SQL vs SAS®: Clash of the Titans

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ABSTRACT

This paper will present a comparison of typical SAS programming techniques to the equivalent code needed to perform similar functionality using PROC SQL. The SQL procedure implements the Structured Query Language (SQL) for the SAS System. SQL is a standardized, open language originally developed to work in conjunction with Relational Database Management Systems (RDBMS) such as Oracle® and DB2®. SQL was primarily designed to perform Direct Data Access (DDA) functions, such as retrieving and updating data in tables (data sets), however its functionality is much more advanced in today's software.

INTRODUCTION

The language was first created by IBM® in 1975 and was called SEQUEL for "Structured English Query Language." SQL was adopted as a standard by the American National Standards Institute (ANSI) in 1986 and the International Organization for Standardization (ISO) in 1987. The SAS System's SQL procedure, introduced in 1990, enables the creation or retrieval of data stored in tables or views. It can create SAS macro variables that co0p\]ntain values from rows of a query's result. The table at the right displays the equivalent nomenclature for SAS and SQL terminology. Throughout this paper SAS and SQL code will be presented in uppercase letters while supplied variable names and values in lowercase letters.

SAS	SQL
Data Set	Table
Observation	Row
Variable	Column
Merge	Join
Extract	Query

CREATING TABLES

The examples in Figures 1 and 2 are meant to show how data sets can be created using the DATA step as well as the SQL procedure. One major difference is the use of the keyword QUIT in lieu of RUN. Multiple statements can be used within the SQL procedure as indicated with the CREATE TABLE and INSERT INTO statements.

```
DATA table1a;
  LENGTH var1 $3. var2  $2.
         var3 $8. numvar 8.;
  INPUT var1 $ var2 $
        var3 $ numvar;
DATALINES;
SaS is Great  1
SaS is Good   2
Let us Thank  4
Jim we Should 8
;
RUN;
```

Figure 1: Creating Tables Using the DATA Step

```
PROC SQL;
  CREATE TABLE table1b
    ( var1 CHAR(3), var2   CHAR(2),
      var3 CHAR(8), numvar NUM );

  INSERT INTO table1b
    VALUES('SaS','is','Great ',1)
    VALUES('SaS','is','Good  ',2)
    VALUES('Let','us','Thank ',4)
    VALUES('Jim','we','Should',8);
QUIT;
```

Figure 2: Creating Tables Using SQL

SUB-SETTING TABLES

Limiting a data set to desired records can be done with the WHERE clause in both a DATA step and SQL. To capture values within a given range the SQL statement can use the BETWEEN condition as shown in Figure 4. The greater than, less than, and equal to operators must be used to obtain the same result within a DATA step where PROC SQL supports both comparison operations. Note the asterisk in the SQL tells the system to output all variables.

```
DATA table2a;
  SET table1a;
  WHERE 2 <= numvar <= 4;
RUN;
```

Figure 3: Sub-Setting Using the DATA Step

```
PROC SQL;
  CREATE TABLE table2b AS
  SELECT *
    FROM table1b
   WHERE numvar BETWEEN 2 AND 4;
QUIT;
```

Figure 4: Sub-Setting Using SQL

SORTING

PROC SORT is typically used to sort data within the SAS system as compared to the ORDER BY clause of SQL. Within the SAS system, SQL will sort data in the exact order as PROC SORT, though implementations of SQL from other vendors can vary. In some cases character variables that begin with numeric values show up in the beginning of the table and others at the end. This has serious implications when joining or merging data from other vendors. Note that tables created using PROC SQL can be later sorted by PROC SORT as the results are a SAS data set.

```
PROC SORT DATA=table1a;
  BY var1;
RUN;
```

Figure 5: Sorting Data using PROC SORT

```
PROC SQL;
  CREATE TABLE table1b AS
  SELECT *
    FROM table1b
   ORDER BY var1;
QUIT;
```

Figure 6: Sorting Data using SQL

ELIMINATING DUPLICATES

Obtaining unique values within a data set can be done in the SAS system by using the NODUPS option within a PROC SORT. The original table can be preserved by including the OUT= option as shown in Figure 7. In SQL unique values can be obtained by using the keyword DISTINCT. In comparison, the original table can be preserved by specifying a different table name on the CREATE TABLE statement.

```
PROC SORT DATA=table1a
  NODUPS OUT=table2a;
  BY var1;
RUN;
```

Figure 7: Eliminating Duplicates using PROC SORT

```
PROC SQL;
  CREATE TABLE table2b AS
  SELECT DISTINCT *
    FROM table1b
   ORDER BY var1;
QUIT;
```

Figure 8: Eliminating Duplicates using SQL

ELIMINATING DUPLICATE KEYS

By using the NODUPKEY option PROC SORT keeps the FIRST record of the BY group similar to the FIRST (dot) notation in a DATA step. This means the first time SAS encounters a new BY group it keeps the first record it encounters regardless of the values within other variables in the data set. An example of FIRST (dot) notation is shown later in this paper.

Although there is not a true equivalent in the SAS implementation of SQL to keep the first record of a BY group as compared to the NODUPKEY option, other functionality exists that can be used to eliminate duplicates with a more clearly defined logic. The example in Figure 10 will only keep the records with the minimum values of all variables.

```
PROC SORT DATA=table1a
  NODUPKEY OUT=table3a;
  BY var1;
RUN;
```

Figure 9: Eliminating Duplicates Keys PROC SORT

```
PROC SQL;
  CREATE TABLE table3b AS
  SELECT MIN(var1) AS var1,
         MIN(var2) AS var2,
         MIN(var3) AS var3,
         MIN(numvar) AS numvar
    FROM table1b
   GROUP BY var1
   ORDER BY var1;
QUIT;
```

Figure 10: Eliminating Duplicates Keys using SQL

GROUPING

The grouping of data allows for the accumulation of summary variables. Using the DATA step to group and summarize information, the data must first be sorted. This is not the case when using SQL, though it can help efficiency tremendously. In Figure 11, the FIRST (dot) notation is used in the DATA step to set the value of the first record in the BY group to zero. Accumulation of values occurs and the LAST record of the group is OUTPUT. SQL may be easier to follow as the COUNT and SUM functions, accompanied by the GROUP BY, perform this function.

```
PROC SORT DATA=table1a;
  BY var1;
RUN;

DATA table5a  ( DROP= numvar );
  SET table1a ( KEEP= var1 numvar);
  BY var1;
  IF FIRST.var1 THEN DO;
     cntvar = 0;
     sumvar = 0;
  END;
     cntvar + 1;
     sumvar + numvar;
  IF LAST.var1 THEN OUTPUT;
RUN;
```

Figure 11: Grouping Data Using the DATA Step

```
PROC SQL;
  CREATE TABLE table5b AS
  SELECT var1,
         COUNT(*)    AS cntvar,
         SUM(numvar) AS sumvar
    FROM table1b
   GROUP BY var1;
QUIT;
```

Figure 12: Grouping Data Using SQL

```
PROC SUMMARY DATA=table1b NWAY MISSING;
  CLASS var1;
  VAR numvar;
  OUTPUT OUT=table5c
           N=cntvar
         SUM=sumvar;
RUN;
```

Figure 13: Grouping Data Using PROC SUMMARY

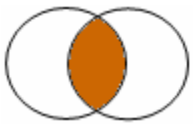
PROC SUMMARY is similar to SQL in that data need not be sorted, though again sorting first can greatly improve efficiency. If the data are not sorted, the BY statement can be replaced by the CLASS sub-group statement. By default, using the CLASS statement will calculate all of the requested statistics for every combination of values within the sub-group. The NWAY option tells the system to only output the highest level of grouping. The MISSING option tells SAS to count missing values. The VAR statement will identify the variables to be summarized. The N and SUM options of the OUPUT statement are used to identify the names of the output variables.

COMBINING DATA

The combining of data sets is typically referred to as a "merge" in SAS terminology and as a "join" in SQL. The figures below help describe the types of joins discussed within this paper. The Inner join, and Left, Right, and Full Outer join.

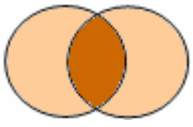
INNER JOIN

An inner join returns a result table for all of the rows in a table that has one or more matching rows in another table. This is often called an Equi-Join as the values within the joining variables must have values that are equal to each other in both tables.



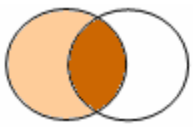
FULL OUTER JOIN

A Full Outer join has all the rows for which the sql-expression is true, plus rows from each table that do not match any row in the other table. Outer joins are inner joins that have been augmented with rows that did not match with any row from the other table.



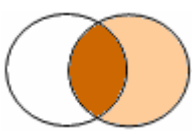
LEFT OUTER JOIN

A left outer join, specified with the keywords LEFT JOIN and ON, has all the data for which the sql-expression is true, plus observations from the first (LEFT) table that do not match any observation in the second (RIGHT) table.



RIGHT OUTER JOIN

A left outer join, specified with the keywords RIGHT JOIN and ON, has all the data for which the sql-expression is true, plus observations from the second (RIGHT) table that do not match any observation in the first (LEFT) table.



INNER JOIN

An inner join is basically a query where the values of the columns being compared are equal. All other records are discarded. In the DATA step, an inner join can be performed by executing the MERGE statement. The IN= data set option creates a variable that indicates which table the data came from. The IF statement tells the SAS System to keep all records that are in both the "left" and "right" tables. The FROM clause in the SQL statement contains two tables separated by a comma indicating a join and the WHERE clause indicates the values to be equal in both tables.

```
PROC SORT DATA=table1d; BY var1; RUN;
PROC SORT DATA=table2d; BY var1; RUN;

DATA table3d;
  MERGE table1d ( IN= left  )
        table2d ( IN= right );
  BY var1;
  IF left AND right;
RUN;
```

Figure 14: Inner Join Using the DATA Step

```
PROC SQL;
  CREATE TABLE table3e AS
  SELECT table1e.var1,
         table2e.var2,
         table2e.var3,
         table2e.numvar
    FROM table1e, table2e
   WHERE table1e.var1 = table2e.var1;
QUIT;
```

Figure 15: Inner Join Using SQL

LEFT JOIN

A left join indicates that all records should be kept from the first or left hand table and only those that match from the right hand table. Note the slight difference in the IF statement in Figure 16 as compared to Figure 14. The SQL procedure is quite different. In order to perform a left join the keywords LEFT JOIN must now appear. The ON clause tells SAS which variables to match on. Another difference, though not required, is the use of table aliases; see T1 and T2 in Figure 17. Note the syntax of the RIGHT join is the same as the LEFT with the use of the syntax RIGHT JOIN.

```
PROC SORT DATA=table1f; BY var1; RUN;
PROC SORT DATA=table2f; BY var1; RUN;

DATA table3f;
  MERGE table1f ( IN= left )
        table2f;
  BY var1;
  IF left;
RUN;
```

Figure 16: Left Join Using the DATA Step

```
PROC SQL;
  CREATE TABLE table3g AS
  SELECT T1.var1, T2.var2,
         T2.var3, T2.numvar
    FROM table1g T1
    LEFT JOIN
         table2g T2
      ON T1.var1 = T2.var1;
QUIT;
```

Figure 17: Left Join Using SQL

FULL JOIN

The full join tells the system to keep all records from both tables and match values with equal BY or ON variables. Note the exclusion of the IF statement in the DATA step and the use of the keyword FULL in PROC SQL.

```
PROC SORT DATA=table1h; BY var1; RUN;
PROC SORT DATA=table2h; BY var1; RUN;

DATA table3h;
  MERGE table1h
        table2h;
  BY var1;
RUN;
```

Figure 18: Full Outer Join Using the DATA Step

```
PROC SQL;
  CREATE TABLE table3i AS
  SELECT T1.var1, T2.var2,
         T2.var3, T2.numvar
    FROM table1i T1
    FULL JOIN
         table2i T2
      ON T1.var1 = T2.var1;
QUIT;
```

Figure 19: Full Outer Join Using SQL

APPENDING DATA

Appending data together in a DATA step can be done by adding the additional tables to the SET statement as in Figure 20. To set data together using SQL the keywords UNION ALL are used. Note the use of the word ALL tells the system not to eliminate duplicate rows.

```
DATA table1j;
 SET table1j
     table2j;
RUN;
```

Figure 20: Appending Data Using the DATA Step

```
PROC SQL;
  CREATE TABLE table1k AS
  SELECT * FROM table1k
    UNION ALL
  SELECT * FROM table2k;
QUIT;
```

Figure 21: Appending Data Using SQL

APPENDING DATA – NO DUPLICATES

The PROC APPEND is shown in Figure 22 to identify another means of appending data. This method is much more efficient as it only needs to read the incoming data to be appended. The subsequent SORT with the NODUPS option will eliminate the duplicate records. The use of the keyword UNION without the word ALL, see Figure 23, eliminates duplicate records in the resulting output, which may or may not be required.

```
PROC APPEND
  DATA=table2l
   OUT=table1l;
RUN;

PROC SORT DATA=table1l
  NODUPS;
  BY var1;
RUN;
```

Figure 22: Appending Data No Dupes Using PROC

```
PROC SQL;
  CREATE TABLE table1m AS
  SELECT * FROM table1m
    UNION
  SELECT * FROM table2m;
QUIT;
```

Figure 23: Appending Data No Dupes Using SQL

IDENTIFYING DUPLICATES

Below are two means of identifying duplicate records within a data set. Figure 24 uses a PROC SORT and the DATA step to count records within a BY group and outputs only those observations where last record in the group is greater than one, hence a duplicate. The SQL procedure shown here introduces the use of the HAVING clause, which occurs after the 'GROUP BY' clause has completed. Once the count of the variables within the by group is accomplished, the HAVING clause requests only those records where the count is again greater than one.

```
PROC SORT DATA=table1;
  BY var1;
RUN;

DATA find_dups_using_datastep;
  SET table1;
  BY var1;
  IF FIRST.var1 THEN cntvar = 0;
     cntvar + 1;
  IF LAST.var1  AND  cntvar > 1;
RUN;
```

Figure 24: Identify Duplicates Using the DATA Step

```
PROC SQL;
  CREATE TABLE find_dups_using_sql AS
  SELECT var1,
         COUNT(*) AS cntvar
    FROM table1
   GROUP BY var1
  HAVING cntvar > 1;
QUIT;
```

Figure 25: Identify Duplicates Using SQL

CASE vs IF

The following is an example of how to set the values of a new variable based on the values of an existing variable. In Figure 26, the DATA step uses an IF statement and the SQL procedure uses the CASE statement as in Figure 27.

```
DATA table1n;
  SET table1a;

  IF   var1 = 'SaS'
  THEN life = 'Good';
  ELSE life = 'Ok';

RUN;
```

Figure 26: IF Statement Example Using the DATA Step

```
PROC SQL;
  CREATE TABLE table2n AS
  SELECT *,

         CASE
           WHEN var1 = 'SaS'
           THEN 'Good'
           ELSE 'Ok'
         END AS life

    FROM table1b;
QUIT;
```

Figure 27: CASE Statement Example Using SQL

SUB-QUERY

A sub-query, sometimes called a nested table expression, is in fact a temporary table. An example of using a sub-query would be to identify all beneficiaries who have had a particular type of claim and then go back to get all of their claims. The first query or sub-query would identify the beneficiary number for use in the second query. In the examples listed below, think of "var3" as a filter for a type of surgical procedure and "var1" as a beneficiary number. The DATA step in Figure 28 is shown here to illustrate the equivalent process of the SQL examples.

```
DATA temp1;
  SET table1a;
  WHERE var3 = 'Good';
  KEEP var1;
RUN;

PROC SORT DATA=table1a; BY var1;
PROC SORT DATA=temp1 NODUPS; BY var1;

DATA table1o;
  MERGE temp1 ( IN= left )
        table1a;
  BY var1;
  IF left;
RUN;
```

Figure 28: Sub-Query Using the DATA Step

```
PROC SQL;
  CREATE TABLE table2o AS
  SELECT T1.*
    FROM table1b T1
   INNER JOIN (
               SELECT DISTINCT var1
                 FROM table1b
                WHERE var3 = 'Good'
                ) T2
      ON T1.var1 = T2.var1;
QUIT;

* Note the use of the keyword
  DISTINCT to obtain unique values;
```

Figure 29: Sub-Query Using INNER JOIN

DATA STEP

The SAS code in Figure 28 creates a temporary data set, sorts the results and merges it back to the original data set to capture all relevant information based on the value of var1.

INNER JOIN

The example displayed in Figure 29 is a sub-query within an INNER JOIN. Note the alias of T2 for the temporary table. The ON clause can then be rendered as T1.var1 = T2.var1.

WHERE CLAUSE

Figure 30 demonstrates the use of a sub-query within a WHERE clause. The outcome is once more a temporary table though it is used similar to an IN list such as ('abc','def','ghi').

```
PROC SQL;
  CREATE TABLE table2o AS
  SELECT *
    FROM table1b
   WHERE var1 IN (
                  SELECT DISTINCT var1
                    FROM table1b
                   WHERE var3= 'Good'
                   );
QUIT;
```

Figure 30: Sub-Query Using WHERE Clause

SAS ACCESS

The SAS/ACCESS products are data access engines that translate read and write requests from SAS into the appropriate call for a specific DBMS or file structure. This means that SAS code can be submitted against data sources such as Oracle®, DB2®, and Teradata® without having to know the engines specific SQL implementation. Please note, each Figure shown here requires a licensed version of SAS Access to Oracle and the Oracle client must also be installed on the remote machine.

```
LIBNAME enroll ORACLE SCHEMA=enroll PATH='hcis' USER="&uid" PASSWORD="&pwd";
LIBNAME ref    ORACLE SCHEMA=ref    PATH='hcis' USER="&uid" PASSWORD="&pwd";
```

DATA STEP

The LIBNAME statements shown here are specific to the Oracle database, Health Care Information System (HCIS) Legacy, at CMS. They are used to identify the location of data for use by SAS DATA steps and procedures. The SAS Access engine will convert the SAS code into the relative SQL code needed for the host database. Note that table and variable names have been shortened for clarity. Variable names need to be the same in a DATA step MERGE hence the RENAME option.

```
DATA hcis1;
  MERGE enroll.bene_smry (IN=left WHERE=(year='2004'))
        ref.state_tbl (RENAME=(state_cd=bene_state));
  BY bene_state;
  KEEP bene_state state_name bene_cnt_tot;
  IF FIRST.bene_state THEN bene_cnt = 0;
     bene_cnt_tot + bene_cnt;
  IF left AND LAST.bene_state THEN OUTPUT;
RUN;
```

Figure 31: SAS Access to Oracle Using the DATA Step

PROC SQL

As with the DATA step option, the SQL procedure uses the LIBNAME engine to access the Oracle data. The SAS SQL will be converted to Oracle SQL and passed to the database. The syntax used to access Oracle data via the LIBNAME engine is exactly the same as if accessing a SAS data set. Native Oracle SQL is a bit different as shown in the next example. Keep in mind that if a SAS function is used that does not have an Oracle equivalent all rows will be returned to the remote machine!

```
PROC SQL;
  CREATE TABLE hcis2 AS
  SELECT T1.bene_state, T2.state_name,
         SUM(T1.bene_cnt) as bene_cnt_tot
    FROM enroll.bene_smry T1
    LEFT JOIN ref.state_tbl T2
      ON T1.bene_state = T2.state_cd
   WHERE T1.year ='2004'
   GROUP by
         T1.bene_state, T2.state_name;
QUIT;
```

Figure 32: SAS Access to Oracle Using SQL

PASS-THROUGH

The pass-through facility will allow the SAS system to send host specific SQL to the Oracle database typically running on a much faster computer such as UNIX. The syntax for the pass-through is quite different than in the previous SQL example. There is the CONNECT statement with values similar to the LIBNAME shown above. The CREATE TABLE statement also contains the syntax SELECT * FROM CONNECTION TO ORACLE, which tells SAS the data will be retrieved from the Oracle database.

```
PROC SQL;
  CONNECT TO ORACLE ( PATH='hcisprd.world'
                      USER="&uid" PASSWORD="&pwd");
  CREATE TABLE hcis3 AS
  SELECT * FROM CONNECTION TO ORACLE
    (
     SELECT T1.bene_state, T2.state_name,
            SUM(T1. bene_cnt) as bene_cnt_tot
       FROM enroll.bene_smry T1,
            ref.state_tbl T2
      WHERE T2.state_cd = T1.bene_state (+)
        AND T1.year = '2004'
      GROUP BY T1.bene_state, T2.state_name
    );
  DISCONNECT FROM ORACLE;
QUIT;
```

Figure 33: Oracle Pass-Through Using SQL

The code that follows is simply a sub-query passing Oracle SQL. Note the syntax of the LEFT JOIN within Oracle is the plus sign (+) surrounded by the parenthesis, which is located within the WHERE clause. This language rule instructs Oracle to keep all of the observations from the table on the side of the equal sign where the plus sign is present. This identifies an obvious example of the varying implementations of SQL.

SIMPLE INDEX

Indexing large data sets can often result in much faster query times, especially if the result of the query is less than 15% of the total number of observations within the table. The method of creating a simple index in traditional SAS code is by using a PROC DATASETS as in Figure 34. The SQL counterpart is shown opposite.

```
PROC DATASETS lib=work;
  MODIFY table1a;
  INDEX CREATE var1;
QUIT;
```

Figure 34: Simple Index Using PROC DATASETS

```
PROC SQL;
  CREATE INDEX var1
  ON table1b (var1);
QUIT;
```

Figure 35: Simple Index Using SQL

COMPOSITE INDEX

A composite index is one where more than one variable is used. Figure 36 demonstrates the name of the index is set equal to the variables requested surrounded by parenthesis. The SQL example identifies the name of the index within the CREATE INDEX statement. Notice the variables in the SQL example are separated by commas.

```
PROC DATASETS lib=work;
  MODIFY table1a;
  INDEX CREATE idx1a=(var1 var2);
QUIT;
```

Figure 36: Composite Index Using PROC DATASETS

```
PROC SQL;
  CREATE INDEX idx1b
  ON table1b (var1,var2);
QUIT;
```

Figure 37: Composite Index Using SQL

MACRO VARIABLES

Another useful mechanism of the DATA step and SQL within the SAS system is the ability to dynamically create macro variables using data within a table. In the examples below, the DATA Step will grab the **LAST** record in the table where the PROC SQL captures the **FIRST** record. The _NULL_ statement instructs SAS not to create a table.

```
DATA _NULL_;
  SET table1a;
  CALL SYMPUT('macvar1', numvar);
RUN;
```

Figure 38: Creating Macro Variables Using the DATA Step

```
PROC SQL NOPRINT;
  SELECT numvar
  INTO : macvar2
  FROM table1b;
QUIT;
```

Figure 39: Creating Macro Variables Using SQL

DYNAMIC IN (LIST)

PROC SQL can also be used to string all of the values together. This is particularly useful if an IN list is needed for use within a WHERE clause. Consider the data set, **table2**, where a list of CPT codes has been stored. This list can be placed into a macro variable and used as such: **WHERE cptcode IN (&mylist)**.

table2
cptcode
21081
21082
21083
21084
21085

```
PROC SQL NOPRINT;
  SELECT "'" || cptcode || "'"
  INTO : mylist
  SEPARATED BY ','
  FROM table2;
QUIT;


%PUT &mylist;
*RESULT = '21081','21082','21083','21084','21085';
```

Figure 40: Dynamic IN List Using SQL

CONCLUSION

There is almost no limit to what can be done with the Base SAS system in regards to manipulating data. Since the advent of SQL the SAS system has even more data processing power. The ability to reach out to other database vendors and often simplify coding schemes is immeasurable. In addition, using SQL within SAS provides new flexibilities with respect to multiple data sets and disparate data sources within a single program and/or data step. Moreover, a new level of acceptance is achieved by using the ability to load, manipulate, and analyze data using SQL to transcribe that knowledge to others who do not know SAS, but who are fluent in the ways of SQL. A basic knowledge of SQL can go a very long way.

REFERENCES

Carpenter, A. (2005): "Storing and Using a List of Values in a Macro Variable",
Proceedings of the Thirtieth Annual SAS Users Group International Conference, 30, 028-30.

Raithel, M. (2004): "Creating and Exploiting SAS Indexes,"
Proceedings of the Twenty-ninth Annual SAS Users Group International Conference, 29, 123-29.

SAS Institute Inc. (1990): *SAS® Guide to Macro Processing, Version 6, Second Edition*.
Cary, NC: SAS Institute Inc.

SAS Institute Inc. 1999: *SAS®* OnlineDoc® Version Eight. "SAS Macro Language Reference."
http://v8doc.sas.com/sashtml/.

Siemers, V. (2000): "Removing Duplicates: Proc Sql Can Help You "See"",
Proceedings of the Twenty-fifth Annual SAS Users Group International Conference, 25, 106-25.

Weiming Hu, (2004): "Top Ten Reasons to Use PROC SQL"
Proceedings of the Twenty-ninth Annual SAS Users Group International Conference, 29, 042-29.

Wikimedia Foundation Inc. 2005: Wikimedia Foundation. "Structured Query Language."
http://en.wikipedia.org/wiki/SQL.

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