

The Utter “Simplicity?” of the TABULATE Procedure - The Final Chapter?

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IN THE BEGINNING

Well, here we are again TABULATE fans. I believe I have exhausted this topic (to DEATH some folks say), so I thought I would put it to rest in this FINAL CHAPTER with a paper on the truly advanced features of the TABULATE procedure. The problem is these advanced features are anything but simple. In this tutorial we look at some simpler advanced features, like FORMCHAR, column and row titling, and formatting, and then the one that is really a bear to understand – percentages (PCTN and PCTSUM). Some of the new Version 8 features will also be covered.

The output from a CONTENTS procedure below is just so you know a little about the dataset we will be working with.

CONTENTS PROCEDURE						
Data Set Name:	SASDATA.CLASS				Observations:	27
Member Type:	DATA				Variables:	5
Engine:	V60x				Indexes:	0
Created:	9:14 Wednesday, Sep 19				Observation Length:	48
Last Modified:	11:40 Tuesday, Feb 5				Deleted Observations:	0
Data Set Type:					Compressed:	NO
					Reuse Space:	NO
-----Alphabetic List of Variables and Attributes-----						
#	Variable	Type	Len	Pos	Format	Label

4	DATE	Num	8	32	DATE5.	Class Date
2	LOC	Char	1	25		Location
1	NAME	Char	25	0		
3	ORG	Char	6	26		Org
5	SCORE	Num	8	40	5.1	Final Exam Score

SOME BASICS

Here are few basic examples and their totally different looking outputs by simply changing where and how the variables are coded. If these are beyond your current proficiency with TABULATE, see my Beginning Tutorial paper in the SUGI 16 and 20 proceedings and my Advanced Tutorial paper in the SUGI 21 proceedings and hang on to your hat because I'm starting from here and assuming you understand this much.

```
PROC TABULATE DATA=CLASS ;
  CLASS ORG LOC DATE;
  VAR SCORE;
  TABLE ORG, LOC*SCORE*(N MEAN)*F=5.1;
```

	Location					
	A		B		C	
	Final Exam Score	Final Exam Score	Final Exam Score	Final Exam Score	Final Exam Score	Final Exam Score
	N	MEAN	N	MEAN	N	MEAN
Org						
Energy	4.0	84.4	2.0	96.4	.	.
Mgt S	2.0	73.4	1.0	85.4	7.0	84.8
Power	4.0	89.0	2.0	70.7	3.0	79.8

Here you see a column for the count (N) and mean of SCORE for each location.

```
TABLE ORG*LOC,
  SCORE*(N MEAN MAX PCTN)*F=5.1;
```

		Final Exam Score			
		N	MEAN	MAX	PCTN
Org	Location				
Energy	A	4.0	84.4	93.0	16.0
	B	2.0	96.4	100.0	8.0
Mgt S	A	2.0	73.4	99.4	8.0
	B	1.0	85.4	85.4	4.0
	C	7.0	84.8	98.3	28.0
Power	A	4.0	89.0	99.1	16.0
	B	2.0	70.7	90.0	8.0
	C	3.0	79.8	93.6	12.0

Here are the same numbers from the previous output. Location was simply moved from the column expression to the row expression.

```
TABLE ORG LOC,
  SCORE*(N MEAN MAX PCTN)*F=5.1;
```

		Final Exam Score			
		N	MEAN	MAX	PCTN
Org					
Energy		6	88.4	100.0	24.0
Mgt S		10	82.6	99.4	40.0
Power		9	81.9	99.1	36.0
Location					
A		10	84.0	99.4	40.0
B		5	83.9	100.0	20.0
C		10	83.3	98.3	40.0

Here are two tables in one: the N, MEAN, MAX, and PCTN statistics in the column expression allows you to use the row expression to see a summary by two different variables (ORG and LOC) in one table.

```
TABLE ORG ALL,
  (LOC ALL)*SCORE*(N MEAN)*F=5.1;
```

		Location							
		A		B		C		ALL	
		Final Exam Score	Final Exam Score	Final Exam Score	Final Exam Score	Final Exam Score	Final Exam Score	Final Exam Score	Final Exam Score
		N	MEAN	N	MEAN	N	MEAN	N	MEAN
Org									
Energy		4	84.4	2	96.4	.	.	6	88.4
Mgt S		2	73.4	1	85.4	7	84.8	10	82.6
Power		4	89.0	2	70.7	3	79.8	9	81.9
ALL		10	84.0	5	83.9	10	83.3	25	83.7

What in the world happened in this last example?
There's no variable named ALL in the dataset?

That's right, but ALL is kind of like a built-in class variable that can be specified accumulate totals for the entire row and/or column. In the above example it was used in the row expression to produce a set of totals after the ORG rows. If you placed it before the ORG variable (i.e. ALL ORG) you would get the totals as the first row of the table. The use of ALL in the column expression caused it to produce a column after the LOC columns. Also notice since it was grouped with LOC and then nested, the column contains the totals for all locations using the same statistics.

You may not be able to tell from this example, but TABULATE computes true statistics (i.e. MEAN above). That means it **DOES NOT** add-up the means from the tables and then divide by the number of table entries; it accumulates each observations value and divides by the number of observations.

TITLES AND LABELS

You can see that to have TABULATE put descriptive titles or labels for the variables you simply need to assign meaningful labels to them. You can either do this in earlier steps that create the dataset or with a LABEL statement in the PROC step. But what about the statistics and ALL? Simply attach a descriptive label to ANY variable or statistic right in the TABLE statement. Follow it with an equals sign (=) and a quoted label ('This is a Label') just like you do in a LABEL statement. Or if you want to use a certain label for every use of the statistic, use the KEYLABEL statement which looks exactly like the LABEL statement except you use the statistic's name instead of a variable name. Here is an example of doing both.

```
TABLE
  ORG ALL,
  (LOC ALL='Row Totals')
  *SCORE*(N MEAN)*F=5.1
/ BOX='SESUG 2K';
KEYLABEL
  N='Count'
  MEAN='Mean'
  ALL='Total' ;
```

SESUG 2K	Location							
	A				B			
	Final Exam		Final Exam		Final Exam		Final Exam	
Department	Score		Score		Score		Score	
	Count	Avg	Count	Avg	Count	Avg	Count	Avg
	Row Totals		Row Totals		Row Totals		Row Totals	
Energy	4	84.4	2	96.4	.	.	6	88.4
Mgt S	2	73.4	1	85.4	7	84.8	10	82.6
Power	4	89.0	2	70.7	3	79.8	9	81.9
Total	10	84.0	5	83.9	10	83.3	25	83.7

The above example has another tables option specified (BOX=) that specifies what to put in the upper-left corner box of the table.

In the following example we added the MISSING and NOSEPS options to the PROC statement to have TABULATE treat missing values as a valid category (which it does not do by default) and remove the separation lines between the rows. I also specified some table options: BOX=SCORE to label the upper-left box with the SCORE variable's label; and MISSTEXT='None' to label missing values in the tables with the text 'None' instead of the standard period.

```
PROC TABULATE DATA=CLASS
  MISSING NOSEPS ;
  CLASS ORG LOC DATE;
  VAR SCORE;
/*  TITLES & LABELS */
TABLE
  ORG ALL='--- Totals ---',
  (LOC ALL='Row Totals')
  *(SCORE*MEAN=' '*F=5.1)
/ BOX=SCORE ROW=FLOAT
  MISSTEXT='None' ;
```

Final Exam Averages	Location				Row
	A				Tota-
	Final Exam		Final Exam		ls
Department	Exam		Exam		Exam
	Aver-		Aver-		Aver-
	ages		ages		ages
Energy	None	None	None	None	None
Mgt S	None	84.4	96.4	None	88.4
Power	None	73.4	85.4	84.8	82.6
--- Totals ---	None	89.0	70.7	79.8	81.9

Notice that since the MEAN label was blank and the ROW=FLOAT was specified, that no space was wasted for it. Now as one final farewell to labeling, a table that doesn't look like a table.

```
PROC TABULATE DATA=CLASS
  MISSING NOSEPS
  FORMCHAR=' ';
  CLASS ORG LOC DATE;
  VAR SCORE;
TABLE
  ORG ALL='--- Totals ---',
  (LOC ALL='Row Totals')
  *(SCORE=' '*MEAN=' '*F=6.1)
/ BOX=SCORE ROW=FLOAT
  MISSTEXT='None' ;
```

Final Exam Averages	Location				Dept
	A				Totals
	Final Exam		Final Exam		Exam
Department	Score		Score		Score
	Count		Count		Count
	Avg		Avg		Avg
Energy	None	84.4	96.4	None	88.4
Mgt S	None	73.4	85.4	84.8	82.6
Power	None	89.0	70.7	79.8	81.9
--- Totals ---	None	84.0	83.9	83.3	83.7

By simply adding the FORMCHAR= option to the PROC statement and specifying 16 blanks, you remove all the lines from around the table. If you have access to a laser printer you can also use characters that form "solid" lines around your table. This example is the specification needed on an OS/390 mainframe (MVS).

```
PROC TABULATE DATA=CLASS
  MISSING NOSEPS
  FORMCHAR='FABFACCCBCEB8FECABCB
  BB4E7E4F60AFE04C6E40'X ;
  CLASS ORG LOC DATE;
  VAR SCORE;
TABLE
  ORG ALL='--- Totals ---',
  (LOC ALL='Row Totals')
  *(SCORE=' '*MEAN=' '*F=6.1)
/ BOX=SCORE ROW=FLOAT
  MISSTEXT='None' ;
```

SUBTOTALING

The only real trick to doing subtotaling is the nesting of ALL in the row expression.

TABLE

```
ORG*(LOC ALL='Loc Subtotal') ALL='Org Total',
SCORE='Average Final Exam Score'
*MEAN=' '*F=6.1
/RTS=25 BOX=SCORE
ROW=FLOAT MISSTEXT='None';
```

Final Exam Averages		Avg
Department	Location	
	A	None
	**Subtotal	None
Energy	Location	
		None
	A	84.4
	B	96.4
	**Subtotal	88.4
Mgt S	Location	
	A	73.4
	B	85.4
	C	84.8
	**Subtotal	82.6
Power	Location	
	A	89.0
	B	70.7
	C	79.8
	**Subtotal	81.9
Dept Total		83.7

Above we see the nesting of (LOC ALL) in ORG. That tells TABULATE to concatenate an ALL row after all the LOC rows for each ORG value.

PERCENTAGES

In its simplest form the PCTN or PCTSUM is just another statistic like N or MEAN you can request.

```
PROC TABULATE DATA=CLASS FORMAT=6.1 ;
CLASS ORG LOC DATE;
VAR SCORE;
TABLE ORG, (LOC ALL)*(N*F=3.0 PCTN);
```

Location		A		B		C		ALL	
		N	PCTN	N	PCTN	N	PCTN	N	PCTN
Org									
Energy		6	22.2	2	7.4	.	.	8	29.6
Mgt S		2	7.4	1	3.7	7	25.9	10	37.0
Power		4	14.8	2	7.4	3	11.1	9	33.3

Unless specified, the percentage is computed based on all the observations in the dataset. Notice that the PCTN under the ALL column does not add up to 100 due to rounding.

To specify how the percentage is computed you simply attach a

denominator specification to PCTN or PCTSUM using the inequality signs less-than (<) and greater-than (>). **The real trick to understanding how the denominator specification works is to remember you are telling TABULATE what the denominator is to divide into the N or SUM value, or what you are dividing by.**

TABLE ORG, (LOC ALL)*(N*F=3.0 PCTN<ORG>);

Location		A		B		C		ALL	
		N	PCTN	N	PCTN	N	PCTN	N	PCTN
Org									
Energy		6	50.0	2	40.0	.	.	8	29.6
Mgt S		2	16.7	1	20.0	7	70.0	10	37.0
Power		4	33.3	2	40.0	3	30.0	9	33.3

The above example shows the row expression in the denominator specification. Notice that none of the counts (N) have changed but the PCTN values have because the denominator has changed from the entire dataset (27 observations) to all the observations for ORG within that columns (LOC) value. Observe that since PCTN is nested in LOC that the denominator specification is saying to divide each cell under that location by the total number of observations that are in that location. So why do you specify the row expression? Because that is simply telling TABULATE which number of observations to total. So, in the above example, we see that location A cells are divided by 12, the total of all the ORG observations in that location. For location B, we see each cell is divided by 5, the total of all the ORG observations in that location. And for location C, we see each cell is divided by 10, the total of all the ORG observations in that location. And for the ALL column we see each cell is divided by the total of all the ORG observations in all the locations.

Here is a handy rule-of-thumb:

**To get percentages by column, use the row expression;
to get percentages by row, use the column expression.**

TABLE ORG,
(LOC ALL)*(N*F=3.0 PCTN<LOC ALL>);

Location		A		B		C		ALL	
		N	PCTN	N	PCTN	N	PCTN	N	PCTN
Org									
Energy		6	75.0	2	25.0	.	.	8	100.0
Mgt S		2	20.0	1	10.0	7	70.0	10	100.0
Power		4	44.4	2	22.2	3	33.3	9	100.0

Notice in the above example that the entire column expression is coded as the denominator specification. If you don't, strange results or even errors can occur. As before, you are simply telling TABULATE which number of observations to total. So, in the above example, we see that organization 'Energy' cells are divided by 8, the total of all the LOC observations in that organization. For organization 'Mgt S' we see each cell is divided by 10, the total of all the LOC observations in that organization. For organization 'Power' we see each cell is divided by 9, the total of all the LOC observations in that organization. And for the ALL column we see each cell is divided by the total of all the LOC observations in that organization, thus the 100 percent.

TABLE ORG,
 (LOC ALL)*SCORE*
 (SUM*F=5.1 PCTSUM<LOC ALL>);

		Location							
		A		B		C		ALL	
		Final Exam Score		Final Exam Score		Final Exam Score		Final Exam Score	
		SUM	PCTSUM	SUM	PCTSUM	SUM	PCTSUM	SUM	PCTSUM
Org	Class								
Energy	Date								
	07APR	1	8.3	.	.	.	.	1	3.7
	03MAY	1	8.3	1	20.0	.	.	2	7.4
	22JUN	1	8.3	.	.	.	.	1	3.7
	12OCT	3	25.0	1	20.0	.	.	4	14.8
Mgt S	07APR	1	8.3	.	.	.	.	1	3.7
	03MAY	.	.	1	20.0	.	.	1	3.7
	22JUN	.	.	.	.	4	40.0	4	14.8
	12OCT	1	8.3	.	.	3	30.0	4	14.8
	07APR	1	8.3	2	40.0	.	.	3	11.1
Power	03MAY	1	8.3	.	.	.	.	1	3.7
	22JUN	1	8.3	.	.	3	30.0	4	14.8
	12OCT	1	8.3	.	.	.	.	1	3.7
	ALL	12	100.0	5	100.0	10	100.0	27	100.0

This example is just to show that the PCTSUM works in the same way. (The summing of exams scores doesn't seem to make much sense, but it is the only numeric variable in the dataset.)

The following examples show that the same rules apply for nesting variables and using ALL.

```
PROC TABULATE DATA=CLASS
  FORMAT=6.1 NOSEPS;
  CLASS ORG LOC DATE;
  VAR SCORE;
  TABLE ORG*DATE,
    (LOC ALL)*(N*F=3.0 PCTN<ORG*DATE>);
```

		Location							
		A		B		C		ALL	
		N	PCTN	N	PCTN	N	PCTN	N	PCTN
Org	Class								
Energy	Date								
	07APR	1	8.3	.	.	.	.	1	3.7
	03MAY	1	8.3	1	20.0	.	.	2	7.4
	22JUN	1	8.3	.	.	.	.	1	3.7
	12OCT	3	25.0	1	20.0	.	.	4	14.8
Mgt S	07APR	1	8.3	.	.	.	.	1	3.7
	03MAY	.	.	1	20.0	.	.	1	3.7
	22JUN	.	.	.	.	4	40.0	4	14.8
	12OCT	1	8.3	.	.	3	30.0	4	14.8
	07APR	1	8.3	2	40.0	.	.	3	11.1
Power	03MAY	1	8.3	.	.	.	.	1	3.7
	22JUN	1	8.3	.	.	3	30.0	4	14.8
	12OCT	1	8.3	.	.	.	.	1	3.7

TABLE ORG*DATE,
 (LOC ALL)*(N*F=3.0 PCTN<LOC ALL>);

		Location							
		A		B		C		ALL	
		N	PCTN	N	PCTN	N	PCTN	N	PCTN
Org	Class								
Energy	Date								
	07APR	1	100.0	.	.	.	.	1	100.0
	03MAY	1	50.0	1	50.0	.	.	2	100.0
	22JUN	1	100.0	.	.	.	.	1	100.0
	12OCT	3	75.0	1	25.0	.	.	4	100.0
Mgt S	07APR	1	100.0	.	.	.	.	1	100.0
	03MAY	.	.	1	100.0	.	.	1	100.0
	22JUN	.	.	.	.	4	100.0	4	100.0
	12OCT	1	25.0	.	.	3	75.0	4	100.0
	07APR	1	33.3	2	66.7	.	.	3	100.0
Power	03MAY	1	100.0	.	.	.	.	1	100.0
	22JUN	1	25.0	.	.	3	75.0	4	100.0
	12OCT	1	100.0	.	.	.	.	1	100.0

TABLE ORG*DATE ALL,
 (LOC ALL)*
 *(N*F=3.0 PCTN<ORG*DATE ALL>);

		Location							
		A		B		C		ALL	
		N	PCTN	N	PCTN	N	PCTN	N	PCTN
Org	Class								
Energy	Date								
	07APR	1	8.3	.	.	.	.	1	3.7
	03MAY	1	8.3	1	20.0	.	.	2	7.4
	22JUN	1	8.3	.	.	.	.	1	3.7
	12OCT	3	25.0	1	20.0	.	.	4	14.8
Mgt S	07APR	1	8.3	.	.	.	.	1	3.7
	03MAY	.	.	1	20.0	.	.	1	3.7
	22JUN	.	.	.	.	4	40.0	4	14.8
	12OCT	1	8.3	.	.	3	30.0	4	14.8
	07APR	1	8.3	2	40.0	.	.	3	11.1
Power	03MAY	1	8.3	.	.	.	.	1	3.7
	22JUN	1	8.3	.	.	3	30.0	4	14.8
	12OCT	1	8.3	.	.	.	.	1	3.7
	ALL	12	100.0	5	100.0	10	100.0	27	100.0

The same rules apply for denominator specifications that are NOT the entire expression.

TABLE ORG*DATE,
 (LOC ALL)*(N*F=3.0 PCTN<DATE>);

		Location							
		A		B		C		ALL	
		N	PCTN	N	PCTN	N	PCTN	N	PCTN
Org	Class								
Energy	Date								
	07APR	1	16.7	.	.	.	.	1	12.5
	03MAY	1	16.7	1	50.0	.	.	2	25.0
	22JUN	1	16.7	.	.	.	.	1	12.5
	12OCT	3	50.0	1	50.0	.	.	4	50.0
Mgt S	07APR	1	50.0	.	.	.	.	1	10.0
	03MAY	.	.	1	100.0	.	.	1	10.0
	22JUN	.	.	.	.	4	57.1	4	40.0
	12OCT	1	50.0	.	.	3	42.9	4	40.0
	07APR	1	25.0	2	100.0	.	.	3	33.3
Power	03MAY	1	25.0	.	.	.	.	1	11.1
	22JUN	1	25.0	.	.	3	100.0	4	44.4
	12OCT	1	25.0	.	.	.	.	1	11.1

With the denominator specification of DATE, TABULATE will use the total number of observations for all dates in that column as the denominator. But since DATE is nested within ORG, it will only use those observations that belong to that ORG. So, in the above example the total number of observations for location A in ORG Energy is 6, which becomes the denominator for computing PCTN for all those dates. You can also see the total number of observations for location B in ORG 'Mgt S' is 1, which becomes the denominator for computing PCTN for all those dates, thus the 100 percent on 03MAY. The total number of observations for the ALL column in ORG 'Power' is 9, which becomes the denominator for computing PCTN for all those dates.

TABLE ORG*DATE,
 (LOC ALL)*(N*F=3.0 PCTN<ORG>);

		Location							
		A		B		C		ALL	
		N	PCTN	N	PCTN	N	PCTN	N	PCTN
Org	Class								
Energy	Date								
	07APR	1	33.3	.	.	.	.	1	20.0
	03MAY	1	50.0	1	50.0	.	.	2	50.0
	22JUN	1	50.0	.	.	.	.	1	11.1
	12OCT	3	60.0	1	100.0	.	.	4	44.4
Mgt S	07APR	1	33.3	.	.	.	.	1	20.0
	03MAY	.	.	1	50.0	.	.	1	25.0
	22JUN	.	.	.	.	4	57.1	4	44.4
	12OCT	1	20.0	.	.	3	100.0	4	44.4
	07APR	1	33.3	2	100.0	.	.	3	60.0
Power	03MAY	1	50.0	.	.	.	.	1	25.0
	22JUN	1	50.0	.	.	3	42.9	4	44.4
	12OCT	1	20.0	.	.	.	.	1	11.1

With the denominator specification of ORG, TABULATE will use

the total number of observations for all organizations in that column as the denominator. But since ORG is nested with DATE, it will only use those observations that belong to that DATE. So, in the above example the total number of observations for location A with a date of 07APR is 3, which becomes the denominator for computing PCTN for that date in every ORG in that location, thus the 33.3 percent for each one with a count of 1. The total number of observations for location A with a date of 12OCT is 5, which becomes the denominator for computing PCTN for that date in every ORG in that location, thus the 20 percent for each one with a count of 1. The total number of observations for location B with a date of 03MAY is 2, which becomes the denominator for computing PCTN for that date in every ORG in that location, thus the 50 percent for each one with a count of 1. The total number of observations for the ALL column with a date of 03MAY is 4, which becomes the denominator for computing PCTN for that date in every ORG, thus the 25 percent for each one with a count of 1.

The ALL in the denominator specification gave me a real hard time at first until I discovered it is really only needed to satisfy the table expression expansion. Typically ALL is used to do some sort of totaling and is thus concatenated not nested. So, all (ha! ha!) you have to do is include it in your denominator as shown below.

TABLE ORG*DATE ALL,
(LOC ALL)*(N*F=3.0 PCTN<ORG ALL>);

		Location							
		A		B		C		ALL	
		N	PCTN	N	PCTN	N	PCTN	N	PCTN
Org	Class								
Energy	Date								
	07APR	1	33.3	.	.	.	.	1	20.0
	03MAY	1	50.0	1	50.0	.	.	2	50.0
	22JUN	1	50.0	.	.	.	.	1	11.1
Mgt S	12OCT	3	60.0	1	100.0	.	.	4	44.4
	07APR	1	33.3	.	.	.	.	1	20.0
	03MAY	.	.	1	50.0	.	.	1	25.0
	22JUN	.	.	.	.	4	57.1	4	44.4
Power	12OCT	1	20.0	.	.	3	100.0	4	44.4
	07APR	1	33.3	2	100.0	.	.	3	60.0
	03MAY	1	50.0	.	.	.	.	1	25.0
	22JUN	1	50.0	.	.	3	42.9	4	44.4
ALL	12OCT	1	20.0	.	.	.	.	1	11.1
		12	100.0	5	100.0	10	100.0	27	100.0

If you leave it out of the denominator specification, you will get the messages:

ERROR: PCTN base is not in table.
ERROR: A PCTN crossing has no denominator.

Where the ALL gets real complicated is when you nest the ALLs in groupings, then you will need to expand the "crossings" as the SAS manuals indicate to be sure you get the proper denominator.

To get a better feel for the use of percentages, let's use the subtotalling example from earlier and add a subtotal percentage.

TABLE
ORG*(LOC ALL='Loc Subtotal') ALL='Org Total',
SCORE*(SUM*F=6.1 PCTSUM<LOC ALL>)
/ RTS=25 BOX=SCORE
ROW=FLOAT MISSTEXT='None';

		Final Exam Score	
		SUM	PCTSUM
Org	Location		
Energy	A	337.6	63.7
	B	192.8	36.3
	Loc		
	Subtotal	530.4	100.0
Mgt S	Location		
	A	146.7	17.8
	B	85.4	10.3
	C	593.5	71.9
Power	Loc		
	Subtotal	825.6	100.0
	Location		
	A	356.2	48.3
	B	141.3	19.2
	C	239.4	32.5
	Loc		
	Subtotal	736.9	100.0
Org Total		2092.9	100.0

VERSION 8 FEATURES

Until I can fully understand (and try!) all the new features of TABULATE in version 8, I will only discuss some of the more interesting ones here. Following are most of the new features. Many of them are in response to the SASware Ballot.

The PROC TABULATE statement supports these new options:

- CLASSDATA= - specifies a data set that contains the combinations of class variable values to include in analysis.
- CONTENTS= - allows you to name the link in the HTML table of contents that points to the ODS output of the first table produced.
- EXCLNPWGT - excludes observations with nonpositive weights from the analysis.
- EXCLUSIVE - excludes from the analysis all class variable combinations that are not in the CLASSDATA= data set.
- NOTRAP - disables trapping mathematical errors due to overflow.
- OUT= - names the output data set.
- QMARKERS= - specifies the default number of markers to use for the P2 (fixed space) quantile estimation method.
- QMETHOD - specifies the method to process the input data to compute quantiles.
- QNTLDEF= - specifies the mathematical definition used to compute quantiles.
- TRAP - enables trapping mathematical errors due to overflow.

TABULATE now supports multiple CLASS statements and the following new options:

- ASCENDING - specifies to sort the class variable levels in ascending order.
- DESCENDING - specifies to sort the class variable levels in descending order.
- EXCLUSIVE - excludes from the analysis all class variable values that are not found in the preloaded range of user-defined formats.
- GROUPINTERNAL - specifies not to apply formats to the class variables when TABULATE sorts the values to create combinations of class variables.
- MISSING - considers missing values as valid class variable levels.
- MLF - enables TABULATE to use the primary and secondary format labels for a given range or overlapping ranges to create the subgroup combinations when a multilabel format is assigned to a class variable.
- ORDER= - specifies the sort order for the levels of the class variables in the output.
- PRELOADFMT - specifies to preload all the formats for the

- MLF - allows you to make use of multiple labels when a multilabel format is assigned to a class variable in PROC FORMAT.

In the TABLE statement, the following options have been enhanced:

- CONDENSE - prints multiple logical pages on a physical page.
- CONTENTS= - allows you to name the link in the HTML table of contents that points to the ODS output of the table produced using the TABLE statement.
- NOCONTINUED - suppresses the printing of the "(Continued)" continuation message for tables that span physical pages.

- COLPCNT
- COLPCTSUM
- MEDIAN
- P1
- P5
- P10
- P90
- P95
- P99
- PAGEPCTN
- PAGEPCTSUM
- Q1
- Q3
- QRANGE
- REPPCTN
- REPPCTSUM
- ROWPCTN
- ROWPCTSUM

```
PROC TABULATE DATA=CLASS OUT=CLASSOUT
    FORMAT=5.1 NOSEPS;
    CLASS ORG LOC DATE;
    VAR SCORE;
    TABLE ORG*DATE all,
    SCORE*(LOC ALL)*(N*F=2. MEDIAN*F=5.1
    COLPCTN*F=3. REPPCTN*F=3. )
    / RTS=15 CONDENSE NOCONTINUED ;
RUN;
```

		Final Exam Score													
		Location													
		A				B				C				All	
		Medi-	Co-	Re-		Medi-	Co-	Re-		Medi-	Co-	Re-			
		an	ctN	ctN	N	an	ctN	ctN	N	an	ctN	ctN	N	an	
Org	Class														
Energy	Date														
	03MAY	1	88.9	10	4	1	92.8	20	4	.	.	.	2	90.9	
	22JUN	1	69.9	10	4	.	.	.	.	.	.	.	1	69.9	
	12OCT	2	89.4	20	8	1	100.0	20	4	.	.	.	3	93.0	
Mgt S	07APR	1	99.4	10	4	.	.	.	.	.	.	.	1	99.4	
	03MAY	.	.	.	1	85.4	20	4	.	.	.	.	1	85.4	
	22JUN	.	.	.	.	.	.	.	4	87.7	40	16	4	87.7	
	12OCT	1	47.3	10	4	.	.	.	3	86.8	30	12	4	76.7	
Power	07APR	1	99.1	10	4	2	70.7	40	8	.	.	.	3	90.0	
	03MAY	1	93.5	10	4	.	.	.	.	.	.	.	1	93.5	
	22JUN	1	70.1	10	4	.	.	.	3	81.2	30	12	4	75.7	
	12OCT	1	93.5	10	4	.	.	.	.	.	.	.	1	93.5	
All		10	91.0	100	40	5	90.0	100	20	10	84.0	100	40	25	88.9

		Final Exam Score	
		All	
		Co-Rel- ctN p-ctN	
Org Energy	Class Date		
	03MAY	8	8
	22JUN	4	4
Mgt S	12OCT	12	12
	07APR	4	4
	03MAY	4	4
	22JUN	16	16
	12OCT	16	16
Power	07APR	12	12
	03MAY	4	4
	22JUN	16	16
	12OCT	4	4
All		100	100

It is amazing that after all these years of SAS programmers trying....**and trying....and trying** to figure out how to make the @!#\$%^&* TABULATE denominator specification work right, **they make a statistic to do it for you!**

```
PROC CONTENTS DATA=CLASSOUT;  
RUN;
```

```

The CONTENTS Procedure

Data Set Name: SASUSER.CLASSOUT                      Observations:    31
Member Type:   DATA                                  Variables:       10
Engine:        V8                                      Indexes:         0
Created:       8:53 Friday, October 13, 2000          Observation Length: 72
Last Modified: 8:53 Friday, October 13, 2000          Deleted Observations: 0
Protection:                                         Compressed:      NO
Data Set Type:                                     Sorted:          NO
Label:

-----Alphabetic List of Variables and Attributes-----
#   Variable              Type    Len    Pos    Format    Label
-----
5   _PAGE_                Num      8      8                Page for Observation
6   _TABLE_               Num      8      16               Table for Observation
4   _TYPE_                Char     3     63                Type of Observation
3   DATE_                 Num      8      0   DATE.          Class Date
2   LOC                   Char     1     62               Location
1   ORG                   Char     6     56                Org
8   SCORE_Median          Num      8     32
7   SCORE_N               Num      8     24
10  SCORE_PctN_000        Num      8     48
9   SCORE_PctN_010       Num      8     40

```

```
PROC PRINT DATA=CLASSOUT;
RUN;
```

Obs	Org	Class	Date	T	P	A	S	M	P	S
1	Energy	A	03MAY80	111	1	1	1	88.90	10	4
2	Energy	B	03MAY80	111	1	1	1	92.80	20	4
3	Energy	A	22JUN80	111	1	1	1	69.90	10	4
4	Energy	A	12OCT80	111	1	1	2	89.40	20	8
5	Energy	B	12OCT80	111	1	1	1	100.00	20	4
6	Mgt S	A	07APR80	111	1	1	1	99.40	10	4
7	Mgt S	B	03MAY80	111	1	1	1	85.40	20	4
8	Mgt S	C	22JUN80	111	1	1	4	87.65	40	16
9	Mgt S	A	12OCT80	111	1	1	1	47.30	10	4
10	Mgt S	C	12OCT80	111	1	1	3	86.80	30	12
11	Power	A	07APR80	111	1	1	1	99.10	10	4
12	Power	B	07APR80	111	1	1	2	70.65	40	8
13	Power	A	03MAY80	111	1	1	1	93.50	10	4
14	Power	A	22JUN80	111	1	1	1	70.10	10	4
15	Power	C	22JUN80	111	1	1	3	81.20	30	12
16	Power	A	12OCT80	111	1	1	1	93.50	10	4
17	Energy		03MAY80	101	1	1	2	90.85	.	8
18	Energy		22JUN80	101	1	1	1	69.90	.	4
19	Energy		12OCT80	101	1	1	3	93.00	.	12
20	Mgt S		07APR80	101	1	1	1	99.40	.	4
21	Mgt S		03MAY80	101	1	1	1	85.40	.	4
22	Mgt S		22JUN80	101	1	1	4	87.65	.	16
23	Mgt S		12OCT80	101	1	1	4	76.65	.	16
24	Power		07APR80	101	1	1	3	90.00	.	12
25	Power		03MAY80	101	1	1	1	93.50	.	4
26	Power		22JUN80	101	1	1	4	75.65	.	16
27	Power		12OCT80	101	1	1	1	93.50	.	4
28		A	.	010	1	1	10	90.95	100	40
29		B	.	010	1	1	5	90.00	100	20
30		C	.	010	1	1	10	84.00	100	40
31		.	000	1	1	25		88.90	.	100

Multiple CLASS statements give you the ability to specify different options to different variables.

```
PROC TABULATE DATA=CLASS FORMAT=7.1 NOSEPS;
CLASS LOC / DESCENDING ;
CLASS DATE / MISSING ;
CLASS ORG / MISSING;
VAR SCORE;
TABLE ORG*DATE ALL,
(LOC ALL)*(N*F=3.0 COLPCTN);
RUN;
```

		Location							
		C		B		A		All	
		N	ColPctN	N	ColPctN	N	ColPctN	N	ColPctN
Org	Class Date								
Energy	.	.	.	.	.	1	9.1	1	3.8
	03MAY	.	.	1	20.0	1	9.1	2	7.7
	22JUN	.	.	.	.	1	9.1	1	3.8
Mgt S	12OCT	.	.	1	20.0	2	18.2	3	11.5
	07APR	.	.	.	.	1	9.1	1	3.8
	03MAY	.	.	1	20.0	.	.	1	3.8
	22JUN	4	40.0	.	.	.	.	4	15.4
	12OCT	3	30.0	.	.	1	9.1	4	15.4
	07APR	.	.	2	40.0	1	9.1	3	11.5
Power	03MAY	.	.	.	.	1	9.1	1	3.8
	22JUN	3	30.0	.	.	1	9.1	4	15.4
	12OCT	.	.	.	.	1	9.1	1	3.8
All		10	100.0	5	100.0	11	100.0	26	100.0

```
PROC FORMAT ;
VALUE $LOCFMT
'A'='Knoxville'
'B'='Chattanooga'
'C'='Nashville'
'D'='Memphis';
RUN;
```

```
PROC TABULATE DATA=CLASS FORMAT=7.1 NOSEPS;
CLASS LOC / DESCENDING PRELOADFMT;
CLASS DATE / MISSING ;
CLASS ORG / MISSING;
Format loc $locfmt. ;
VAR SCORE;
TABLE ORG*DATE ALL,
(LOC)*(N*F=3.0 COLPCTN)
/ PRINTMISS ;
RUN;
```

		Location							
		Memphis		Nashville		Chattanooga		Knoxville	
		N	ColPctN	N	ColPctN	N	ColPctN	N	ColPctN
Org	Class Date								
	.	.	.	.	0.0	.	0.0	1	9.1
	07APR	.	.	.	0.0	.	0.0	.	0.0
	03MAY	.	.	.	0.0	.	0.0	.	0.0
	22JUN	.	.	.	0.0	.	0.0	.	0.0
	12OCT	.	.	.	0.0	.	0.0	.	0.0
Energy	.	.	.	.	0.0	.	0.0	.	0.0
	07APR	.	.	.	0.0	.	0.0	.	0.0
	03MAY	.	.	.	0.0	1	20.0	1	9.1
	22JUN	.	.	.	0.0	.	0.0	1	9.1
	12OCT	.	.	.	0.0	1	20.0	2	18.2
Mgt S	.	.	.	.	0.0	.	0.0	.	0.0
	07APR	.	.	.	0.0	.	0.0	1	9.1
	03MAY	.	.	.	0.0	1	20.0	.	0.0
	22JUN	.	.	4	40.0	.	0.0	.	0.0
	12OCT	.	.	3	30.0	.	0.0	1	9.1
Power	.	.	.	.	0.0	.	0.0	.	0.0
	07APR	.	.	.	0.0	2	40.0	1	9.1
	03MAY	.	.	.	0.0	.	0.0	1	9.1
	22JUN	.	.	3	30.0	.	0.0	1	9.1
	12OCT	.	.	.	0.0	.	0.0	1	9.1
All		.	.	10	100.0	5	100.0	11	100.0

But what I think is one of the most useful new features of version 8 is ODS. If you get a chance, attend one of Ray Pass's workshops or papers on ODS; they are very well done and very informative. Actually any class or paper on ODS would be useful. Virtually any output SAS can generate can use ODS.

```
ODS html body="e:\sugi\advtabl.html";
PROC TABULATE DATA=CLASS FORMAT=7.1 NOSEPS;
CLASS LOC / DESCENDING ;
CLASS DATE / MISSING ;
CLASS ORG / MISSING;
VAR SCORE;
TABLE ORG*DATE ALL,
(LOC ALL)*(N*F=3.0 COLPCTN);
RUN;
ODS html close;
```

		Location						All	
		C		B		A			
		N	ColPet N	N	ColPet N	N	ColPet N	N	ColPet N
Org	Class Date	.	.	.	.	1	9.1	1	3.8
	.								
Energy	03MAY	.	.	1	20.0	1	9.1	2	7.7
	22JUN	.	.	.	.	1	9.1	1	3.8
	12OCT	.	.	1	20.0	2	18.2	3	11.5
Mgt S	07APR	.	.	.	.	1	9.1	1	3.8
	03MAY	.	.	1	20.0	.	.	1	3.8
	22JUN	4	40.0	.	.	.	.	4	15.4
	12OCT	3	30.0	.	.	1	9.1	4	15.4
Power	07APR	.	.	2	40.0	1	9.1	3	11.5
	03MAY	.	.	.	.	1	9.1	1	3.8
	22JUN	3	30.0	.	.	1	9.1	4	15.4
	12OCT	.	.	.	.	1	9.1	1	3.8
All		10	100.0	5	100.0	11	100.0	26	100.0

IN SUMMARY

I never thought when I first wrote the first version of this in 1992, that it would survive until the next version. Well, it has and versions 7 and 8 have introduced some new features...***So is this really the FINAL CHAPTER?!?! Only time will tell!***

The one thing SAS has done over the years is virtually guarantee code written in prior versions will continue to work in later ones ... upward compatibility. TABULATE is no different; even though some of the new features make old techniques obsolete; it is still good to know them.

This paper is not intended to be a cure for all your TABULATE problems. Every use of TABULATE is unique in some ways. All I have attempted to do is give you a good starting point or foundation to better understand how to get TABULATE to give you what you want. The more complicated your "crossings", as the SAS manuals refer to them, the tougher it is going to be to determine the denominator specification. Most everything else about TABULATE is very straight forward.

So good luck and happy tabulating!!!

ACKNOWLEDGEMENTS

For a complete discussion of TABULATE and its uses see the "SAS Guide to TABULATE Processing, Second Edition" and the "SAS Language and Procedures, Usage, Version 6, First Edition", chapter 25, "Creating Summary Tables". There is a very good article in the first issue of "Observations, The Technical Journal for SAS Software Users", vol. 1, no. 1, entitled "Computing Percentages with PROC TABULATE" by Tina Keene.

Lauren Haworth has written a book entitled "PROC TABULATE By Example" that is full of all kinds of examples for all kinds of applications and well worth the money.

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