1 Using formats to get SAS to print something other than the values a variable actually contains.

We will be using the billionaire dataset again today. Its variable called `region` contains abbreviations ("A" for Asia, "E" for Europe, etc.). If we want SAS to print out the complete words instead of the abbreviations, so that tables and graphs are more understandable, we need to run a "proc format" before the data step. The data step must then refer to the formats defined in the format procedure. The `formchar` option is needed when printing tables as we will be doing later in the lab. You can copy it in from the file `formchar.sas` in the Datasets listing.

```sas
options linesize = 75
formchar = |----|+|---+=|-/<>*;
proc format;
  value $regfmt 'A' = 'Asia' 'E' = 'Europe' 'M' = 'Middle East'
    'O' = 'Other' 'U' = 'US';
run;
```

Because the original data values in the region variable are characters rather than numbers, we have to use a dollar sign as the first character in the name of the format.

Note the format statement in the data step below. It tells SAS to apply the format you have defined here to a particular variable. When you use the format statement in a data step, you must put a period at the end of the format name.

```sas
data billion;
  input wealth age region $;
  format region $regfmt. wealth amtfmt. ;
  label wealth = 'Wealth in Billion $'
    age = 'Age in Years';
datalines;
< copy and paste data in here>
run;
```

To see the effect of adding this format:

```sas
proc print data = billion;
run;
proc freq data = billion;
  tables region;
run;
```

2 Using labels to get SAS to print more descriptive variable names

```sas
data billion;
  input wealth age region $;
  format region $regfmt. wealth amtfmt. ;
  label wealth = 'Wealth in Billion $'
    age = 'Age in Years';
datalines;
< copy and paste data in here>
run;
```

Now enter and run the following code to see how the formats and labels affect the output of the "print" and "freq" procedures.

```sas
proc print data = billion (obs = 20);
run;
proc print label data = billion (obs = 20);
run;
proc freq data = billion;
run;
```

3 Formats for numeric variables

Formats can also be used to group numeric data. Add a line to your format procedure and change one line in the data step as follows:

```sas
proc format;
  value $regfmt 'A' = 'Asia' 'E' = 'Europe' 'M' = 'Middle East'
    'O' = 'Other' 'U' = 'US';
  value amtfmt low-<5 = '<5' 5-<10 = '5-<10' 10-<20 = '10-<20' 20-high = '20+';
run;
```

```sas
data billion;
  input wealth age region $;
  format region $regfmt. wealth amtfmt. ;
  label wealth = 'Wealth in Billion $'
    age = 'Age in Years';
datalines;
< copy and paste data in here>
run;
```

To see the effect of adding this format:

```sas
proc print data = billion;
run;
proc freq data = billion;
  tables wealth;
run;
```

4 Proc means

Gulanick (Heart and Lung, 1991) studied patients who were recovering from heart surgery. She was interested in whether different combinations of supervised exercise or teaching would affect patients’ self-efficacy (or confidence) to perform physical activity.

Patients were randomly assigned to one of three groups. Group 1 received teaching, treadmill exercise testing, and exercise training three times per week. Group 2 received only teaching and exercise testing. Group 3 received only routine care without supervised exercise or teaching. After 4 weeks, each patient was scored on self-efficacy.

Self-efficacy was measured on a continuous scale and scores were assumed to be distributed normally in each of the populations of interest. Her results are in the dataset “gulanick.dat.” We wish to produce a table that shows the number of observations and the mean and standard deviation of scores within each of the three groups.

```sas
proc format;
  value grpfmt 1 = 'Teaching and Training' 2 = 'Teaching' 3 = 'Neither';
run;
```

```sas
proc means;
  tables region;
run;
```
data gulan;
input score group;
format group grpfmt.;
datalines;
< copy data in here>;
run;

We can use proc means to get various summary statistics in a more compact format than proc univariate provides. The default statistics provided are:

- n = number of observations
- mean
- std dev = standard deviation
- minimum
- maximum

proc means data = gulan;
var score;
where group eq 1; /* restricts to those records with group = 1 */
run;

The MEANS Procedure
Analysis Variable : score

<table>
<thead>
<tr>
<th>N</th>
<th>Mean</th>
<th>Std Dev</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>126.8181818</td>
<td>24.2520852</td>
<td>100.0000000</td>
<td>170.0000000</td>
</tr>
</tbody>
</table>

5 Confidence intervals

We can request other descriptive statistics by specifying them as part of the proc means statement. One that you will need soon is the confidence interval for the mean. Putting "clm alpha = .05" on the end of the proc means statement produces a 95% confidence interval.

proc means data = gulan;
var score;
where group eq 1; /* restricts to those records with group = 1 */
run;

The MEANS Procedure
Analysis Variable : score

<table>
<thead>
<tr>
<th>N</th>
<th>Lower 95%</th>
<th>Upper 95%</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>110.5254093</td>
<td>143.1109543</td>
</tr>
</tbody>
</table>

6 Using proc tabulate to summarize the distributions of quantitative variables in different groups

proc tabulate data = gulan;
class group; /* class statement identifies qualitative variables */
var score; /* var statement identifies quantitative variables */
tables group , score * (n mean std) ;
run;

--------------------------------------------------------
<p>| | score |
|--------------------------------------|</p>
<table>
<thead>
<tr>
<th>group</th>
<th>N</th>
<th>Mean</th>
<th>Std</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching and Training</td>
<td>11.00</td>
<td>126.82</td>
<td>24.25</td>
</tr>
<tr>
<td>Teaching</td>
<td>12.00</td>
<td>128.42</td>
<td>25.04</td>
</tr>
<tr>
<td>Neither</td>
<td>13.00</td>
<td>103.92</td>
<td>17.71</td>
</tr>
</tbody>
</table>

7 More on proc means

The following code will produce means for this dataset of the values in the variables "wealth" and "age."

proc means data = billion n mean;
var wealth age;
title 'Average Age and Wealth of 1992 Billionaires' ;
run;

The MEANS Procedure

<table>
<thead>
<tr>
<th>Variable</th>
<th>Label</th>
<th>N</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>wealth</td>
<td>Wealth in Billion $</td>
<td>233</td>
<td>2.6815451</td>
</tr>
<tr>
<td>age</td>
<td>Age in Years</td>
<td>225</td>
<td>64.031111</td>
</tr>
</tbody>
</table>

Average Age and Wealth of 1992 Billionaires

Since our dataset contains an observation for every billionaire in the world in 1992, if the population of interest is billionaires in 1992, is this a population mean or a sample mean?

If we want a separate mean for each region, we must first make sure that the dataset is sorted in order by region, and then run "proc means" with an additional "by" statement.

proc sort;
by region;
run;
proc means data = billion n mean ;
var wealth age ;
by region ;
title 'Average Age and Wealth of 1992 Billionaires' ;
title2 'By Region' ;
run ;

Average Age and Wealth of 1992 Billionaires
By Region 10:19 Friday, March 14, 2014

------------------------------ region=Asia -------------------------------
Variable Label N Mean
------------------------------------------------------
wealth Wealth in Billion $ 38 2.6210526
age Age in Years 37 63.6486486

------------------------------ region=Europe -------------------------------
Variable Label N Mean
------------------------------------------------------
wealth Wealth in Billion $ 80 2.2075000
age Age in Years 76 64.0263158

-------------------------- region=Middle East ---------------------------
Variable Label N Mean
------------------------------------------------------
wealth Wealth in Billion $ 22 4.2636364
age Age in Years 22 64.2272727

----------------------------- region=Other ------------------------------
Variable Label N Mean
------------------------------------------------------
wealth Wealth in Billion $ 29 2.3448280
age Age in Years 28 64.128571

----------------------------- region=US --------------------------------
Variable Label N Mean
------------------------------------------------------
wealth Wealth in Billion $ 64 2.9687500

proc means data = billion ;
class region ;
var wealth age ;
run ;

N region Obs Variable Label Maximum
------------------------------------------------------------------
Asia 38 wealth Wealth in Billion $ 14.0000000
age Age in Years 83.0000000
Europe 80 wealth Wealth in Billion $ 11.7000000
age Age in Years 96.0000000
Middle East 22 wealth Wealth in Billion $ 37.0000000
age Age in Years 102.0000000
Other 29 wealth Wealth in Billion $ 6.2000000
age Age in Years 84.0000000
US 64 wealth Wealth in Billion $ 24.0000000
age Age in Years 88.0000000
------------------------------------------------------------------
Proc tabulate for the billionaire data.

```
proc tabulate data = billion ;
class region ;
var age ;
tables region, age * (mean stddev) ;
run ;
```

<table>
<thead>
<tr>
<th>Region</th>
<th>Age in Years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
</tr>
<tr>
<td>Asia</td>
<td>63.65</td>
</tr>
<tr>
<td>Europe</td>
<td>64.03</td>
</tr>
<tr>
<td>Middle East</td>
<td>64.23</td>
</tr>
<tr>
<td>Other</td>
<td>64.14</td>
</tr>
<tr>
<td>US</td>
<td>64.15</td>
</tr>
</tbody>
</table>