The Building Blocks of SAS® Datasets – S-M-U (Set, Merge, and Update)

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What is S-M-U?

What is S-M-U?

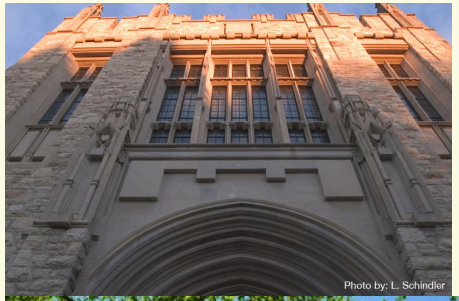
Shmoo?

S-M-U

What is S-M-U?

Southern Methodist University?

S-M-U



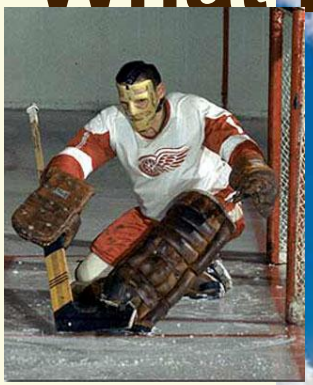
What is S-M-U?

Saskatchewan and Manitoba Universities?

UNIVERSITY OF SASKATCHEWAN

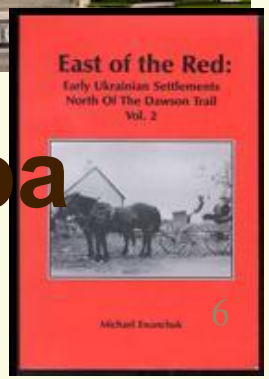
UNIVERSITY OF MANITOBA

S-M-U



What is S-M-U?

Saskatchewan and Manitoba Ukrainians?



S-M-U

So, what *is* S-M-U?

A representation of the building blocks to process a SAS Dataset through a DATA Step?

- **SET** statement
- **MERGE** statement
- **UPDATE** statement

Set-Merge-Update Preparatory Info

SAS datasets are stored in *SAS Data Libraries*.

The standard specification for a SAS dataset contains 2 levels:

```
SAS-Data-Library.SAS-dataset-name
```

If a SAS dataset reference contains only one level, it is implied that the SAS Data Library is the *WORK* library.

Set-Merge-Update Preparatory Info

SAS Data Libraries must be denoted by a *Libname (also known as a Libref)*. This is a "nickname" for your Data Library.

Set-Merge-Update Preparatory Info

How to define a Libref:

1) **Let the operating system do it:**

```
//LREF1 DD DSN=mvs.data.set,DISP=SHR
```

2) **Let SAS do it as a global statement:**

```
LIBNAME  libref  <engine>
   'external file' <options>;
```

3) **Let SAS do it as a function:**

```
X = LIBNAME(libref, 'external file'
   <,engine> <,options>);
```

Set-Merge-Update Preparatory Info

Special LIBNAME keywords:

To deactivate a Libref:

```
LIBNAME libref CLEAR;
```

To display all active Librefs:

```
LIBNAME libref LIST;
```

Set-Merge-Update SET statement

The **SET** statement, according to the manual, "… reads observations from one or more existing SAS datasets."

Set-Merge-Update SET statement

The simplest example:

```
DATA  newdata;
   SET olddata;
RUN;
```

This routine creates an exact replica of a SAS dataset called *olddata* and stores it in a SAS dataset called *newdata*.

Set-Merge-Update SET statement

You can combine two or more SAS datasets into one:

```
DATA  newdata;
   SET olddata1 olddata2;
RUN;
```

The new dataset contains the contents of *olddata1*, followed by *olddata2*.

This is commonly referred to as *concatenation*.

Set-Merge-Update SET statement

You can combine two or more SAS datasets:

```
DATA  newdata;
   SET olddata1 olddata2;
RUN;
```

NOTE: You could also use PROC APPEND to do this. The I/O will be more efficient . However, you can only process two datasets at a time, and you cannot perform any additional processing against the data.

Set-Merge-Update SET statement

IMPORTANT SAFETY TIP!

You
SAS

Variables that are common to multiple datasets *must have* consistent definitions.

DIFFERENT LENGTHS:

SAS will use the first definition it encounters, which can result in padding or truncation of values. Fix this with a `LENGTH` statement prior to the SET statement.

Set-Merge-Update SET statement

You
SAS

IMPORTANT SAFETY TIP!

Variables that are common to multiple datasets *must have* consistent definitions.

CHARACTER vs. NUMERIC:

- `ERROR: Variable <varname> has been defined as both character and numeric.`
- `_ERROR_ = 1`
- `RC = 8`

Set-Merge-Update SET statement

You can do conditional processing for each input dataset:

```
DATA  newdata;
  SET student(IN=in_stdnt)
      teacher(IN=in_teach);
  IF in_teach THEN salary = salary+bonus;
RUN;
```

IN= specifies a <u>temporary</u> variable that is set to 1 if the corresponding dataset is the source of the current obs. Otherwise, it is set to 0.

Set-Merge-Update SET statement

You can *interleave* two or more SAS datasets:

```
DATA  newdata;
   SET olddata1 olddata2;
   BY keyvar;
RUN;
```

The new dataset contains the contents of *olddata1* and *olddata2*, sorted by *keyvar*. NOTE: *olddata1* and *olddata2* must each be sorted by *keyvar* prior to executing this DATA step.

Set-Merge-Update SET statement

You can create a *subset* of your original dataset:

```
DATA  newdata;
   SET olddata1;
   IF  keyvar < 10;
RUN;
```

-or –

```
-DATA  newdata;
   SET olddata1;
   WHERE  keyvar < 10;
RUN;
```

(continued) …

Set-Merge-Update SET statement

You can create a subset of your original dataset:

- or -

```
DATA  newdata;
   SET olddata1
        (WHERE=(keyvar < 10));
RUN;
```

Any of these three methods can be used for subsetting.

Set-Merge-Update SET statement

You can determine when you have reached the end of your input data:

```
DATA  newdata;
   SET olddata1 END=lastrec;
   count + 1;
   ttlval = ttlval + value;
   IF lastrec  THEN
      avg = ttlval / count;
RUN;
```

Temporary variable *lastrec*

Initialized to 0

Set to 1 when the SET statement processes its last observation.

Set-Merge-Update SET statement

All of the examples to this point have sequentially processed the input data.

It is also possible to read a SAS dataset using *direct access* (also known as *random access*).

Set-Merge-Update SET statement

Reading a SAS dataset using Direct Access:

```
DATA  newdata;
  DO rec=2 TO maxrec BY 2;
    SET olddata1  POINT=rec
        NOBS=maxrec;
    OUTPUT;
  END;
  STOP;
RUN;
```

Let's take a closer look at the arguments in this example.

Set-Merge-Update SET statement

```
DATA  newdata;
  DO rec=2 TO maxrec BY 2;
    SET olddata1  POINT=rec   ①
        NOBS=maxrec;          ②
    OUTPUT;
  END;
  STOP;
RUN;
```

① Reads the observation number corresponding to the <u>temporary</u> variable *rec*.

② Determines the total number of observations in olddata1, and stores that value in <u>temporary</u> variable *maxrec*.

Set-Merge-Update SET statement

```
DATA  newdata;
  DO rec=2 TO maxrec BY 2;
    SET olddata1  POINT=rec      ①
        NOBS=maxrec;             ②
    OUTPUT;                      ③
  END;
  STOP;                          ④
RUN;
```

③ An OUTPUT statement is necessary in this example.

④ A STOP statement is necessary whenever you use the POINT= option.

WHY?

Set-Merge-Update SET statement

Let us look at some assorted examples that really exercise the SET statement …

Set-Merge-Update SET statement

Determining and using NOBS without executing SET statement.

```
DATA  _NULL_;
  IF cnt > 100000 THEN
    PUT 'Big Dataset!';
  STOP;
  SET  dataset  NOBS=cnt;
RUN;
```

The STOP statement stops further execution – before SET statement executes. BUT, value of variable `cnt` *is* determined.

Set-Merge-Update SET statement

Initializing constants at the beginning of a job:

```
DATA  newdata;
  IF _N_ = 1  THEN  DO;
    RETAIN  k1-k5;
    SET  konstant;
  END;
  SET fulldata;
  /* more statements follow */
```

Note that *konstant* is only read once - at the beginning of the DATA step.

The RETAIN statement holds the variables values for subsequent obs.

Set-Merge-Update SET statement

Using multiple SET statements against the same dataset:

```
DATA  newdata;
  SET family;
  IF  peoplect > 1  THEN
    DO  I = 2 TO peoplect;
      SET  family;
    END;
/* code snipped here */
```

Set-Merge-Update SET statement

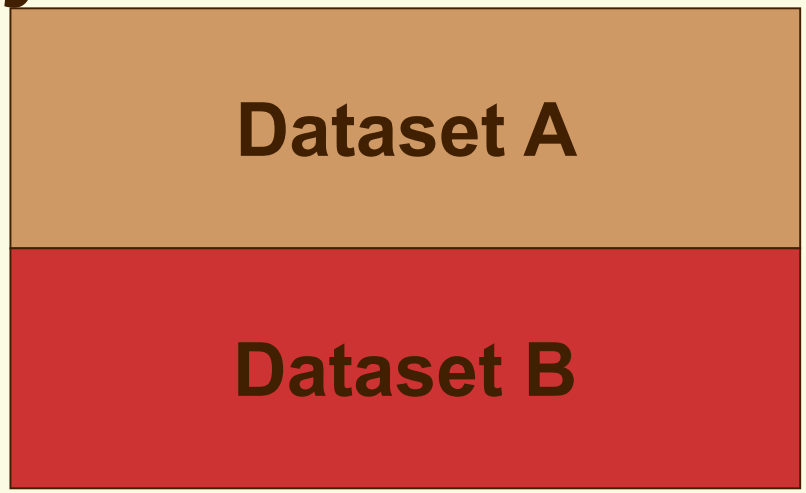
Using the contents of one dataset to process another:

```
DATA  newdata;
  SET parent;
  IF  married = 'Y'  THEN
    SET  spouse;
  IF  childct > 1  THEN
    DO  I = 1 TO childcnt;
      SET  children;
    END;
/* code snipped here */
```

Can you find the flaw in this logic?

Set-Merge-Update SET statement

A single SET statement combines two or more SAS datasets *vertically*.



Set-Merge-Update SET statement

This is true even when a BY statement is used to interleave records.

A-1
B-1
B-2
A-2
A-3
A-4
B-3
A-5
B-4
B-5

Set-Merge-Update SET statement

Multiple SET statements can combine SAS datasets *horizontally*.

A-1	B-1
A-2	B-2
A-3	B-3
A-4	B-4
A-5	B-5

This is known as *One-to-One Reading*.

Set-Merge-Update SET statement

WARNING: Multiple SET statements can produce undesirable results!

For one thing, the coding can be cumbersome. For another, processing stops once the <u>smallest</u> dataset has reached the End of File.

There is an easier way …

Set-Merge-Update MERGE statement

The MERGE statement, according to the manual, "… joins corresponding observations from two or more SAS datasets into single observations in a new SAS dataset."

Set-Merge-Update MERGE statement

The simplest example – *One-to-One Merging*

```
DATA  newdata;
   MERGE olddata1 olddata2;
RUN;
```

This routine takes the 1st record in *olddata1* and the first record in *olddata2*, and joins them together into a single record in *newdata*. This is repeated for the 2nd records in each dataset, the 3rd records, etc.

Set-Merge-Update MERGE statement

One-to-One Merging is generally safer than One-to-One Reading - but not safe enough in most instances.

For example, the files must be pre-arranged to be in the correct order and to have a one-to-one match on each record.

There is a safer way …

Set-Merge-Update MERGE statement

Match-Merging **combines observations based on a common variable(s):**

```
DATA  newdata;
   MERGE olddata1 olddata2;
   BY  keyvar(s) ;
RUN;
```

Set-Merge-Update MERGE statement

Match-Merging continued …

```
DATA  newdata;
   MERGE olddata1 olddata2;
   BY keyvar(s) ;
RUN;
```

Both datasets must be sorted by *keyvar(s)*. The MERGE statement will properly handle one-to-one, one-to-many, and many-to-one matches.

Set-Merge-Update MERGE statement

Match-Merging continued …

Data1

A
B
C
C

Data2

A
B
B
C

1-1 ("A"), 1-many ("B"), and many-1 merges ("C") within the same datasets.

Set-Merge-Update MERGE statement

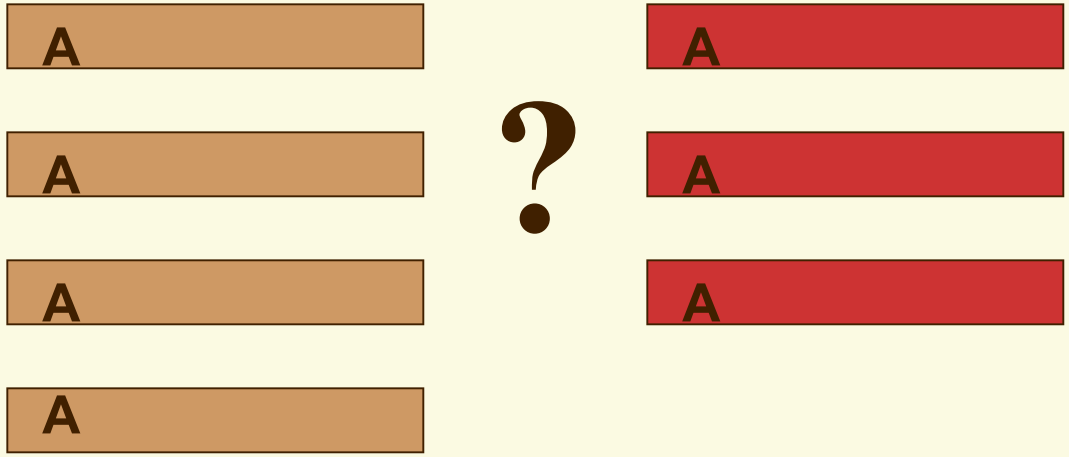
Match-Merging continued …

Data1	Data2
A	A
B	B
B	B
C	C
C	C

1-1 ("A"), 1-many ("B"), and many-1 merges ("C") within the same datasets.

Set-Merge-Update MERGE statement

Match-Merging **cannot be used to address many to many merges.**



Set-Merge-Update MERGE statement

Example: Using MERGE to perform conditional processing.

```
DATA newdata;
 MERGE olddata1(IN=in_old1)
       olddata2(IN=in_old2);
 IF in_old1 & in_old2  THEN both_cnt + 1;
 IF in_old1 & ¬in_old2 THEN old_only + 1;
 IF ¬in_old1 & in_old2 THEN new_only + 1;
 IF ¬in_old1 & ¬in_old2 THEN  no_cnt + 1;
```

Set-Merge-Update MERGE statement

Example: Using MERGE to perform conditional processing.

```
DATA newdata;
 MERGE olddata1(IN=in_old1)
       olddata2(IN=in_old2);
 IF in_old1 & in_old2  THEN both_cnt + 1;
 IF in_old1 & ¬in_old2 THEN old_only + 1;
 IF ¬in_old1 & in_old2 THEN new_only + 1;
```

~~IF ¬in_old1 & ¬in_old2 THEN no_cnt + 1;~~

Why is this statement unnecessary?

Set-Merge-Update MERGE statement

Useful dataset options to use with the SET and MERGE statements …

***dsname*(IN=*variable*)**

specifies a <u>temporary</u> True/False variable.

***dsname*(WHERE=(*condition*))**

limits the incoming records to only those meeting the specified condition.

(These two options were mentioned earlier today.)

Set-Merge-Update MERGE statement

Useful dataset options to use with the SET and MERGE statements …

***dsname*(FIRSTOBS=*number*)**
starts processing at the specified observation.

***dsname*(OBS=*number*)**
stops processing at the specified observation.

Set-Merge-Update MERGE statement

Useful dataset options to use with the SET and MERGE statements …

dsname(RENAME=*(oldname1=newname1)*)
changes the name of a variable.

This is especially useful when combining datasets that have variables with the same name.

Set-Merge-Update UPDATE statement

The UPDATE statement is similar to the MERGE statement. However, according to the manual, "… the UPDATE statement performs the special function of updating master file information by applying transactions …"

Set-Merge-Update UPDATE statement

Differences between the UPDATE and MERGE statements:

UPDATE can only process *two* SAS datasets at a time - *Master* and *Transaction*. MERGE can process *three or more* SAS datasets.

Set-Merge-Update UPDATE statement

Differences between the UPDATE and MERGE statements:

The BY statement is *required* with UPDATE, but is *optional* with MERGE. (However, it is *very* common to employ a BY statement with MERGE.)

Set-Merge-Update UPDATE statement

Differences between the UPDATE and MERGE statements:

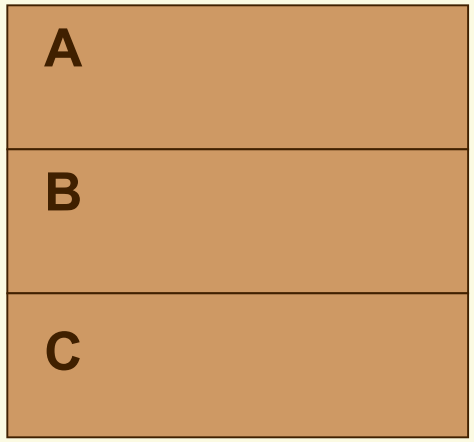
UPDATE can only process 1 record per unique BY group value in the Master dataset.

UPDATE *can* process multiple records in the Transaction dataset. However, they will be overlaying the same Master record - they may be canceling themselves out.

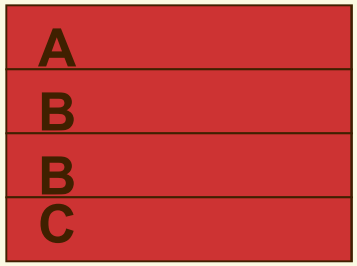
Set-Merge-Update UPDATE statement

Depicted graphically:

Master



Transaction

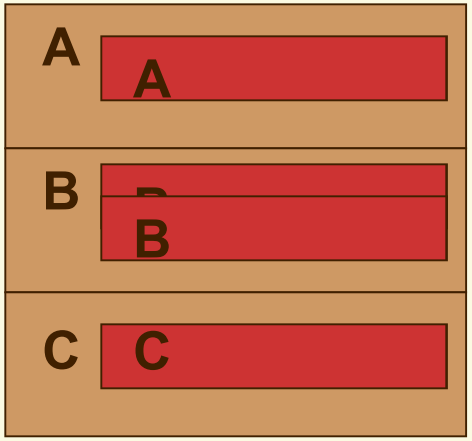


Set-Merge-Update UPDATE statement

Depicted graphically:

Master Transaction

UPDATE



Set-Merge-Update UPDATE statement

UPDATE is easy to code:

```
DATA  newdata;
   UPDATE olddata1 olddata2;
   BY  keyvar(s) ;
RUN;
```

The only difference in basic syntax between MERGE and UPDATE is the actual word "UPDATE".

Set-Merge-Update UPDATE statement

The true utility of the UPDATE statement is best demonstrated by examining the data - BEFORE and AFTER executing UPDATE:

Set-Merge-Update UPDATE statement

UPDATE example - data:

SAS Dataset: MASTER

OBS	KEY1	UPDT1	UPDT2
1	AB	1001	2
2	BC	1002	4
3	MB	1003	8
4	NS	1004	16

SAS Dataset: XACTION

OBS	KEY1	UPDT1	UPDT2	NEW3
1	AB	1111	52	A
2	MB	1133	54	
3	MB	2133	.	C
4	NS	.	.	D
5	SK	4555	65	E

UPDATE example - data:

```
SAS Dataset: MASTER
OBS KEY1 UPDT1 UPDT2
 1   AB   1001    2

SAS Dataset: XACTION
OBS KEY1 UPDT1 UPDT2 NEW3
 1   AB   1111   52    A

SAS Dataset: UPDATIT
OBS KEY1 UPDT1 UPDT2 NEW3
 1   AB   1111   52    A
```

changed added
changed

Set-Merge-Update UPDATE statement

UPDATE example - data:

```
SAS Dataset: MASTER
OBS KEY1 UPDT1 UPDT2
 2   BC   1002    4
```

```
SAS Dataset: XACTION
OBS KEY1 UPDT1 UPDT2 NEW3
```

(No corresponding record)

```
SAS Dataset: UPDATIT
OBS KEY1 UPDT1 UPDT2 NEW3
 2   BC   1002    4
```

Record unchanged

Set-Merge-Update
UPDATE statement

UPDATE example - data:

```
SAS Dataset: MASTER
OBS KEY1 UPDT1 UPDT2
 3   MB   1003    8
SAS Dataset: XACTION
OBS KEY1 UPDT1 UPDT2 NEW3
 2   MB   1133   54
 3   MB   2133    .    C
SAS Dataset: UPDATIT
OBS KEY1 UPDT1 UPDT2 NEW3
 3   MB   1133   54
```

changed missing
changed

Set-Merge-Update UPDATE statement

UPDATE example - data:

```
SAS Dataset: MASTER
OBS KEY1 UPDT1 UPDT2
 3   MB   1003    8
SAS Dataset: XACTION
OBS KEY1 UPDT1 UPDT2 NEW3
 2   MB   1133   54
 3   MB   2133    .    C
SAS Dataset: UPDATIT
OBS KEY1 UPDT1 UPDT2 NEW3
 3   MB   2133   54    C
```

changed changed

Left alone

Set-Merge-Update UPDATE statement

UPDATE example - data:

```
SAS Dataset: MASTER
OBS KEY1 UPDT1 UPDT2
 4   NS   1004   16
SAS Dataset: XACTION
OBS KEY1 UPDT1 UPDT2 NEW3
 4   NS      .     .    D

SAS Dataset: UPDATIT
OBS KEY1 UPDT1 UPDT2 NEW3
 4   NS   1004   16    D
```

Left alone added

Left alone

Set-Merge-Update
UPDATE statement

UPDATE example - data:

```
SAS Dataset: MASTER
OBS KEY1 UPDT1 UPDT2
```

(No corresponding record)

```
SAS Dataset: XACTION
OBS KEY1 UPDT1 UPDT2 NEW3
 5   SK   4555   65    E
```

```
SAS Dataset: UPDATIT
OBS KEY1 UPDT1 UPDT2 NEW3
 5   SK   4555   65    E
```

Record added

Set-Merge-Update UPDATE statement

UPDATE example - data:

SAS Dataset: MASTER

OBS	KEY
1	AB
2	BC
3	MB
4	NS

SAS Dataset: UPDATIT

OBS	KEY1	UPDT1	UPDT2	NEW3
1	AB	1111	52	A
2	BC	1002	4	
3	MB	2133	54	C
4	NS	1004	16	D
5	SK	4555	65	E

XACTION

			DT2	NEW3
			52	A
			54	
			.	C
4	NS	.	.	D
5	SK	4555	65	E

Set-Merge-Update UPDATE statement

Question: What if you *want* to update your Master dataset with missing values?

Answer: Use the `MISSING` statement to define special missing values.

Set-Merge-Update ^ *modify*

The `MODIFY` statement, introduced back in Version 6.07, "… extends the capabilities of the DATA step, enabling you to manipulate a SAS data set in place without creating an additional copy," according to the 6.07 Changes & Enhancements Report.

Set-Merge-Update ^ MODIFY

The MODIFY statement, when used with a BY statement, is like an UPDATE statement

… except neither the Master dataset nor the Transaction dataset needs to be sorted or indexed. (*1)

Set-Merge-Update ^ MODIFY

The `MODIFY` statement, when used with a BY statement, is like an UPDATE statement

… except both the Master and Transaction datasets can have duplicate BY values. (*2)

Set-Merge-Update ^ modify

The `MODIFY` statement, when used with a BY statement, is like an UPDATE statement

… except it cannot add variables to the dataset.

SET-MERGE-UPDATE

MODIFY

The MODIFY [illegible]nt, when us[illegible]ment, is ar[illegible]nt

Set-Merge-Update ^ MODIFY

(*1) Failure to sort your datasets prior to a MODIFY/BY statement combination could result in excessive processing overhead

Set-Merge-Update ^ modify

(*2) The processing rules for duplicate BY values depend on whether those values are consecutive.

Set-Merge-Update ^ MODIFY

"Damage to the SAS data set can occur if the system terminates abnormally during a DATA st containing the MODIFY statement."

Set-Merge-Update ^ MODIFY

The MODIFY statement can also be used via Sequential (Random) access, similar to a SET statement with the POINT= option.

Set-Merge-Update ^ MODIFY

You could go to the 6.07 Changes and Enhancements report – if you can find one! (*Check in my attic!*)

Better yet, go to the Version 9 online documentation for more information and examples using the MODIFY statement.

Set-Merge-Update Related Material

PROC SQL

SELECT / FROM similar to SET

SELECT / FROM / JOIN similar to MERGE

Set-Merge-Update Conclusion

The presentation was a *brief* introduction to SET, MERGE, and UPDATE.

In-depth details on options available for each command can be found in the manual(s).

Set-Merge-Update Conclusion

Hands-on experimentation will increase your comprehension.

Even your mistakes can provide a much better education for you than anything I presented – provided you learn from them.

Set-Merge-Update Conclusion

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Set-Merge-Update

Andy's Final Thought

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My lawyer →