddd.ddd.ddd.ddd.ddd,dddz	123.456,78	(12.345,67)
F3	ydd ddd ddd ddd ddd ddd ddd ddd ddd dddz	123 456,78	(12 345,67)
F4	ydd'ddd'ddd'ddd'ddd'ddd'ddd'ddd'ddd,dddz	123'456.78	(12'345.67)
F5	ydd'ddd'ddd'ddd'ddd'ddd'ddd'ddd'ddd,dddz	123'456,78	(12'345,67)
G1	wddd,ddd,ddd,ddd,ddd,ddd,ddd,ddd,ddd	1,234.5678	-123.4567

Table 59. Edit Mask Patterns (continued)

Mask	Pattern	12345678	-1234567
G2	wddd.ddd.ddd.ddd.ddd.ddd.ddd.ddd,dddd	1.234,5678	-123,4567
G3	wddd ddd ddd ddd ddd ddd ddd ddd,dddd	1 234,5678	-123,4567
G4	wddd'ddd'ddd'ddd'ddd'ddd'ddd'ddd,dddd	1'234,5678	-123,4567
G5	wddd'ddd'ddd'ddd'ddd'ddd'ddd'ddd,dddd	1'234,5678	-123,4567
G6	ddd ddd ddd ddd ddd ddd ddd ddd,ddddx	1 234,5678	123,4567-

To use the E1 edit mask for the Profit field in the previous report, just change ON(28,6,PD) to ON(28,6,PD,E1). The RPT data set looks like this:

10/21/03	Colorado Branches Report	- 1 -
City	Profit	Employees
-----	-----	-----
Aspen	5,200	20
Boulder	7,351	32
Denver	6,288	33
Fort Collins	(2,863)	22
Vail	5,027	19
Total	21,003	126
Average	4,200	25
Lowest	(2,863)	19

Leading Zeros

By default, leading zeros are not displayed when you use an edit mask, but you can change that by adding LZ to your formatting items as in the second ON field below:

```
HEADER('No leading zeros','(without LZ)') ON(28,6,PD,E1) -
HEADER('Leading zeros','(with LZ)') ON(28,6,PD,E1,LZ)
```

The resulting report shows the difference in the way the Profit values from SORT.BRANCH are displayed with the E1 edit mask and without and with LZ. Note the use of HEADER('string1','string2') to produce a two line heading.

No leading zeros (without LZ)	Leading zeros (with LZ)
-----	-----
(4,278)	(00,000,004,278)
6,832	00,000,006,832
(2,863)	(00,000,002,863)
8,276	00,000,008,276
(978)	(00,000,000,978)
6,288	00,000,006,288
7,351	00,000,007,351
3,271	00,000,003,271
5,027	00,000,005,027
8,264	00,000,008,264
8,275	00,000,008,275
5,200	00,000,005,200

Edit Patterns

The edit masks are not particularly useful for unsigned numeric data such as telephone numbers, dates, time-of-day, identification numbers, and so on. Instead,



you can use edit patterns to change the way these types of numeric values are displayed in your report. E'pattern' is used to specify an edit pattern. You use a 9 in the pattern where you want a digit (0-9) from the numeric value to appear, and any other characters anywhere you want them to appear.

If you have an 8-byte ZD date in the form *mmddyyyy* in positions 21-28, you can display it as *mm/dd/yyyy* using ON(21,8,ZD,E'99/99/9999'). An 8-byte value of 03122004 is displayed as 03/12/2004.

If you have a 10-byte ZD telephone number in the form *aaapppnnnn* in positions 31-40, you can display it as (aaa)-ppp-nnnn using ON(31,10,ZD, E'(999)-999-9999'). A 10-byte value of 0123456789 is displayed as (012)-345-6789.

## No Statistics

By default, any statistics you request using TOTAL, MAXIMUM, MINIMUM, and AVERAGE (as well as BTOTAL, BMINIMUM, BMAXIMUM and BAVERAGE, which you will learn about later) are displayed for every numeric ON field. You can use the NOST formatting item to suppress statistics for numeric fields, such as telephone numbers, for which they are meaningless. The following DISPLAY operator prints a report from the SORT.BRANCH data set with totals for the Revenue and Profit fields, but not for the Employees field.

```
DISPLAY FROM(IN) LIST(RPT3) -
  HEADER('City') ON(1,15,CH) -
  HEADER('Employees') ON(18,4,ZD,NOST) -
  HEADER('Revenue') ON(22,6,PD) -
  HEADER('Profit') ON(28,6,PD) -
  TOTAL('Totals')
```

The RPT3 data set looks like this:

City	Employees	Revenue	Profit
Los Angeles	32	22530	-4278
San Francisco	35	42820	6832
Fort Collins	22	12300	-2863
Sacramento	29	42726	8276
Sunnyvale	18	16152	-978
Denver	33	31876	6288
Boulder	32	33866	7351
Morgan Hill	15	18200	3271
Vail	19	23202	5027
San Jose	21	27225	8264
San Diego	22	32940	8275
Aspen	20	25800	5200
Totals		329637	50665

## Division

You can select from ten division items as follows:

- /D - divide by 10
- /C - divide by 100
- /K - divide by 1000
- /DK - divide by 10000 (10\*1000)
- /CK - divide by 100000 (100\*1000)
- /M - divide by 1000000 (1000\*1000)
- /G - divide by 1000000000 (1000\*1000\*1000)
- /KB - divide by 1024
- /MB - divide by 1048576 (1024\*1024)
- /GB - divide by 1073741824 (1024\*1024\*1024)

The Profit values from SORT.BRANCH look as follows with  
 HEADER('Profit/(Loss) in K\$') and ON(28,6,PD,E1,/K):

```
Profit/(Loss) in K$
-----
(4)
6
(2)
8
0
6
7
3
5
8
8
5
```

## Leading, Floating and Trailing Characters

You can add floating characters to your numeric fields and add leading and trailing characters to your numeric and character fields as follows:

- **F'string'** - a floating string to appear to the left of the first non-blank character of the formatted numeric data.
- **L'string'** - a leading string to appear at the beginning of the character or numeric data column.
- **T'string'** - a trailing string to appear at the end of the character or numeric data column.

The Profit values from SORT.BRANCH look as follows with HEADER('Profit') and ON(28,6,PD,A1,F'\$',T'\*\*'):

```
Profit
-----
$-4,278**
$6,832**
$-2,863**
$8,276**
$-978**
$6,288**
$7,351**
$3,271**
$5,027**
$8,264**
$8,275**
$5,200**
```

---

## Printing Sectioned Reports

The previous tutorial showed you how to print tailored reports using the DISPLAY operator. By using the BREAK operand of DISPLAY, you can create reports divided into sections by a character or numeric break field on which you have previously sorted. You can use formatting items with BREAK(p,m,f,formatting) in the same way you can use them with ON(p,m,f,formatting). You can also specify a string for the break title (BTITLE operand) and statistics for the individual sections (BTOTAL, BAVERAGE, BMAXIMUM and BMINIMUM operands).

For this example, we will use the data set with books from publishers VALD and WETH, sorted by publisher and title, that we created previously. To print a report with sections by publisher showing the title and price fields with a title line, field headings, break title, break averages and totals, and overall averages and totals, write the following DISPLAY operator:

\* Print a report of books for individual publishers

```
DISPLAY FROM(DAPUBS) LIST(SECTIONS) -  
                                     └─ ddnames of data sets  
TITLE('BOOKS FOR INDIVIDUAL PUBLISHERS') PAGE -  
                                     └─ Title line elements  
HEADER('TITLE OF BOOK') ON(1,35,CH) -  
                                     └─ Heading and field  
HEADER('PRICE OF BOOK') ON(1704,BI,C1,F'$') -  
                                     └─ Heading and field  
BTITLE('PUBLISHER:') BREAK(106,4,CH) -  
    └─ Break field  
    └─ Break title  
BAVERAGE('AVERAGE FOR THIS PUBLISHER') -  
                                     └─ Section average  
BTOTAL('TOTAL FOR THIS PUBLISHER') -  
                                     └─ Section total  
AVERAGE('AVERAGE FOR ALL PUBLISHERS') -  
                                     └─ Overall average  
TOTAL('TOTAL FOR ALL PUBLISHERS') -  
                                     └─ Overall total
```

DAPUBS is the ddname for the previously created VALD and WETH data set. SECTIONS is the ddname for the list data set in which you want the report to be printed.

TITLE and PAGE indicate the elements to be included in the title line and their placement.

Each HEADER and ON pair indicate a field to be included in the report and the heading to be used for it.

BTITLE indicates a string to be used for the break title and its placement (before or after the break field). BREAK indicates the break field to be used to create sections. BAVERAGE and BTOTAL indicate section statistics to be produced at the end of each section.

AVERAGE and TOTAL indicate overall statistics to be produced at the end of the report.

Because SECTIONS has not been defined previously, you must add a JCL statement for it at the end of the job:

```
//SECTIONS DD SYSOUT=A
```

When this DISPLAY operator is run, it produces a three-page report for the SECTIONS data set that looks like this:

BOOKS FOR INDIVIDUAL PUBLISHERS - 1 -

PUBLISHER: VALD

TITLE OF BOOK	PRICE OF BOOK
CELLS AND HOW THEY WORK	\$24.95
COMPLETE SPANISH DICTIONARY	\$6.50
EDITING SOFTWARE MANUALS	\$14.50
FREUD'S THEORIES	\$12.50
INTRODUCTION TO BIOLOGY	\$23.50
NOVEL IDEAS	\$24.50
SHORT STORIES AND TALL TALES	\$15.20
STRATEGIC MARKETING	\$23.50
VIDEO GAME DESIGN	\$21.99
ZEN BUSINESS	\$12.00
AVERAGE FOR THIS PUBLISHER	\$17.91
TOTAL FOR THIS PUBLISHER	\$179.14

BOOKS FOR INDIVIDUAL PUBLISHERS - 2 -

PUBLISHER: WETH

TITLE OF BOOK	PRICE OF BOOK
ANTICIPATING THE MARKET	\$20.00
CIVILIZATION SINCE ROME FELL	\$13.50
COMPUTERS: AN INTRODUCTION	\$18.99
EIGHTEENTH CENTURY EUROPE	\$17.90
GUIDE TO COLLEGE LIFE	\$20.00
GUNTHER'S GERMAN DICTIONARY	\$10.88
REBIRTH FROM ITALY	\$25.60
SYSTEM PROGRAMMING	\$31.95
THE INDUSTRIAL REVOLUTION	\$7.95
AVERAGE FOR THIS PUBLISHER	\$18.53
TOTAL FOR THIS PUBLISHER	\$166.77

BOOKS FOR INDIVIDUAL PUBLISHERS - 3 -

TITLE OF BOOK	PRICE OF BOOK
AVERAGE FOR ALL PUBLISHERS	\$18.20
TOTAL FOR ALL PUBLISHERS	\$345.91

#### So Far

You have now learned how to print simple, tailored and sectioned reports using ICETOOL's DISPLAY operator. Next, you will learn about ICETOOL's OCCUR operator.

## Printing How Many Times Fields Occur

You can use ICETOOL's OCCUR operator to print a simple or tailored report showing how many times different ON field values occur, sorted by those ON field values. Values that occur only once are called "non-duplicate" values. Values that occur more than once are called "duplicate" values.

You can list all of the values in the data set, or list different combinations of duplicate and non-duplicate values, using the following operands:

- **ALLDUPS** - only list duplicate values
- **NODUPS** - only list non-duplicate values
- **EQUAL** - only list values that occur a specified number of times
- **HIGHER** - only list values that occur more than a specified number of times
- **LOWER** - only list values that occur less than a specified number of times

Setting up an OCCUR report is similar to setting up a DISPLAY report. Specify ON fields for OCCUR in the same order you want their values to be printed in the list data set. OCCUR also has two special ON fields you can use:

- **ON(VALCNT)** can be used to print the number of times each field value occurs.
- **ON(VLEN)** can be used for the record length of variable length records.

You can use up to 10 ON fields; all of the ON field values, except ON(VALCNT) and ON(VLEN), are used for sorting and counting occurrences. For example, if you use ON(1,4,CH), 'ABCD+01' and 'ABCD-01' are sorted in that order (by 1,4,CH) and counted as two occurrences of 'ABCD'. However, if you use ON(1,4,CH) and ON(5,3,FS), 'ABCD-01' is sorted before 'ABCD+01' (by 1,4,CH,A and 5,3,FS,A) and counted as one occurrence of 'ABCD-01' and one occurrence of 'ABCD+01'.

You can use the following for an OCCUR report in the same way you use them for a DISPLAY report:

- title elements (TITLE, DATE, PAGE, and TIME operands)
- field headings (HEADER operand)
- spacing for columns (INDENT and BETWEEN operands)
- field formatting (BLANK and PLUS operands), and formatting items for individual ON fields as follows: ON(p,m,f,formatting), ON(VALCNT,formatting) and ON(VLEN,formatting)
- lines per page (LINES operand)

Refer to *z/OS DFSORT Application Programming Guide* for complete details on these and other operands you can use with OCCUR.

For this example, we will use the sample bookstore data set as input. To print a report showing the number of different books in use from each publisher, write the following OCCUR statement:

```
* Print the count of books in use from each publisher
OCCUR  FROM(BKIN) LIST(PUBCT) BLANK -
                                     └─> Alternate print format
                                     └─> ddnames of data sets

TITLE('Books from Publishers') DATE(DMY.) -
                                     └─> Title line elements

HEADER('Publisher') HEADER('Books Used') -
                                     └─> Field headings

ON(106,4,CH) ON(VALCNT,N05)
                                     └─> Publisher and Count
```

BKIN is the ddname for the sample bookstore data set. PUBCT is the ddname for the list data set in which you want the report to be printed. BLANK specifies the field format to be used.

TITLE indicates the title string to appear in the title line. DATE indicates the format in which the date is to appear in the title line (dd.mm.yy where dd is the two-digit day, mm is the two-digit month and yy is the last two digits of the year).

The HEADER strings correspond to the ON fields. ON(VALCNT,N05) is a special ON field used with OCCUR to print the count of occurrences. N05 is a formatting item used to set the number of digits for the count to 5, overriding the default of 15 digits for VALCNT.

Write DD statements for the A123456.SORT.SAMPIN and PUBCT data sets and place them at the end of the job:

```
//BKIN DD DSN=A123456.SORT.SAMPIN,DISP=SHR
//PUBCT DD SYSOUT=A
```

When this OCCUR operator is run, the PUBCT data set looks like this:

Books from Publishers            21.10.03

Publisher	Books Used
-----	-----
COR	7
FERN	4
VALD	5
WETH	4

The name of each publisher is printed along with the number of times that publisher appeared in the sample bookstore data set, which is equivalent to the number of different books from that publisher.

#### So Far

You have now learned how to use ICETOOL's OCCUR operator to print a simple or tailored report showing how many times different field values occur. Next, you will learn how to use ICETOOL's SELECT operator.

## Selecting Records by Field Occurrences

You can use ICETOOL's SELECT operator to create an output data set with records selected according to how many times different ON field values occur, sorted by those ON field values. As with the OCCUR operator, values that occur only once are called non-duplicate values, and values that occur more than once are called duplicate values.

You can use up to 10 ON fields; all of the ON field values are used for sorting and counting occurrences. For example, if you use ON(1,4,CH), 'ABCD+01' and 'ABCD-01' are sorted in that order (by 1,4,CH,A) and counted two occurrences of ('ABCD'). However, if you use ON(1,4,CH) and ON(5,3,FS), 'ABCD-01' is sorted before 'ABCD+01' (by 1,4,CH,A and 5,3,FS,A) and counted as one occurrence of 'ABCD-01' and one occurrence of 'ABCD+01'.

You can select different combinations of records with duplicate and non-duplicate values using the following operands:

- **FIRST** - keep only the first record for each value (that is, records with non-duplicate values, and the first record for duplicate values)
- **LAST** - keep only the last record for each value (that is, records with non-duplicate values, and the last record for duplicate values)
- **FIRSTDUP** - only keep the first record for duplicate values
- **LASTDUP** - only keep the last record for duplicate values
- **ALLDUPS** - only keep records with duplicate values
- **NODUPS** - only keep records with non-duplicate values
- **EQUAL** - only keep records with values that occur a specified number of times
- **HIGHER** - only keep records with values that occur more than a specified number of times
- **LOWER** - only keep records with values that occur less than a specified number of times

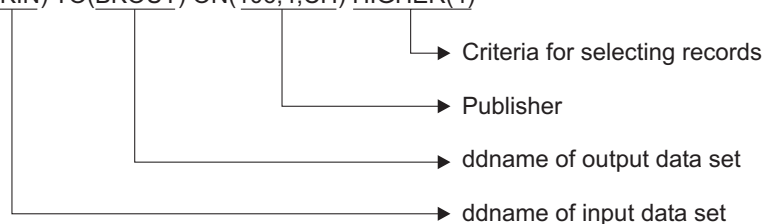
The selected records are written to the output data set identified by the TO operand. If appropriate, you can use the DISCARD operand with any of the other operands above to save the records that are **not** selected in a separate output data set identified by the DISCARD operand. You can create just the TO data set, just the DISCARD data set, or both.

You can use a USING data set to specify DFSORT INCLUDE, OMIT and OUTFIL statements for your SELECT operation. INCLUDE or OMIT statement processing is performed before SELECT processing. OUTFIL statement processing is performed after SELECT processing.

To create an output data set containing records for publishers with more than four different books in use, write the following SELECT statement:

- \* Separate output containing records for publishers
- \* with more than 4 books in use

```
SELECT FROM(BKIN) TO(BKOUT) ON(106,4,CH) HIGHER(4)
```



BKIN is the ddname for the sample bookstore data set. BKOUT is the ddname of the output data set that will contain the records for each publisher field value that occurs more than 4 times (all of the records for COR and VALD in this case).

Write a DD statement for the A123456.BOOKS1 data sets and place it at the end of the job:

```
//BKOUT DD DSN=A123456.BOOKS1,DISP=(NEW,CATLG,DELETE),
// SPACE=(CYL,(3,3)),UNIT=3390
```

Table 60 shows the Book Title and Publisher fields for the records in the resulting output data set. The actual records contain all of the fields.

Table 60. Books from Publishers with More than Four Books in Use

Book Title		Publisher
1	75	106 109

Table 60. Books from Publishers with More than Four Books in Use (continued)

Book Title	Publisher
LIVING WELL ON A SMALL BUDGET	COR
SUPPLYING THE DEMAND	COR
INKLINGS: AN ANTHOLOGY OF YOUNG POETS	COR
PICK'S POCKET DICTIONARY	COR
MODERN ANTHOLOGY OF WOMEN POETS	COR
INTRODUCTION TO PSYCHOLOGY	COR
CRISES OF THE MIDDLE AGES	COR
VIDEO GAME DESIGN	VALD
EDITING SOFTWARE MANUALS	VALD
STRATEGIC MARKETING	VALD
SHORT STORIES AND TALL TALES	VALD
INTRODUCTION TO BIOLOGY	VALD

To create separate output data sets containing records with only the course name and author's last name, both for courses that use more than one book, and for courses that use only one book, write the following SELECT statement:

```
* Course name and author's last name for courses with more than one book
* and only one book
SELECT FROM(BKIN) TO(DUP) DISCARD(NODUP)
ON(120,25,CH) ALLDUPS USING(CTL1)
```

Diagram illustrating the components of the SELECT statement:

- BKIN**: ddname of input data set
- DUP**: ddname of dup output data set
- NODUP**: ddname of nodup output data set
- ON(120,25,CH)**: Criteria for selecting records
- ALLDUPS**: First four chars of DFSORT control data set
- USING(CTL1)**: Course name

BKIN is the ddname for the sample bookstore data set. DUP is the ddname of the output data set to contain the records for courses with more than one book. NODUP is the ddname of the output data set to contain the records for courses with only one book.

Here is the complete JCL for the job, including control statements:

```
//SEL2 JOB A492,PROGRAMMER
//EXTRACT EXEC PGM=ICETOOL
//TOOLMSG DD SYSOUT=*
//DFSMSG DD SYSOUT=*
//BKIN DD DSN=A123456.SORT.SAMPIN,DISP=SHR
//TOOLIN DD *
* Course name and author's last name for courses with more than one book
* and only one book
SELECT FROM(BKIN) TO(DUP) DISCARD(NODUP) -
ON(120,25,CH) ALLDUPS USING(CTL1)
/*
//CTL1CNTL DD *
OMIT COND=(120,25,CH,EQ,C' ')
OUTFIL FNames=DUP,OUTREC=(120,25,2X,145,15)
OUTFIL FNames=NODUP,OUTREC=(120,25,2X,145,15)
/*
//DUP DD SYSOUT=*
//NODUP DD SYSOUT=*
```



The OMIT statement removes records with a blank course name before SELECT processing. The OUTFIL statement for DUP reformats the selected records for courses with more than one book to have just the course name and author's last name. The OUTFIL statement for NODUP reformats the selected records for courses with only one book to have just the course name and author's last name.

Here are the DUP records exactly as they would appear:

INTRO TO COMPUTERS	CHATTERJEE
INTRO TO COMPUTERS	CHATTERJEE
INTRO TO COMPUTERS	CHATTERJEE
MODERN POETRY	FRIEDMAN
MODERN POETRY	FRIEDMAN
WORLD HISTORY	GOODGOLD
WORLD HISTORY	WILLERTON

Here are the NODUP records exactly as they would appear:

ADVANCED MARKETING	LORCH
BIOLOGY I	GREENBERG
DATA MANAGEMENT	SMITH
EUROPEAN HISTORY	BISCARDI
FICTION WRITING	BUCK
MARKETING	MAXWELL
PSYCHOANALYSIS	NAKATSU
PSYCHOLOGY I	ZABOSKI
TECHINCAL EDITING	MADRID
TECHNICAL EDITING	MADRID
VIDEO GAMES	NEUMANN

Note that "TECHINCAL EDITING" and "TECHNICAL EDITING" are both included in the NODUP data set because they are different ("TECHINCAL" is spelled incorrectly).

#### So Far

So far in this chapter you have learned how to print statistics for numeric fields, create sorted and unsorted data sets, obtain a count of numeric fields in a range for a particular field, print fields from an input data set, print reports, print a count of field occurrences and select output records based on field occurrences. Next, you will learn how to use ICETOOL's SPLICE operator.

## Joining Fields from Different Data Sets

You can use ICETOOL's SPLICE operator to create output records in a variety of ways by splicing together up to 50 fields from records that have the same ON field values, but different information. The output records are sorted by the ON field values. The records to be spliced can originate from different input data sets, making it possible to perform various "join" and "match" operations.

You can use up to 10 ON fields; all of the ON field values are used for sorting and splicing. For example, if you use ON(1,4,CH), 'ABCD+01' and 'ABCD-01' are sorted in that order (by 1,4,CH,A) and counted as two occurrences of 'ABCD'. However, if you use ON(1,4,CH) and ON(5,3,FS), 'ABCD-01' is sorted before 'ABCD+01' (by 1,4,CH,A and 5,3,FS,A) and counted as one occurrence of 'ABCD-01' and one occurrence of 'ABCD+01'.

To do a join or match operation on two input data sets, you need to have the fields aligned appropriately for each pair of records to be spliced. Typically, you accomplish that by copying and reformatting one or both input data sets to temporary data sets, so you can splice the temporary data sets together.

Suppose you have two input data sets, REGION.IN1 and REGION.IN2, as shown in Table 61 and Table 62.

*Table 61. REGION.IN1 data set for join*

Region	Headquarters	Regional Director
1 5	6 20	21 35
East	Philadelphia	C. Kent
West	San Jose	B. Wayne
North	Boston	P. Parker
South	Charlotte	D. Prince

*Table 62. REGION.IN2 data set for join*

Office	Region	Employees	Evaluation	Established
1 4	5 9	10 13	14 23	24 27
0001	East	0050	Fair	1983
0001	South	0023	Good	1976
0002	South	0068	Fair	1978
0002	East	0125	Excellent	1986
0001	West	0052	Good	1995
0003	East	0028	Good	1994
0002	West	0105	Excellent	2001
0003	South	0054	Fair	1992
0001	North	0200	Fair	1991
0004	South	0070	Good	2002

From these two input data sets, you want to create an output data set, REGION.OUT. For each record in REGION.IN2, you want to look up the corresponding Region in REGION.IN1, and combine fields from the two records into one output record in REGION.OUT, as shown in Table 63.

*Table 63. REGION.OUT data set for join*

Office	Region	Regional Director	Employees	Evaluation	Headquarters
1 4	5 9	10 24	25 28	29 38	39 53
0001	East	C. Kent	0050	Fair	Philadelphia
0002	East	C. Kent	0125	Excellent	Philadelphia
0003	East	C. Kent	0028	Good	Philadelphia
0001	North	P. Parker	0200	Fair	Boston
0001	South	D. Prince	0023	Good	Charlotte
0002	South	D. Prince	0068	Fair	Charlotte
0003	South	D. Prince	0054	Fair	Charlotte
0004	South	D. Prince	0070	Good	Charlotte
0001	West	B. Wayne	0052	Good	San Jose
0002	West	B. Wayne	0105	Excellent	San Jose

Write the following ICETOOL statements and JCL statements to create REGION.OUT from REGION.IN1 and REGION.IN2:

```

* Reformat REGION.IN1 to T1 so it can be spliced
COPY FROM(REGNIN1) TO(T1) USING(CTL1)
* Reformat REGION.IN2 to T2 so it can be spliced
COPY FROM(REGNIN2) TO(T2) USING(CTL2)
* Splice records in T1 and T2 with matching ON fields
SPICE FROM(CONCT1) WITHALL -
    ON(5,5,CH) - Region
    WITH(1,4) - Office
    WITH(25,4) - Employees
    WITH(29,10) - Evaluation
    TO(REGNOUT)
/*
//REGNIN1 DD DSN=A123456.REGION.IN1,DISP=SHR
//REGNIN2 DD DSN=A123456.REGION.IN2,DISP=SHR
//T1 DD DSN=*&&T1,UNIT=3390,SPACE=(CYL,(5,5)),DISP=(,PASS)
//T2 DD DSN=*&&T2,UNIT=3390,SPACE=(CYL,(5,5)),DISP=(,PASS)
//CONCT1 DD DSN=*.T1,VOL=REF=*.T1,DISP=(OLD,PASS)
//          DD DSN=*.T2,VOL=REF=*.T2,DISP=(OLD,PASS)
//REGNOUT DD DSN=A123456.REGION.OUT,DISP=(NEW,CATLG,DELETE),UNIT=3390,
// SPACE=(CYL,(5,5))
//CTL1CNTL DD *
* Move REGION.IN1 fields to their locations for the
* output data set
    OUTREC FIELDS=(5:1,5,      Region
                    10:21,15,   Regional Director
                    39:6,15)    Headquarters
/*
//CTL2CNTL DD *
* Move REGION.IN2 fields to their locations for the
* output data set
    OUTREC FIELDS=(1:1,4,      Office
                    5:5,5,      Region
                    25:10,4,     Employees
                    29:14,10,    Evaluation
                    53:X)
/*

```

The first COPY operator creates temporary data set T1 with the fields from REGION.IN1 as shown in Table 64.

Table 64. T1 data set fields from REGION.IN1

Blanks		Region		Regional Director		Blanks		Blanks		Headquarters	
1	4	5	9	10	24	25	28	29	38	39	53

The second COPY operator creates temporary data set T2 with the fields from REGION.IN2 as shown in Table 65.

Table 65. T2 data set fields from REGION.IN2

Office		Region		Blanks		Employees		Evaluation		Blanks	
1	4	5	9	10	24	25	28	29	38	39	53

Because the Region field is the ON field you want SPLICE to use to match your records, you must move it to the same location in both temporary data sets (positions 5-9). You must move all of the other fields that you want in your output records to the locations in which you want them to appear in the combined record. Put blanks in the records of the other temporary data set for the corresponding fields. For example, the Regional Director field from REGION.IN1 appears in positions 10-24 of T1 while blanks appear in the corresponding positions 10-24 for T2, and the Office field from REGION.IN2 appears in positions 1-4 of T2 while blanks appear in the corresponding positions 1-4 for T1.

The TO(CONCT1) operand tells DFSORT that the input for the SPLICE operation is the concatenation of the T1 and T2 records, in that order. The order of the concatenated input data sets is important, because the first record for each matching ON field acts as the base record on to which the second or subsequent record is spliced.

In this case, because the order of concatenation is T1 followed by T2, all of the T1 records come before all of the T2 records. So the SPLICE operator splices the WITH fields from the T2 records to the T1 record whenever their ON fields match. WITHALL tells SPLICE to splice the first record with every other record for which the ON fields match. Without WITHALL, only the first and last records are spliced.

This is just one example of the many types of join operations you can do with SPLICE, using some of its available operands.

You can also use a USING data set to specify DFSORT INCLUDE, OMIT and OUTFIL statements for your SPLICE operation. INCLUDE or OMIT statement processing is performed before SPLICE processing. OUTFIL statement processing is performed after SPLICE processing.

For complete details of all of the operands you can use with SPLICE, as well as many more examples of join operations, see *z/OS DFSORT Application Programming Guide*.

---

## Matching Records from Different Data Sets

SPLICE can be used for match operations as well as join operations. Suppose you want to look at the courses in SORT.SAMPIN and SORT.SAMPADD and produce three output data sets as follows:

- COURSE.MATCH to show the courses that appear in both SORT.SAMPIN and SORT.SAMPADD
- COURSE.INONLY to show the courses that appear only in SORT.SAMPIN
- COURSE.ADDONLY to show the courses that appear only in SORT.SAMPADD

The following JCL and ICETOOL statements create these three data sets:

```
//S1 EXEC PGM=ICETOOL
//TOOLMSG DD SYSOUT=*
//DFSMSG DD SYSOUT=*
//F1IN DD DSN=A123456.SORT.SAMPIN,DISP=SHR
//F2IN DD DSN=A123456.SORT.SAMPADD,DISP=SHR
//T1 DD DSN=*&&T1,DISP=(,PASS),UNIT=SYSDA,SPACE=(CYL,(5,5),RLSE)
//T2 DD DSN=*&&T2,DISP=(,PASS),UNIT=SYSDA,SPACE=(CYL,(5,5),RLSE)
//CONCT DD DSN=*.T1,VOL=REF=*.T1,DISP=(OLD,DELETE)
// DD DSN=*.T2,VOL=REF=*.T2,DISP=(OLD,DELETE)
//MATCH DD DSN=COURSE.MATCH,DISP=(NEW,CATLG,DELETE),
// SPACE=(CYL,(5,5)),UNIT=3390
//F1ONLY DD DSN=COURSE.INONLY,DISP=(NEW,CATLG,DELETE),
// SPACE=(CYL,(5,5)),UNIT=3390
//F2ONLY DD DSN=COURSE.ADDONLY,DISP=(NEW,CATLG,DELETE),
// SPACE=(CYL,(5,5)),UNIT=3390
//TOOLIN DD *
* Copy needed File1 fields to T1 and add '11' id
COPY FROM(F1IN) TO(T1) USING(MATA)
* Copy needed File2 fields to T2 and add '22' id
COPY FROM(F2IN) TO(T2) USING(MATB)
* Splice second id character from T2 to T1 for
* matching course numbers. Use resulting spliced or
* unspliced id to write records to MATCH, F1ONLY
* or F2ONLY as appropriate.
```

```

        SPLICE FROM(CONCT) TO(MATCH) ON(1,5,CH) -
        WITH(32,1) KEEPNOUDUPS USING(MATC)
/*
//MATACNTL DD *
* Extract needed File1 fields and add '11' id
  OUTREC FIELDS=(1:115,5,      Course number
                  6:120,25,    Course name
                  31:C'11')    '11' id for File1 records
/*
//MATBCNTL DD *
* Extract needed File2 fields and add '22' id
  OUTREC FIELDS=(1:115,5,      Course number
                  6:120,25,    Course name
                  31:C'22')    '22' id for File2 records
/*
//MATCCNTL DD *
* A '12' id indicates a match between File1 and File2.
* Remove the '12' id and write the records to MATCH.
  OUTFIL FNames=MATCH,INCLUDE=(31,2,CH,EQ,C'12'),OUTREC=(1,30)
* A '11' id indicates a record in File1 only.
* Remove the '11' id and write the records to F1ONLY.
  OUTFIL FNames=F1ONLY,INCLUDE=(31,2,CH,EQ,C'11'),OUTREC=(1,30)
* A '22' id indicates a record in File2 only.
* Remove the '22' id and write the records to F2ONLY.
  OUTFIL FNames=F2ONLY,INCLUDE=(31,2,CH,EQ,C'22'),OUTREC=(1,30)
/*

```

The first COPY operator creates temporary data set T1 consisting of the course number and course name fields from SORT.SAMPIN, and an id of '11', as shown in Table 66.

Table 66. T1 data set fields from SORT.SAMPIN

Course Number		Course Name		'11'
1	5	6	30	31 32

The second COPY operator creates temporary data set T2 consisting of the course number and course name fields from SORT.SAMPADD, and an id of '22', as shown in Table 67.

Table 67. T2 data set fields from SORT.SAMPADD

Course Number		Course Name		'22'
1	5	6	30	31 32

The SPLICE operator matches the course numbers (ON field). When a match is found, the second id character is spliced into the base record. Because WITHALL is not specified, only the last record for each match is spliced with the first record for each match. KEEPNOUDUPS tells DFSORT to keep records that are not spliced. Without KEEPNOUDUPS, records for course numbers that appear once in one data set, but not in the other data set, would be deleted instead of being written to COURSE.INONLY or COURSE.ADDONLY.

Here's what happens for all of the possible types of matches and non-matches:

- For a course number that appears one or more times in T1 (id is '11') and one or more times in T2 (id is '22'), the second '2' from the last T2 record is spliced into the first T1 record to get an id of '12'. Thus an id of '12' represents a course number that appears in both SORT.SAMPIN and SORT.SAMPADD.

- For a course number that appears only once in T1 (and not in T2), the id of '11' is not changed. For a course number that appears more than once in T1 (and not in T2), the second '1' from the last T1 record is spliced into the first T1 record to get an id of '11'. Thus an id of '11' represents a course number that only appears in SORTIN.SAMPIN.
- For a course number that appears only once in T2 (and not in T1), the id of '22' is not changed. For a course number that appears more than once in T2 (and not in T1), the second '2' from the last T2 record is spliced into the first T2 record to get an id of '22'. Thus an id of '22' represents a course number that only appears in SORTIN.SAMPADD.

The output created for COURSE.MATCH containing the information for course numbers that appear in both SORT.SAMPIN and SORT.SAMPADD is shown in Table 68.

*Table 68. COURSE.MATCH output*

Course Number	Course Name
1 5	6 30
00103	DATA MANAGEMENT
00205	VIDEO GAMES
10054	FICTION WRITING
30016	PSYCHOLOGY I
30975	PSYCHOANALYSIS
50420	WORLD HISTORY
50521	WORLD HISTORY
50632	EUROPEAN HISTORY
70124	ADVANCED MARKETING
70251	MARKETING

The output created for COURSE.INONLY containing the information for course numbers that appear only in SORT.SAMPIN is shown in Table 69.

*Table 69. COURSE.INONLY output*

Course Number	Course Name
1 5	6 30
00032	INTRO TO COMPUTERS
10347	TECHNICAL EDITING
10856	MODERN POETRY
80521	BIOLOGY I

The output created for COURSE.ADDONLY containing the information for course numbers that appear only in SORT.SAMPADD is shown in Table 70.

*Table 70. COURSE.ADDONLY output*

Course Number	Course Name
1 5	6 30
70255	BUSINESS THEORY
80522	BIOLOGY II
80523	INTRO TO GENETICS

### So Far

So far in this chapter you have learned how to print statistics for numeric fields, create sorted and unsorted data sets, obtain a count of numeric fields in a range for a particular field, print fields from an input data set, print reports, print a count of field occurrences, select output records based on field occurrences, join fields from different data sets, and match records from different data sets. The last part of this chapter shows the complete main ICETOOL job and its resulting TOOLMSG output.

## Complete ICETOOL Job and TOOLMSG Output

Here is the complete ICETOOL job you created in this chapter:

```
//EXAMP    JOB    A492,PROGRAMMER
//TOOL      EXEC   PGM=ICETOOL
//TOOLMSG   DD     SYSOUT=A
//DFSMSG    DD     SYSOUT=A
//TOOLIN    DD     *

* Statistics from all branches
STATS FROM(ALL) ON(18,4,ZD) ON(28,6,PD) ON(22,6,PD)
* Books from VALD and WETH
SORT FROM(BKS) TO(DAPUBS,PRPUBS) USING(SPUB)
* Separate output for California and Colorado branches
SORT FROM(ALL) USING(CACO)
* California branches profit analysis
RANGE FROM(CADASD) ON(28,6,PD) HIGHER(-1500) LOWER(+8000)
* Branches with less than 32 employees
RANGE FROM(ALL) ON(18,4,ZD) LOWER(32)
* Print profit, employees, and city for each Colorado branch
DISPLAY FROM(CODASD) LIST(OUT) ON(28,6,PD) ON(18,4,ZD) ON(1,15,CH)
* Print a report for the Colorado branches
DISPLAY FROM(CODASD) LIST(RPT) -
  DATE TITLE('Colorado Branches Report') PAGE -
  HEADER('City') HEADER('Profit') HEADER('Employees') -
  ON(1,15,CH) ON(28,6,PD) ON(18,4,ZD) BLANK BETWEEN(5) -
  TOTAL('Total') AVERAGE('Average') MINIMUM('Lowest')
* Print a report of books for individual publishers
DISPLAY FROM(DAPUBS) LIST(SECTIONS) -
  TITLE('BOOKS FOR INDIVIDUAL PUBLISHERS') PAGE -
  HEADER('TITLE OF BOOK') ON(1,35,CH) -
  HEADER('PRICE OF BOOK') ON(170,4,BI,C1,F'$') -
  BTITLE('PUBLISHER:') BREAK(106,4,CH) -
  BAVERAGE('AVERAGE FOR THIS PUBLISHER') -
  BTOTAL('TOTAL FOR THIS PUBLISHER') -
  AVERAGE('AVERAGE FOR ALL PUBLISHERS') -
  TOTAL('TOTAL FOR ALL PUBLISHERS')
```

Figure 5. Complete ICETOOL Job (Part 1 of 3)

---

```

* Print the count of books in use from each publisher
OCCUR FROM(BKIN) LIST(PUBCT) BLANK -
  TITLE('Books from Publishers') DATE(DMY.) -
  HEADER('Publisher') HEADER('Books Used') -
  ON(106,4,CH) ON(VALCNT,N05)
* Separate output containing records for publishers
* with more than 4 books in use
SELECT FROM(BKIN) TO(BKOUT) ON(106,4,CH) HIGHER(4)
* Reformat REGION.IN1 to T1 so it can be spliced
COPY FROM(REGNIN1) TO(T1) USING(CTL1)
* Reformat REGION.IN2 to T2 so it can be spliced
COPY FROM(REGNIN2) TO(T2) USING(CTL2)
* Splice records in T1 and T2 with matching ON fields
SPLICE FROM(CONCT1) WITHALL -
  ON(5,5,CH) - Region
  WITH(1,4) - Office
  WITH(25,4) - Employees
  WITH(29,10) - Evaluation
  TO(REGNOUT)

/*
//ALL DD DSN=A123456.SORT.BRANCH,DISP=SHR
//BKS DD DSN=A123456.SORT.SAMPIN,DISP=SHR
// DD DSN=A123456.SORT.SAMPADD,DISP=SHR
//DAPUBS DD DSN=&&DSRT,DISP=(,PASS),SPACE=(CYL,(2,2)),UNIT=SYSDA
//PRPUBS DD SYSOUT=A
//SPUBCNTL DD *
  SORT FIELDS=(106,4,A,1,75,A),FORMAT=CH
  INCLUDE COND=(106,4,EQ,C'VALD',OR,106,4,EQ,C'WETH'),
    FORMAT=CH

/*
//CACOCNTL DD *
  SORT FIELDS=(1,15,CH,A)
  OUTFIL FNAMES=(CADASD,CATAPE),INCLUDE=(16,2,CH,EQ,C'CA')
  OUTFIL FNAMES=(CODASD,COTAPE),INCLUDE=(16,2,CH,EQ,C'CO')

/*
//CADASD DD DSN=&&CA,DISP=(,PASS),SPACE=(CYL,(2,2)),UNIT=3390
//CATAPE DD DSN=CA.BRANCH,UNIT=3480,VOL=SER=111111,
// DISP=(NEW,KEEP),LABEL=(,SL)
//CODASD DD DSN=&&CO,DISP=(,PASS),SPACE=(CYL,(2,2)),UNIT=3390
//COTAPE DD DSN=CO.BRANCH,UNIT=3480,VOL=SER=222222,
// DISP=(NEW,KEEP),LABEL=(,SL)
//OUT DD SYSOUT=A
//RPT DD SYSOUT=A
//SECTIONS DD SYSOUT=A
//BKIN DD DSN=A123456.SORT.SAMPIN,DISP=SHR
//PUBCT DD SYSOUT=A
//BKOUT DD DSN=A123456.BOOKS1,DISP=(NEW,CATLG,DELETE),
// SPACE=(CYL,(3,3)),UNIT=3390
//REGNIN1 DD DSN=A123456.REGION.IN1,DISP=SHR
//REGNIN2 DD DSN=A123456.REGION.IN2,DISP=SHR
//T1 DD DSN=&&T1,UNIT=3390,SPACE=(CYL,(5,5)),DISP=(,PASS)
//T2 DD DSN=&&T2,UNIT=3390,SPACE=(CYL,(5,5)),DISP=(,PASS)
//CONCT1 DD DSN=*.T1,VOL=REF=*.T1,DISP=(OLD,PASS)
// DD DSN=*.T2,VOL=REF=*.T2,DISP=(OLD,PASS)
//REGNOUT DD DSN=A123456.REGION.OUT,DISP=(NEW,CATLG,DELETE),UNIT=3390,
// SPACE=(CYL,(5,5))
//CTL1CNTL DD *
* Move REGION.IN1 fields to their locations for the
* output data set
  OUTREC FIELDS=(5:1,5, Region
                  10:21,15, Regional Director
                  39:6,15) Headquarters

/*

```

---

Figure 5. Complete ICETOOL Job (Part 2 of 3)



---

```
//CTL2CNTL DD *
* Move REGION.IN2 fields to their locations for the
* output data set
  OUTREC FIELDS=(1:1,4,      Office
                  5:5,5,      Region
                  25:10,4,     Employees
                  29:14,10,    Evaluation
                  53:X)
/*
```

---

*Figure 5. Complete ICETOOL Job (Part 3 of 3)*

Here is the complete TOOLMSG data set produced by running this job:

---

```
ICE600I 0 DFSORT ICETOOL UTILITY RUN STARTED

ICE650I 0 VISIT http://www.ibm.com/storage/dfsor FOR ICETOOL PAPERS, EXAMPLES AND MORE

ICE632I 0 SOURCE FOR ICETOOL STATEMENTS:  TOOLIN

ICE630I 0 MODE IN EFFECT:  STOP

      * Statistics from all branches
      STATS FROM(ALL) ON(18,4,ZD) ON(28,6,PD) ON(22,6,PD)
ICE627I 0 DFSORT CALL 0001 FOR COPY FROM ALL      TO E35  EXIT COMPLETED
ICE628I 0 RECORD COUNT: 000000000000012
ICE607I 0 STATISTICS FOR (18,4,ZD)      :
ICE608I 0   MINIMUM: +000000000000015, MAXIMUM: +000000000000035
ICE609I 0   AVERAGE: +000000000000024, TOTAL  : +0000000000000298
ICE607I 0 STATISTICS FOR (28,6,PD)      :
ICE608I 0   MINIMUM: -0000000000004278, MAXIMUM: +0000000000008276
ICE609I 0   AVERAGE: +0000000000004222, TOTAL  : +00000000000050665
ICE607I 0 STATISTICS FOR (22,6,PD)      :
ICE608I 0   MINIMUM: +0000000000012300, MAXIMUM: +0000000000042820
ICE609I 0   AVERAGE: +0000000000027469, TOTAL  : +0000000000329637
ICE602I 0 OPERATION RETURN CODE:  00

      * Books from VALD and WETH
      SORT FROM(BKS) TO(DAPUBS,PRPUBS) USING(S PUB)
ICE606I 0 DFSORT CALL 0002 FOR SORT FROM BKS      TO OUTFIL  USING SPUBCNTL COMPLETED
ICE602I 0 OPERATION RETURN CODE:  00

      * Separate output for California and Colorado branches
      SORT FROM(ALL) USING(CACO)
ICE606I 0 DFSORT CALL 0003 FOR SORT FROM ALL      TO OUTFIL  USING CACOCNTL COMPLETED
ICE602I 0 OPERATION RETURN CODE:  00

      * California branches profit analysis
      RANGE FROM(CADASD) ON(28,6,PD) HIGHER(-1500) LOWER(+8000)
ICE627I 0 DFSORT CALL 0004 FOR COPY FROM CADASD  TO E35  EXIT COMPLETED
ICE628I 0 RECORD COUNT: 000000000000007
ICE631I 0 NUMBER OF VALUES IN RANGE FOR (28,6,PD)      : 000000000000003
ICE602I 0 OPERATION RETURN CODE:  00

      * Branches with less than 32 employees
      RANGE FROM(ALL) ON(18,4,ZD) LOWER(32)
ICE627I 0 DFSORT CALL 0005 FOR COPY FROM ALL      TO E35  EXIT COMPLETED
ICE628I 0 RECORD COUNT: 000000000000012
ICE631I 0 NUMBER OF VALUES IN RANGE FOR (18,4,ZD)      : 000000000000008
ICE602I 0 OPERATION RETURN CODE:  00
```

---

*Figure 6. Complete TOOLMSG Data Set. (Part 1 of 3)*

---

```

* Print profit, employees, and city for each Colorado branch
  DISPLAY FROM(CODASD) LIST(OUT) ON(28,6,PD) ON(18,4,ZD) ON(1,15,CH)
ICE643I 0 WIDTH OF REPORT IS 0121 BYTES
ICE627I 0 DFSORT CALL 0006 FOR COPY FROM CODASD TO E35 EXIT COMPLETED
ICE603I 0 INFORMATION PRINTED IN OUT DATA SET
ICE628I 0 RECORD COUNT: 000000000000005
ICE602I 0 OPERATION RETURN CODE: 00

* Print a report for the Colorado branches
  DISPLAY FROM(CODASD) LIST(RPT) -
  DATE TITLE('Colorado Branches Report') PAGE -
  HEADER('City') HEADER('Profit') HEADER('Employees') -
  ON(1,15,CH) ON(28,6,PD) ON(18,4,ZD) BLANK BETWEEN(5) -
  TOTAL('Total') AVERAGE('Average') MINIMUM('Lowest')
ICE643I 0 WIDTH OF REPORT IS 0121 BYTES
ICE627I 0 DFSORT CALL 0007 FOR COPY FROM CODASD TO E35 EXIT COMPLETED
ICE603I 0 INFORMATION PRINTED IN RPT DATA SET
ICE628I 0 RECORD COUNT: 000000000000005
ICE602I 0 OPERATION RETURN CODE: 00

* Print a report of books for individual publishers
  DISPLAY FROM(DAPUBS) LIST(SECTIONS) -
  TITLE('BOOKS FOR INDIVIDUAL PUBLISHERS') PAGE -
  HEADER('TITLE OF BOOK') ON(1,35,CH) -
  HEADER('PRICE OF BOOK') ON(170,4,BI,C1,F'$') -
  BTITLE('PUBLISHER:') BREAK(106,4,CH) -
  BAVVERAGE('AVERAGE FOR THIS PUBLISHER') -
  BTOTAL('TOTAL FOR THIS PUBLISHER') -
  AVERAGE('AVERAGE FOR ALL PUBLISHERS') -
  TOTAL('TOTAL FOR ALL PUBLISHERS')
ICE643I 0 WIDTH OF REPORT IS 0121 BYTES
ICE627I 0 DFSORT CALL 0008 FOR COPY FROM DAPUBS TO E35 EXIT COMPLETED
ICE603I 0 INFORMATION PRINTED IN SECTIONS DATA SET
ICE628I 0 RECORD COUNT: 000000000000019
ICE602I 0 OPERATION RETURN CODE: 00

* Print the count of books in use from each publisher
  OCCUR FROM(BKIN) LIST(PUBCT) BLANK -
  TITLE('Books from Publishers') DATE(DMY.) -
  HEADER('Publisher') HEADER('Books Used') -
  ON(106,4,CH) ON(VALCNT)
ICE643I 0 WIDTH OF REPORT IS 0121 BYTES
ICE627I 0 DFSORT CALL 0009 FOR SORT FROM BKIN TO E35 EXIT COMPLETED
ICE603I 0 INFORMATION PRINTED IN PUBCT DATA SET
ICE628I 0 RECORD COUNT: 000000000000020
ICE638I 0 NUMBER OF RECORDS RESULTING FROM CRITERIA: 000000000000004
ICE602I 0 OPERATION RETURN CODE: 00

* Separate output containing records for publishers
* with more than 4 books in use
  SELECT FROM(BKIN) TO(BKOUT) ON(106,4,CH) HIGHER(4)
ICE627I 0 DFSORT CALL 0010 FOR SORT FROM BKIN TO BKOUT COMPLETED
ICE628I 0 RECORD COUNT: 000000000000020
ICE638I 0 NUMBER OF RECORDS RESULTING FROM CRITERIA: 000000000000012
ICE602I 0 OPERATION RETURN CODE: 00

* Reformat REGION.IN1 to T1 so it can be spliced
  COPY FROM(REGNIN1) TO(T1) USING(CTL1)
ICE606I 0 DFSORT CALL 0011 FOR COPY FROM REGNIN1 TO T1 USING CTL1CNTL COMPLETED
ICE602I 0 OPERATION RETURN CODE: 00

ICE601I 0 DFSORT ICETOOL UTILITY RUN ENDED - RETURN CODE: 00

```

---

*Figure 6. Complete TOOLMSG Data Set. (Part 2 of 3)*

---

```

      * Reformat REGION.IN2 to T2 so it can be spliced
      COPY FROM(REGIN2) TO(T2) USING(CTL2)
ICE606I 0 DFSORT CALL 0012 FOR COPY FROM REGIN2 TO T2 USING CTL2CNTL COMPLETED
ICE602I 0 OPERATION RETURN CODE: 00

      * Splice records in T1 and T2 with matching ON fields
      SPLICE FROM(CONCT1) WITHALL -
        ON(5,5,CH) - Region
        WITH(1,4) - Office
        WITH(25,4) - Employees
        WITH(29,10) - Evaluation
        TO(REGNOUT)
ICE627I 0 DFSORT CALL 0013 FOR SORT FROM CONCT1 TO REGNOUT COMPLETED
ICE628I 0 RECORD COUNT: 000000000000014
ICE638I 0 NUMBER OF RECORDS RESULTING FROM CRITERIA: 00000000000010
ICE602I 0 OPERATION RETURN CODE: 00

```

---

*Figure 6. Complete TOOLMSG Data Set. (Part 3 of 3)*

### Summary

This chapter introduced the thirteen ICETOOL operators, and showed some of the ways you can use them to perform various tasks. For complete information on DFSORT's ICETOOL, refer to *z/OS DFSORT Application Programming Guide*.



---

## Part 4. Learning to Use Symbols

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---

## Chapter 11. Defining and Using Symbols

A *symbol* is a name (preferably something meaningful) you can use to represent a field or a constant. Sets of symbols, also called mappings, can be used to describe a group of related fields and constants such as the information in a particular type of record. Such mappings allow you to refer to fields and constants by their symbols, freeing you from having to know the position, length and format of fields or the values of constants you want to use.

DFSORT's symbol processing feature allows you or your site to create symbols for the fields in your own records and for constants associated with those fields. You can then use those symbols in DFSORT control statements and ICETOOL operators.

In addition, you can obtain predefined sets of symbols to use for the records created by other products such as RACF®, DCOLLECT and DFSMSrmm™. Visit the DFSORT home page at the following URL for information about obtaining DFSORT symbol mappings for records produced by other products, and examples that use these symbols:

<http://www.ibm.com/storage/dfsor>

The chapter in this section explains how to define symbols for the bookstore data set and use them in several DFSORT control statements and ICETOOL operators. For a full description of how symbols can be used with DFSORT and ICETOOL, see *z/OS DFSORT Application Programming Guide*.

---

### Creating the SYMNAMES Data Set

DFSORT and ICETOOL obtain the symbols to be used from the data set specified in a SYMNAMES DD statement. Create the SYMNAMES data set you want to use with RECFM=FB and LRECL=80 in the same way you would create a data set containing DFSORT JCL and control statements. Then use an editor, such as ISPF EDIT, to write the SYMNAMES statements defining your symbols, as described below.

After you create the SYMNAMES data set, you can use it in any DFSORT or ICETOOL application for which you want to use the symbols you defined. You can add, delete and change SYMNAMES statements in the SYMNAMES data set at any time using the editor.

For this chapter, we will assume you have created a data set called SORT.SYMBOLS to put your SYMNAMES statements in.

---

### Defining Symbols for Fields

Appendix B, "Descriptions of the Sample Data Sets," on page 155 shows the fields of the bookstore data set. To define the symbols for these fields, write a SYMNAMES statement for each one in SORT.SYMBOLS. The SYMNAMES statements for the symbols Title and Author\_Last\_Name look like this:

```
* Symbols for fields
Title,1,75,CH
Author_Last_Name,*,15,CH
```

To write these SYMNAMES statements that define the symbol *Title* for the Title field and the symbol *Author\_Last\_Name* for the Author's Last Name field, follow these steps:

*Table 71. Steps to Define Symbols for Fields*

Step	Action
1	Write a comment statement (optional):  * Symbols for fields
2	Type <b>Title</b> followed by a comma.  This is the symbol you will use for the Title field. A symbol can be 1 to 50 characters consisting of uppercase letters (A-Z), lowercase letters (a-z), numbers (0-9), the number sign (#), the dollar sign (\$), the commercial at sign (@), the underscore(_), and the hyphen (-). However, the first character must not be a number. Title, TITLE, and title are three <b>different</b> symbols.
3	Type the position of the Title field followed by a comma.  The position of the Title field is <b>1</b> .
4	Type the length of the Title field followed by a comma.  The length of the Title field is <b>75</b> .
5	Type the format of the Title field followed by a blank.  The format of the Title field is <b>CH</b> .
6	Type <b>Author_Last_Name</b> followed by a comma.  This is the symbol you will use for the Author's Last Name field.
7	Type * for the position followed by a comma.  An asterisk (*) for the position shows that this field immediately follows the previous field. The * here will automatically assign <b>76</b> as the position of the Author_Last_Name symbol. You could specify 76 instead of *, but * is preferable when fields are adjacent. * allows symbols for fields to be inserted without changes to symbols for other fields.
8	Type the length of the Author's Last Name field followed by a comma.  The length of the Author's Last Name field is <b>15</b> .
9	Type the format of the Author's Last Name field followed by a blank.  The format of the Author's Last Name field is <b>CH</b> .

The SYMNAMES statements to define the symbols for the other fields in the bookstore data set look like this:

```

Author_First_Name,*,15,CH
Publisher,*,4,CH
Course_Department,*,5,CH
Course_Number,*,5,CH
Course_Name,*,25,CH
Instructor_Last_Name,*,15,CH
Instructor_Initials,*,2,CH
Number_in_Stock,*,4,BI
Number_Sold_YTD,*,4,BI
Price,*,4,BI

```



### So Far

So far, you have learned how to create a SYMNAMES data set and use it to define symbols for your fields. Now you will learn how to use the symbols for the fields you defined.

## Using Symbols for Fields in DFSORT Statements

Now that you have your symbols for the bookstore data set defined in SORT.SYMBOLS, you can use those symbols in DFSORT control statements wherever fields can appear.

Here's an example of a DFSORT application that uses symbols. It selects the books for courses 00032 and 10347 from SORT.SAMPIN and sorts them by title, instructor and price:

```
//SYM1 JOB A492,PROGRAMMER
//SORTIT EXEC PGM=SORT
//SYSOUT DD SYSOUT=A
//SYMNAMES DD DSN=A123456.SORT.SYMBOLS,DISP=SHR
//SYMNOUT DD SYSOUT=*
//SORTIN DD DSN=A123456.SORT.SAMPIN,DISP=SHR
//SORTOUT DD DSN=A123456.SORT.SAMPOUT,DISP=SHR
//SYSIN DD *
    INCLUDE COND=(Course_Number,EQ,C'00032',OR,
                  Course_Number,EQ,C'10347')
    SORT FIELDS=(Title,A,
                  Instructor_Last_Name,A,Instructor_Initials,A,
                  Price,A)
/*
```

The SYMNAMES DD statement specifies the SYMNAMES data set to be used for this application.

The SYMNOUT DD statement specifies a data set in which you want DFSORT to list your original SYMNAMES statements and the symbol table constructed from them. You can omit the SYMNOUT data set if you don't want to see that information. For this SYMNAMES data set, the SYMNOUT listing looks like this:

```
----- ORIGINAL STATEMENTS FROM SYMNAMES -----
* Symbols for fields
Title,1,75,CH
Author_Last_Name,*,15,CH
Author_First_Name,*,15,CH
Publisher,*,4,CH
Course_Department,*,5,CH
Course_Number,*,5,CH
Course_Name,*,25,CH
Instructor_Last_Name,*,15,CH
Instructor_Initials,*,2,CH
Number_in_Stock,*,4,BI
Number_Sold_YTD,*,4,BI
Price,*,4,BI

----- SYMBOL TABLE -----
Title,1,75,CH
Author_Last_Name,76,15,CH
Author_First_Name,91,15,CH
Publisher,106,4,CH
Course_Department,110,5,CH
Course_Number,115,5,CH
```

```

Course_Name,120,25,CH
Instructor_Last_Name,145,15,CH
Instructor_Initials,160,2,CH
Number_in_Stock,162,4,BI
Number_Sold_YTD,166,4,BI
Price,170,4,BI

```

The INCLUDE and SORT statements use symbols for the fields instead of position, length and format.

---

## Using Symbols for Fields in ICETOOL Operators

You can also use the symbols from SORT.SYMBOLS in ICETOOL operators and their associated DFSORT control statements wherever fields can appear. Here's an example of an ICETOOL application that uses symbols for fields. It does what the DFSORT example in "Using Symbols for Fields in DFSORT Statements" on page 147 does, but also shows the number of selected books priced below 7 dollars and the number priced above 20 dollars:

```

//SYM2 JOB A492,PROGRAMMER
//TOOL EXEC PGM=ICETOOL
//TOOLMSG DD SYSOUT=A
//DFSMSG DD SYSOUT=A
//SYMNAMES DD DSN=A123456.SORT.SYMBOLS,DISP=SHR
//SYMNOUT DD SYSOUT=*
//IN DD DSN=A123456.SORT.SAMPIN,DISP=SHR
//OUT DD DSN=A123456.SORT.SAMPOUT,DISP=OLD
//TOOLIN DD *
    SORT FROM(IN) TO(OUT) USING(CTL1)
    RANGE FROM(OUT) ON(Price) LOWER(+700)
    RANGE FROM(OUT) ON(Price) HIGHER(+2000)
//CTL1CNTL DD *
    INCLUDE COND=(Course_Number,EQ,C'00032',OR,
                  Course_Number,EQ,C'10347')
    SORT FIELDS=(Title,A,
                  Instructor_Last_Name,A,Instructor_Initials,A,
                  Price,A)
/*

```

The SYMNAMES DD statement specifies the SYMNAMES data set to be used for this application.

The SYMNOUT DD statement specifies a data set in which you want ICETOOL to list your original SYMNAMES statements and the symbol table constructed from them. Because the SYMNAMES data set is the same as for the DFSORT application shown in "Using Symbols for Fields in DFSORT Statements" on page 147, the SYMNOUT listing will be the same as well.

The RANGE operators and the INCLUDE and SORT statements use symbols for the fields instead of position, length and format.

### So Far

You have now learned how to use symbols for fields in DFSORT control statements and ICETOOL operators. Next, you will learn how to define and use symbols for your constants.

---

## Defining and Using Symbols for Constants

You can use symbols wherever decimal constants, character constants, hexadecimal constants or bit constants can appear in DFSORT control statements and ICETOOL operators.

The ICETOOL example in “Using Symbols for Fields in ICETOOL Operators” on page 148 uses the following RANGE operators:

```
RANGE FROM(OUT) ON(Price) LOWER(+700)
RANGE FROM(OUT) ON(Price) HIGHER(+2000)
```

and the following INCLUDE statement:

```
INCLUDE COND=(Course_Number,EQ,C'00032',OR,
              Course_Number,EQ,C'10347')
```

+700 and +2000 are decimal constants. C'00032' and C'10347' are character constants. You can use symbols for these constants to make them more understandable in the ICETOOL operators and DFSORT control statements you write. The SYMNAMES statements for these constants look like this:

```
* Symbols for constants
Discount,+700
Premium,+2000
Beginning_Economics,C'00032'
Advanced_Sociology,C'10347'
```

To add these symbols for the four constants to the SORT.SYMBOLS data set, follow these steps:

*Table 72. Steps to Define Symbols for Constants*

Step	Action
1	Write a comment statement (optional):  * Symbols for constants
2	Type <b>Discount</b> followed by a comma.  This is the symbol you will use for the decimal constant +700.
3	Type the constant followed by a blank.  The constant is <b>+700</b> . You can also use <b>700</b> , but we recommend using a + sign for positive decimal constants.
4	Type <b>Premium</b> followed by a comma.  This is the symbol you will use for the decimal constant <b>+2000</b> .
5	Type the constant followed by a blank.  The constant is <b>+2000</b> . You can also use <b>2000</b> , but we recommend using a + sign for positive decimal constants.
6	Type <b>Beginning_Economics</b> followed by a comma.  This is the symbol you will use for the character constant C'00032'.
7	Type the constant followed by a blank.  The constant is <b>C'00032'</b> . You can also use <b>'00032'</b> or <b>c'00032'</b> .
8	Type <b>Advanced_Sociology</b> followed by a comma.  This is the symbol you will use for the character constant C'10347'.

Table 72. Steps to Define Symbols for Constants (continued)

Step	Action
9	Type the constant followed by a blank.  The constant is C'10347'. You can also use '10347' or c'10347'.

The RANGE operators can now be written as:

```
RANGE FROM(OUT) ON(Price) LOWER(Discount)
RANGE FROM(OUT) ON(Price) HIGHER(Premium)
```

The INCLUDE statement can now be written as:

```
INCLUDE COND=(Course_Number,EQ,Beginning_Economics,OR,
              Course_Number,EQ,Advanced_Sociology)
```

### Summary

This chapter covered how to define and use symbols for fields and constants in DFSORT control statements and ICETOOL operators. For more information on DFSORT symbols, please refer to *z/OS DFSORT Application Programming Guide*.

This completes the *z/OS DFSORT: Getting Started* tutorials. The appendixes that follow contain important information about the Sample Data Sets and the order in which DFSORT processes its various control statements.

---

## **Part 5. Appendixes**



---

## Appendix A. Creating the Sample Data Sets

Many of the examples in this document use A123456.SORT.SAMPIN, A123456.SORT.SAMPADD, and A123456.SORT.BRANCH as input data sets, and A123456.SORT.SAMPOUT as an output data set. If you want to try the examples in this document that use these data sets, create your own userid.SORT.SAMPIN, userid.SORT.SAMPADD, userid.SORT.BRANCH and userid.SORT.SAMPOUT data sets with your own userid by running the ICEDCRE job below.

Substitute your own JOB statement for the ICEDCRE JOB statement. Substitute your own userid for 'userid' in the four DD statements.

If you use a JOBLIB or STEPLIB to run DFSORT jobs, add it to the ICEDCRE job. If you prefer a value for UNIT other than SYSALLDA, change that parameter in the DD statements. Add a VOL=SER=vvvvvv parameter to the DD statements, if appropriate.

```
//ICEDCRE JOB A492,PROGRAMMER
//SAMPCOPY EXEC PGM=ICESAMP,PARM=(BOOKS)
//SYSPRINT DD SYSOUT=*
//SAMPLE DD DSN=userid.SORT.SAMPIN,DISP=(NEW,CATLG),
//          SPACE=(TRK,(1,1),RLSE),
//          DCB=(RECFM=FB,LRECL=173,BLKSIZE=1730),
//          UNIT=SYSALLDA
//*
//ADD DD DSN=userid.SORT.SAMPADD,DISP=(NEW,CATLG),
//      SPACE=(TRK,(1,1),RLSE),
//      DCB=(RECFM=FB,LRECL=173,BLKSIZE=1730),
//      UNIT=SYSALLDA
//*
//OUTPUT DD DSN=userid.SORT.SAMPOUT,DISP=(NEW,CATLG),
//          SPACE=(TRK,(1,1),RLSE),
//          DCB=(RECFM=FB,LRECL=173,BLKSIZE=1730),
//          UNIT=SYSALLDA
//*
//BRANCH DD DSN=userid.SORT.BRANCH,DISP=(NEW,CATLG),
//          SPACE=(TRK,(1,1),RLSE),
//          DCB=(RECFM=FB,LRECL=33,BLKSIZE=330),
//          UNIT=SYSALLDA
//*
//SYSIN DD DUMMY
```

Once you run this job successfully, you can substitute your userid for A123456 in the data set names of these four data sets. For example, if you see a DD statement like this:

```
//SORTIN DD DSN=A123456.SORT.SAMPIN,DISP=SHR
```

you can use your own DD statement like this:

```
//SORTIN DD DSN=userid.SORT.SAMPIN,DISP=SHR
```

**Note:** Some of the examples use data sets other than A123456.SORT.SAMPIN, A123456.SORT.SAMPOUT, A123456.SORT.SAMPADD, and A123456.SORT.BRANCH. You can either create data sets from scratch to match the ones used in the text, or else perform a similar exercise on data sets you already have.





---

## Appendix B. Descriptions of the Sample Data Sets

The fields in the records of the sample data sets SORT.SAMPIN, SORT.SAMPADD and SORT.BRANCH are described on this page, and the contents of the records are described on the following pages.

Table 73 shows the length and data format of each field in the sample bookstore data set SORT.SAMPIN, and in the additional bookstore data set SORT.SAMPADD. Both of these data sets have fixed-length records (RECFM=FB) that are 173 bytes long (LRECL=133).

*Table 73. SORT.SAMPIN and SORT.SAMPADD Field Descriptions*

Field	Length	Data Format
Title	75	CH
Author's Last Name	15	CH
Author's First Name	15	CH
Publisher	4	CH
Course Department	5	CH
Course Number	5	CH
Course Name	25	CH
Instructor's Last Name	15	CH
Instructor's Initials	2	CH
Number In Stock	4	BI
Number Sold Y-to-D	4	BI
Price	4	BI

Table 74 shows the length and data format of each field in the sample branch data set SORT.BRANCH. This data set has fixed-length records (RECFM=FB) that are 33 bytes long (LRECL=33).

*Table 74. SORT.BRANCH Field Descriptions*

Field	Length	Data Format
City	15	CH
State	2	CH
Employees	4	ZD
Revenue	6	PD
Profit	6	PD

The contents of the records in the sample data sets are shown on the following pages. Each horizontal line represents a record, and each column represents a field. Headings show the field names and the starting and ending position of each field. Of course, these headings do not actually appear in the data sets. Numeric fields (BI, ZD, PD) would not actually be readable if displayed, but are shown as their equivalent readable values.

## Sample Bookstore Data Sets

Sample Data Set - SORT.SAMPIN

Book Title	Author's Last Name	Author's First Name	Publisher	Course Department
1 75	76 90	91 105	106 109	110 114
COMPUTER LANGUAGES	MURRAY	ROBERT	FERN	COMP
LIVING WELL ON A SMALL BUDGET	DEWAN	FRANK	COR	
SUPPLYING THE DEMAND	MILLER	TOM	COR	BUSIN
VIDEO GAME DESIGN	RASMUSSEN	LORI	VALD	COMP
INKLINGS: AN ANTHOLOGY OF YOUNG POETS	WILDE	KAREN	COR	ENGL
COMPUTERS: AN INTRODUCTION	DINSHAW	JOKII	WETH	COMP
PICK'S POCKET DICTIONARY	GUSTLIN	CAROL	COR	
EDITING SOFTWARE MANUALS	OJALVO	VICTOR	VALD	ENGL
NUMBERING SYSTEMS	BAYLESS	WILLIAM	FERN	COMP
STRATEGIC MARKETING	YAEGER	MARK	VALD	BUSIN
THE INDUSTRIAL REVOLUTION	GROSS	DON	WETH	HIST
MODERN ANTHOLOGY OF WOMEN POETS	COWARD	PETER	COR	ENGL
INTRODUCTION TO PSYCHOLOGY	DUZET	LINDA	COR	PSYCH
THE COMPLETE PROOFREADER	GREEN	ANN	FERN	ENGL
SYSTEM PROGRAMMING	CAUDILLO	RAUL	WETH	COMP
SHORT STORIES AND TALL TALES	AVRIL	LILIANA	VALD	ENGL
INTRODUCTION TO BIOLOGY	WU	CHIEN	VALD	BIOL
ADVANCED TOPICS IN PSYCHOANALYSIS	OSTOICH	DIANNE	FERN	PSYCH
EIGHTEENTH CENTURY EUROPE	MUNGER	ALICE	WETH	HIST
CRISES OF THE MIDDLE AGES	BENDER	GREG	COR	HIST

Sample Data Set - SORT.SAMPADD

Book Title	Author's Last Name	Author's First Name	Publisher	Course Department
1 75	76 90	91 105	106 109	110 114
GUNTHER'S GERMAN DICTIONARY	WILLIS	GUNTER	WETH	
COMPLETE SPANISH DICTIONARY	ROBERTS	ANGEL	VALD	
ANOTHER ITALIAN DICTIONARY	UNDER	JOAN	COR	
FRENCH TO ENGLISH DICTIONARY	JONES	JACK	FERN	
GUIDE TO COLLEGE LIFE	LAMB	CHARLENE	WETH	
THE ANIMAL KINGDOM	YOUNG	KEVIN	COR	BIOL
A SMALLER WORLD: MICROBES	BEESELY	GEORGE	FERN	BIOL
DNA: BLUEPRINT FOR YOU	IAVERS	ILSE	FERN	BIOL
CELLS AND HOW THEY WORK	JETTS	PETER	VALD	BIOL
KNOW YOUR CONSUMER	ZANE	JENNIFER	COR	BUSIN
ANTICIPATING THE MARKET	ALLEN	CLYDE	WETH	BUSIN
ZEN BUSINESS	WILLIAMS	KATIE	VALD	BUSIN
THE ART OF TAKEOVERS	HUNT	ROBERT	FERN	BUSIN
THE TOY STORE TEST	LITTLE	MARIE	COR	COMP
NOVEL IDEAS	PETERS	SETH	VALD	ENGL
POLITICS AND HISTORY	TOMPSOM	KEN	FERN	HIST
CIVILIZATION SINCE ROME FELL	PIERCE	NICOLE	WETH	HIST
REBIRTH FROM ITALY	FISH	JOHN	WETH	HIST
FREUD'S THEORIES	GOOLE	APRIL	VALD	PSYCH
MAP OF THE HUMAN BRAIN	WINTER	POLLY	COR	PSYCH
QUEUE THEORY	FOX	THAD	FERN	BUSIN
DESIGNING APPLICATIONS	STEVENS	NOAH	COR	COMP

Sample Data Set - SORT.SAMPIN (continued)

Course Number	Course Name	Instructor's Last Name	Instructor's Initials	Number In Stock	Number Sold Year-to-Date	Price
115 119	120 144	145 159	160 161	162 165	166 169	170 173
00032	INTRO TO COMPUTERS	CHATTERJEE	CL	5	29	2600
				14	1	9900
70251	MARKETING	MAXWELL	RF	0	32	1925
00205	VIDEO GAMES	NEUMANN	LB	10	10	2199
10856	MODERN POETRY	FRIEDMAN	KR	2	32	595
00032	INTRO TO COMPUTERS	CHATTERJEE	CL	20	26	1899
				46	38	295
10347	TECHNICAL EDITING	MADRID	MM	13	32	1450
00032	INTRO TO COMPUTERS	CHATTERJEE	AN	6	27	360
70124	ADVANCED MARKETING	LORCH	MH	3	35	2350
50420	WORLD HISTORY	GOODGOLD	ST	15	9	795
10856	MODERN POETRY	FRIEDMAN	KR	1	26	450
30016	PSYCHOLOGY I	ZABOSKI	RL	26	15	2200
10347	TECHNICAL EDITING	MADRID	MM	7	19	625
00103	DATA MANAGEMENT	SMITH	DC	4	23	3195
10054	FICTION WRITING	BUCK	GR	10	9	1520
80521	BIOLOGY I	GREENBERG	HC	6	11	2350
30975	PSYCHOANALYSIS	NAKATSU	FL	1	12	2800
50632	EUROPEAN HISTORY	BISCARDI	HR	23	21	1790
50521	WORLD HISTORY	WILLERTON	DW	14	17	1200

Sample Data Set - SORT.SAMPADD (continued)

Course Number	Course Name	Instructor's Last Name	Instructor's Initials	Number In Stock	Number Sold Year-to-Date	Price
115 119	120 144	145 159	160 161	162 165	166 169	170 173
				3	16	1088
				8	4	650
				26	6	925
				7	17	1100
				20	1	2000
80522	BIOLOGY II	HAROLD	LM	2	30	3000
80522	BIOLOGY II	HAROLD	LM	9	20	1955
80523	INTRO TO GENETICS	ABRAHAM	NG	15	21	2195
80523	INTRO TO GENETICS	ABRAHAM	NG	8	46	2495
70251	MARKETING	MAXWELL	RF	16	3	4500
70124	ADVANCED MARKETING	LORCH	MH	20	25	2000
70255	BUSINESS THEORY	SCHOFFE	KN	12	12	1200
70255	BUSINESS THEORY	SCHOFFE	KN	17	15	615
00205	VIDEO GAMES	NEUMANN	LB	15	12	2600
10054	FICTION WRITING	BUCK	GR	11	25	2450
50521	WORLD HISTORY	WILLERTON	DW	3	17	995
50420	WORLD HISTORY	GOODGOLD	ST	6	15	1350
50632	EUROPEAN HISTORY	BISCARDI	HR	10	20	2560
30975	PSYCHOANALYSIS	NAKATSU	FL	12	15	1250
30016	PSYCHOLOGY I	ZABOSKI	RL	6	9	895
70255	BUSINESS THEORY	SCHOFFE	KN	2	20	1500
00103	DATA MANAGEMENT	SMITH	DC	7	15	1435

## Sample Bookstore Data Sets

Sample Data Set - SORT.BRANCH

City		State	Employees	Revenue	Profit
1	15	16 17	18 21	22 27	28 33
Los Angeles		CA	32	22530	-4278
San Francisco		CA	35	42820	6832
Fort Collins		CO	22	12300	-2863
Sacramento		CA	29	42726	8276
Sunnyvale		CA	18	16152	-978
Denver		CO	33	31876	6288
Boulder		CO	32	33866	7351
Morgan Hill		CA	15	18200	3271
Vail		CO	19	23202	5027
San Jose		CA	21	27225	8264
San Diego		CA	22	32940	8275
Aspen		CO	20	25800	5200

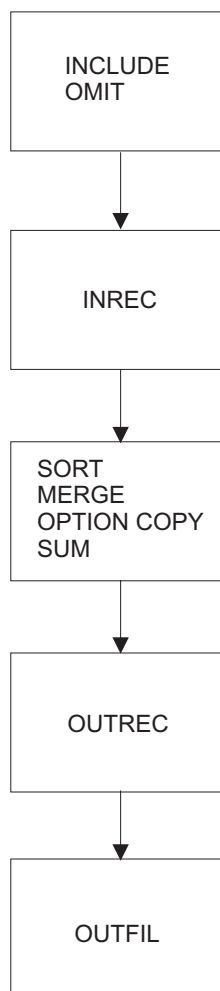
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## Appendix C. Processing Order of Control Statements

The flowchart below shows the order in which control statements are processed. (SUM is processed at the same time as SORT or MERGE. It is not used with COPY.)

Although you can write the statements in any order, DFSORT always processes the statements in the order shown below.

---



---

Figure 7. Processing Order of Control Statements



---

## Appendix D. Accessibility

Accessibility features help a user who has a physical disability, such as restricted mobility or limited vision, to use software products successfully. The major accessibility features in z/OS enable users to:

- Use assistive technologies such as screen readers and screen magnifier software
- Operate specific or equivalent features using only the keyboard
- Customize display attributes such as color, contrast, and font size

---

### Using assistive technologies

Assistive technology products, such as screen readers, function with the user interfaces found in z/OS. Consult the assistive technology documentation for specific information when using such products to access z/OS interfaces.

---

### Keyboard navigation of the user interface

Users can access z/OS user interfaces using TSO/E or ISPF. Refer to *z/OS TSO/E Primer*, *z/OS TSO/E User's Guide*, and *z/OS ISPF User's Guide* for information about accessing TSO/E and ISPF interfaces. These guides describe how to use TSO/E and ISPF, including the use of keyboard shortcuts or function keys (PF keys). Each guide includes the default settings for the PF keys and explains how to modify their functions.

---

### z/OS information

z/OS information is accessible using screen readers with the BookServer/Library Server versions of z/OS books in the Internet library at:

[www.ibm.com/servers/eserver/zseries/zos/bkserv/](http://www.ibm.com/servers/eserver/zseries/zos/bkserv/)

One exception is command syntax that is published in railroad track format; screen-readable copies of z/OS books with that syntax information are separately available in HTML zipped file form upon request to [mhvrdfs@us.ibm.com](mailto:mhvrdfs@us.ibm.com).





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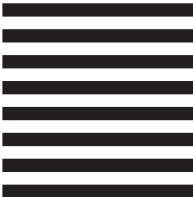
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