

SQL Processing

Prepared by



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SQL Statements

PROC SQL consists of TEN statements:

1. SELECT to perform queries
2. VALIDATE to validate the syntax of a query
3. DESCRIBE to show how a view has been defined
4. CREATE to create a table (SAS data set), index or view
5. DROP to delete a table, index or view
6. UPDATE change the values in a table
7. INSERT add rows to a table
8. DELETE to delete rows from a table
9. ALTER to add, delete or modify columns in a table
10. RESET add, change or deletion of options

Of these, by far the most important is the **SELECT** statement.

The Select Statement

PROGRAM EDITOR

```
*Q02E01 The Select statement;
proc sql;
  select *
  from saved.computer;
```

** The Proc SQL statement is loaded into memory and remains resident until another Data or Proc step is run or a QUIT; statement is executed. Therefore, subsequent queries or other SQL statements can be run without the need to re-submit the Proc SQL statement.

** each SQL statement is processed individually. No RUN; is required.

** Proc Print style output is automatically produced. Note there is no observation number and there is a line below the variable names. This output can be suppressed with the NOPRINT option on the Proc SQL statement:

```
proc sql noprint;
select....
```

Usage

Invoke Proc SQL and then use a **SELECT** statement:

PROGRAM EDITOR

```
proc sql;
```

PROGRAM EDITOR

```
select *
from saved.computer;
```

PROGRAM EDITOR

```
quit;
```

Note that while Proc SQL is running, the RUN; statement itself simply produces an interesting note on the Log:

Basic Examples

The SQL procedure uses the SELECT statement to perform a wide variety of queries. Within the SELECT statement are different Clauses:

Order by Character Variable

Select input (Char 3.) during order by during;

Ordering the Result

The order by clause determines the order in which the rows are displayed in the resulting table:

PROGRAM EDITOR

```
*Q02E02 The Order By clause to determine order for rows;
select *
from saved.computer
order by disk;
```

This code produces the same result as:

PROGRAM EDITOR

```
proc sort data = saved.computer;
  by disk;
proc print data = saved.computer;
run;
```

HANDS ON WORKSHOPS

Advantages of SQL:

- ** No physical sort has to be performed

Notice that no physical output file has been produced from this query, simply a listing as output.

Selecting Rows

Selecting Rows is done with the *WHERE* clause:

PROGRAM EDITOR

```
*Q02E03 The subsetting rows with where;
proc sql;
  select *
  from saved computer
  where supplier = 'KETCHUP COMPUTERS'
  order by disk;
quit;
```

The *WHERE* clause syntax:

(These variants also apply to the *Having* clause. Notes:

- ** $\neq$ is normally the symbol used for Not Equals on an IBM mainframe.
- ** $\neq$ is normally the symbol used for Not Equals on ASCII based machines.
- ** NOT= and NE can also be used for Not Equals.
- ** The 'Sounds Like' operator uses the Soundex algorithm. This is normally used to search for variants in names, for example telephone directory applications, but is not perfect.
- ** The BETWEEN operator includes values defined in the range.
- ** IS NULL and IS MISSING are equivalent and match with all missing values including special missing values.
- ** Computed columns cannot be referred to by name in a WHERE clause. They have to be recalculated for the WHERE clause.
- ** SAS functions are supported except for LAG, DIF and SOUND. These 'ordinary SAS' functions should not be confused with SQL summary functions seen in Q2.3.

Controls and Enhancements

Selecting columns

Using the column names from the SAS file allows choice of the columns in the report:

PROGRAM

```
*Q02E04 Selecting columns to display in select statement;
proc sql;
  select type,disk,retail
  from saved.computer
  where supplier = 'KETCHUP COMPUTERS'
  order by disk;
```

This is the equivalent of:

PROGRAM EDITOR

```
proc sort data = saved.computer
  by disk;
run;
proc print data=saved.computer
  (where=(supplier='KETCHUP COMPUTERS'));
  var type disk retail;
run;
```

Again, the SQL advantage is the lack of the sort step.

Note that the list of column names require to be delimited by commas:

select type, disk, retail

All lists of column names and table names require commas in SQL syntax.

Calculating Columns

Columns can be calculated by assigning an expression to an item name:

PROGRAM EDITOR

```
*Q02E05 Assigning an expression to column name;
proc sql;
  select type,
    disk,
    retail,
    retail * 7/47 as vat
  from saved. Computer
  where supplier = 'KETCHUP COMPUTERS'
  order by disk;
quit;
```

Notice the structure: **expression AS variable**

as opposed to the traditional SAS: **variable = expression;**

Notice that the traditional equivalent would now require an additional step:

PROGRAM EDITOR

```
data new;
  set saved.computer;
  vat = retail * 7/47;
proc sort data = new;
  by disk;
proc print data = new
  (where=(supplier='KETCHUP COMPUTERS'));
  var type disk retail vat;
run;
```

Formatting Values - A Column Modifier

The format option appears after the column name, not as a separate statement:

PROGRAM EDITOR

```
*Q02E06 Formatting values with a column modifier;

title 'Ketchup Computers, VAT element of prices';
select type,
       disk,
       retail,
       retail*7/47 as vat format=7.2
from saved.computer
where supplier='KETCHUP COMPUTERS'
order by disk ;
```

This is a SAS enhancement to a standard SQL.

Labelling Columns - a Column Modifier

Column headings can be changed with the LABEL option:

PROGRAM EDITOR

```
*Q02E07 Labeling columns with a column modifier;

proc format;
  picture pound low-high='000,000,009.99'(prefix='$');
proc sql;
  title 'Ketchup Computers, VAT element of prices';
  select type label='Computer Type',
         retail label='Retail Price' format=pound9.2,
         retail*7/47 as vat format=pound7.2
  from saved.computer
  where supplier='KETCHUP COMPUTERS'
  order by disk ;
```

This is a SAS enhancement to standard SQL.

Using Functions

Ordinary 'Data Step' functions can be used in these expressions as noted in Q2.1:

PROGRAM EDITOR

```
*Q02E08 Using functions;

options nodate nonumber;
title 'Charges raised for car hire';
proc format;
  picture pound low-high = '000,009.99' (prefix= '$');
  value $model 'F' = 'Fiesta'
              'E' = 'Escort'
              'O' = 'Orion'
              'S' = 'Sierra'
              'G' = 'Granada';
proc sql;
  select substr(carkey,2,1) format=$model.,
         custkey label='Customer Code',
         daychg label='Daily Charge',
```

```
(enddate - stdate +1) as duration
  label= 'Days Hired',
(enddate - stdate +1)*daychg
  format = pound7.2,
round(((enddate - stdate +1)*daychg*7/47),0.01)
  as vat format = pound7.2
from saved.carhire
order by 5 desc;
```

Notes:

Functions can be used to derive calculated columns as shown by the SUBSTR function above and can be used to change calculate values as shown by the ROUND function. Derived columns need not be given aliases using the AS syntax.

Aliases cannot be used in further calculations. For example, if the expression in line 17 above:

```
(enddate - stdate +1)*daychg
were replaced by
duration*daychg
an error would result, duration not being found.
```

The order by clause can use the ordinal position of the column. In the example above the 5th column is used. Ordering can be done a calculated column with no alias.

Distinct Values

A useful keyword is *DISTINCT*, which allows selection of unique values of a column:

PROGRAM EDITOR

```
*Q02E09 Selection of unique key values with Distinct;

title 'Which disk types are sold by Ketchup?';
select distinct disk
from saved.computer
where supplier='KETCHUP COMPUTERS'
order by disk ;          <-- not required
```

OUTPUT

Which disk types are sold by Ketchup?

DISK
20
40
60
100
120
200

Traditional SAS programming would involve the following:

HANDS ON WORKSHOPS

PROGRAM EDITOR

```
title 'Which disk types are sold by Ketchup?';
proc sort data=saved.computer out=sorted; <-----
required
  by disk;
data unique(keep=disk);
  set sorted(keep=disk supplier);
  by disk;
  if last.disk;
  where supplier='KETCHUP COMPUTERS';
proc print data=unique;
run;
```

Selecting data with DISTINCT

The **DISTINCT** keyword can be used to select data for all combinations of columns:

PROGRAM EDITOR

```
*Q02E10 Distinct can apply to unique combinations;

title 'All combinations of disk and type';
select distinct disk label='Hard Disk Size',
  type label='Computer Type'
from saved.computer
where supplier='KETCHUP COMPUTERS'
order by disk ;
```

The **DISTINCT** keyword applies to all the column names and each unique combination of values is returned.

Data/Proc Step methods would use two BY variables. Note the effect on the inner variable (*type*) when the outer variable (*disk*) changes value:

PROGRAM EDITOR

```
title 'Which disk types are sold by Ketchup?';
proc sort data=saved.computer out=sorted;
  by disk type;
data unique(keep=disk type);
  set sorted(keep=disk type supplier);
  by disk type;
  if last.type;
  where supplier='KETCHUP COMPUTERS';
proc print data=unique;
run;
```

Syntax Checking

Use the **VALIDATE** statement, before the **SELECT** statement, to check the SQL statements without executing them:

PROGRAM EDITOR

```
*Q02E11 Checking select statement syntax without executing;

validate
select distinct disk label = 'Hard Disk Size'.
  Type label = 'Computer Type'
from saved computer
```

```
where supplier = 'KETCHUP COMPUTERS'
order by disk ;
```

LOG

Proc SQL has valid syntax

This facility can only be used with a *Query-expression* i.e. to qualify the syntax of a **SELECT**.

Syntax Errors

This syntax error is caused by the **ORDER BY** option:

PROGRAM EDITOR

```
*Q02E12 Where is the syntax error here?;

validate
select distinct disk label = 'Hard Disk Size',
  type label = 'Computer Type'
from saved.Computer
order by disk
where supplier = 'KETCHUP COMPUTERS' ;
```

LOG

```
validate
select distinct disk label = 'Hard Disk Size',
  type label = 'Computer Type'
from saved. Computer
order by disk
where supplier = 'KETCHUP COMPUTERS' ;
```

22

202

ERROR 22-322: Expecting one of the following: (, **, *, /, +, -, ||, ||,

<, <=, <>, =, >, >=, ?, CONTAINS,

eq, ge, gt, le, lt, ne, ^=, ^=,

&, AND, !, or, !, OR, !, !,

The statement is being ignored.

ERROR 202-322: The option or parameter is not recognized.
Make sure the **ORDER BY** statement is the last option on the **SELECT** statement.

Analysis on Groups

Summary Functions

A series of functions are provided to work 'down the columns'. A complete list of these functions is given in Q2.5.

PROGRAM EDITOR

*Q02E13 Analysis down a column for groups;

```
select mean(retail) as avprice
from saved.computer;
```

OUTPUT

AVPRICE

1929.167

This is the equivalent of:

PROGRAM EDITOR

```
proc means data = saved.computer mean;
var retail;
run;
```

With more than one argument, the function performs for each row:

PROGRAM EDITOR

*Q02E14 More than one argument to analyze each row;

```
select retail format= pound10.2,
       retail * 7/47 as VAT format = pound8.2,
       sum(retail,retail*7/47) as gross
       format =pound10.2
from saved.computer;
```

With a single argument, but with other selected columns, the function gives a result for all the rows, then merges the summary back with each row:

PROGRAM EDITOR

*Q02E15 Merges summary value onto each row of output;

```
select cpu,
       disk,
       (retail -wholesale)
       as profit label='Profit',
       mean(retail-wholesale)
       as avprofit label = 'Average Profit',
       (retail-wholesale) - mean(retail -wholesale)
       as diff label = 'Difference'
from saved.computer
where supplier contains 'FLOPPY';
```

To accomplish the same thing in Data/Proc step either requires use of Proc Means/Summary to create a one-observation, one-variable data set which is then read into the data step alongside saved.computer or two passes of the data in the same data step:

PROGRAM EDITOR

```
data new;
retain avprofit;
if _n_ = 1 then do;
do until(finish);
set saved.computer end = finish
nobs = numobs;
profit=retail-wholesale;
totprof+profit;
end;
avprofit = totprof / numobs;
end;
set saved.computer;
profit = retail - wholesale;
diff = (retail - wholesale) - avprofit;
run;
proc print data=new;
var cpu disk profit avprofit diff;
label profit='Profit'
avprofit='Average Profit'
diff = 'Difference';
run;
```

An important function is COUNT(*) which gives the number of rows:

PROGRAM EDITOR

*Q02E16 The count function supplies the number of rows;

```
select count(*) as no_rows
from saved.computer;
select sum(retail)/count(*) as average
from saved.computer;
quit;
```