Where Does This Where Go?
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ABSTRACT
The clever folks at SAS® have given the user community a variety of ways to accomplish tasks. Being the creative bunch that we are, SAS programmers have yet to tire of discovering and using different paths to get to the same end.

In a typical clinical study (read: ALL) there will be adverse events. Many times, programmers find themselves doing validation on an adverse event table that either they created or was created by someone else. We all know the power of the NODUPKEY option in PROC SORT, and countless experts have forewarned about the dangers that come with its use. For those of us who have heeded those warnings and proceeded with care, it turns out that another danger awaits when using a subsetting WHERE clause in your PROC SORT.

This paper explores the placement of a WHERE statement in a PROC SORT during input and output and how very different the results can be depending on your data.

INTRODUCTION
Programmers are required to check their code for a variety of reasons. How the checking is performed, and who performs it can vary greatly. Often times we find ourselves writing independent code to check the validity of an existing program.

In the clinical world, the task is usually related to number validation, i.e., are the values being produced for the table accurate? When checking the numbers, we usually don’t have to worry about the appearance of the output since the validation program can often use ‘quick and dirty’ techniques to generate the output. A quick sort of the data, a frequency run, and ta-da, numbers are all generated. It usually is that easy, but sometimes…

I encountered some unexpected results when combining PROC SORT with a WHERE clause and the NODUPKEY option. I was checking the numbers for an adverse event table and I thought it was going to be easy. It’s important to note here that, at the time, the table I was checking contained incorrect results. Had the numbers been correct I may never have followed the rabbit down this hole.

PROBLEM
I’ve often said that a programmer’s knowledge of SAS is what’s key, and the data is just data. I’ve used this “theory” in discussion (at times successfully, and other times not so much) to suggest that if your SAS knowledge is strong then you should be able to transfer that working knowledge to virtually any industry, be it pharmaceutical, financial, retail, etc. While I firmly believe that, I also believe that you need to become familiar with the data set(s) involved in your work.

When working with data, it is imperative to have a deep enough understanding so that you are able to process it and get to the desired end. Beyond knowing the variables, their types, lengths and whatnot, it is also very helpful to know how key variables are related and what they mean. In doing so, you are well prepared to define what you expect as the source programmer, or as the validation programmer, to be able to verify if the source programmer reached the desired end. You can then correctly identify issues and work to understand how to fix them. Sometimes (never if your boss is reading this) there may be a syntax error or other misuse that the programmer has introduced to the code, other times (almost always unless you are in data management) there is a problem with the data.

ANATOMY OF THE PROC SORT
The data set I am using to demonstrate the problem consists of a handful of variables from a general adverse event data set. Here’s an example:

```sas
data testae;
  infile datalines dsd;
  input trt pt serious : $char1. aesoc : $char30. aept : $char25. aestart : date7. aestop : date7.;
```
Here’s the listing of the testae dataset:

```
format aestart aestop date7.;
datalines;
1,1001,Y,Gastrointestinal disorders,Nausea,01Jun08,03Jun08
1,1001,N,Gastrointestinal disorders,Nausea,04Jun08,04Jun08
1,1002,N,Gastrointestinal disorders,Stomach pain,01Jun08,02Jun08
1,1002,N,Gastrointestinal disorders,Stomach pain,06Jun08,08Jun08
1,1002,Y,Gastrointestinal disorders,Nausea,01Jun08,02Jun08
1,1002,N,Gastrointestinal disorders,Stomach pain,04Jun08,05Jun08
1,1002,N,Gastrointestinal disorders,Stomach pain,06Jun08,07Jun08
1,1003,N,Gastrointestinal disorders,Nausea,21Jun08,21Jun08
1,1003,N,Gastrointestinal disorders,Nausea,24Jun08,25Jun08
1,1003,N,Gastrointestinal disorders,Nausea,26Jun08,26Jun08
1,1003,Y,Gastrointestinal disorders,Nausea,27Jun08,29Jun08
1,1003,N,Gastrointestinal disorders,Nausea,30Jun08,30Jun08
1,1004,Y,Gastrointestinal disorders,Stomach pain,11Jun08,15Jun08
1,1004,N,Gastrointestinal disorders,Stomach pain,21Jun08,22Jun08
;
run;
```

Table 1. Testae dataset

<table>
<thead>
<tr>
<th>Obs</th>
<th>trt</th>
<th>pt</th>
<th>serious</th>
<th>aesoc</th>
<th>aep</th>
<th>aestart</th>
<th>aestop</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1001</td>
<td>Y</td>
<td>Gastrointestinal disorders</td>
<td>Nausea</td>
<td>01Jun08</td>
<td>03Jun08</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>1001</td>
<td>N</td>
<td>Gastrointestinal disorders</td>
<td>Nausea</td>
<td>04Jun08</td>
<td>04Jun08</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>1002</td>
<td>N</td>
<td>Gastrointestinal disorders</td>
<td>Stomach pain</td>
<td>01Jun08</td>
<td>02Jun08</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>1002</td>
<td>N</td>
<td>Gastrointestinal disorders</td>
<td>Stomach pain</td>
<td>06Jun08</td>
<td>08Jun08</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>1002</td>
<td>Y</td>
<td>Gastrointestinal disorders</td>
<td>Nausea</td>
<td>01Jun08</td>
<td>02Jun08</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>1002</td>
<td>N</td>
<td>Gastrointestinal disorders</td>
<td>Stomach pain</td>
<td>04Jun08</td>
<td>05Jun08</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>1002</td>
<td>N</td>
<td>Gastrointestinal disorders</td>
<td>Stomach pain</td>
<td>06Jun08</td>
<td>08Jun08</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>1003</td>
<td>N</td>
<td>Gastrointestinal disorders</td>
<td>Nausea</td>
<td>21Jun08</td>
<td>21Jun08</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>1003</td>
<td>N</td>
<td>Gastrointestinal disorders</td>
<td>Nausea</td>
<td>24Jun08</td>
<td>25Jun08</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>1003</td>
<td>N</td>
<td>Gastrointestinal disorders</td>
<td>Nausea</td>
<td>26Jun08</td>
<td>26Jun08</td>
</tr>
<tr>
<td>11</td>
<td>1</td>
<td>1003</td>
<td>Y</td>
<td>Gastrointestinal disorders</td>
<td>Nausea</td>
<td>27Jun08</td>
<td>29Jun08</td>
</tr>
<tr>
<td>12</td>
<td>1</td>
<td>1003</td>
<td>N</td>
<td>Gastrointestinal disorders</td>
<td>Nausea</td>
<td>30Jun08</td>
<td>30Jun08</td>
</tr>
<tr>
<td>13</td>
<td>1</td>
<td>1004</td>
<td>Y</td>
<td>Gastrointestinal disorders</td>
<td>Stomach pain</td>
<td>11Jun08</td>
<td>15Jun08</td>
</tr>
<tr>
<td>14</td>
<td>1</td>
<td>1004</td>
<td>N</td>
<td>Gastrointestinal disorders</td>
<td>Stomach pain</td>
<td>21Jun08</td>
<td>22Jun08</td>
</tr>
</tbody>
</table>

Table 1. Testae dataset

I used the DATA=, OUT=, and NODUPKEY options along with the required BY statement. Since I was interested in a particular subset of the data, I also chose to add a WHERE statement to my PROC SORT. I placed the WHERE= option on the input data set.

```
proc sort data=testae(where=(serious='Y')) out=testae_input nodupkey;
by trt pt aesoc;
run;
```

The data looks like this with the above WHERE clause applied:

```
<table>
<thead>
<tr>
<th>Obs</th>
<th>trt</th>
<th>pt</th>
<th>serious</th>
<th>aesoc</th>
<th>aep</th>
<th>aestart</th>
<th>aestop</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1001</td>
<td>Y</td>
<td>Gastrointestinal disorders</td>
<td>Nausea</td>
<td>01Jun08</td>
<td>03Jun08</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>1002</td>
<td>Y</td>
<td>Gastrointestinal disorders</td>
<td>Nausea</td>
<td>01Jun08</td>
<td>02Jun08</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>1003</td>
<td>Y</td>
<td>Gastrointestinal disorders</td>
<td>Nausea</td>
<td>27Jun08</td>
<td>29Jun08</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>1004</td>
<td>Y</td>
<td>Gastrointestinal disorders</td>
<td>Stomach pain</td>
<td>11Jun08</td>
<td>15Jun08</td>
</tr>
</tbody>
</table>
```

Table 2. Testae dataset with WHERE applied to data
A frequency on this data produced these results:

Table 3. Frequency of testae dataset with WHERE applied to data=

<table>
<thead>
<tr>
<th>aesoc</th>
<th>trt</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastrointestinal disorders</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

Since these results did not match to the table that I was trying to validate, I found myself slicing and dicing the data differently to see what the issue might be. One approach I decided to take was to place the WHERE option on the output data set.

```sas
proc sort data=testae out=testae_output(where=(serious='Y')) nodupkey;
  by trt pt aesoc;
run;
```

The data looks like this with the above WHERE clause applied:

Table 4. Frequency of testae dataset with WHERE applied to data=

<table>
<thead>
<tr>
<th>Obs</th>
<th>trt</th>
<th>pt</th>
<th>serious</th>
<th>aesoc</th>
<th>aepst</th>
<th>aestart</th>
<th>aestop</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1001</td>
<td>Y</td>
<td>Gastrointestinal disorders</td>
<td>Nausea</td>
<td>01JUN08</td>
<td>03JUN08</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>1004</td>
<td>Y</td>
<td>Gastrointestinal disorders</td>
<td>Stomach pain</td>
<td>11JUN08</td>
<td>15JUN08</td>
</tr>
</tbody>
</table>

A frequency on this data produced these results:

Table 5. Frequency of testae dataset with WHERE applied to out=

<table>
<thead>
<tr>
<th>aesoc</th>
<th>trt</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastrointestinal disorders</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

What's going on here? The location of the where clause causes SAS to produce different results.

**CONCLUSION**

When the WHERE clause is on the DATA= option, SAS will apply the WHERE first and then do the sort with the NODUPKEY.

When the WHERE clause is on the OUT= option, SAS will do the sort with the NODUPKEY and then apply the WHERE clause.

This seems painfully obvious when presented in this step-by-step illustration of a small sample data set, but when you’re knee-deep in a problem working with a large volume of data, the solution isn’t always as clear as we’d like it to be. Sometimes when you are struggling to validate someone else’s work, it can become quite challenging to wade through your own mistakes. It’s important to be careful and trust your instincts.

**ACKNOWLEDGMENTS**

I would like to thank Rosie Grzebyk for her support in reviewing this paper.
RECOMMENDED READING
Britta Kelsey, “The Mystery of the PROC SORT Options NODUPRECS and NODUPKEY Revealed”.
http://www2.sas.com/proceedings/sugi30/037-30.pdf

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