SAS Enterprise Guide with SAS On-Demand

SAS® Enterprise Guide® with SAS® On-Demand for Academics: Everything You Need to Know After "It's Free"

AnnMaria De Mars, The Julia Group, Santa Monica, CA

ABSTRACT

SAS On-Demand for Academics is a free "cloud-based" version of SAS® software available to university faculty, researchers, and students. In this hands-on workshop, participants will learn the administrative details (how and where to get it, set up student accounts, upload files), use SAS Enterprise Guide to solve both simple and complex statistical problems and practice troubleshooting some of the more common issues that arise when using SAS On-Demand for teaching. Because SAS On-Demand is now free to university researchers as well, participants will also run tasks that were used for two research projects, an analysis of survey data and a survival analysis.

INTRODUCTION

SAS® offers many benefits for academic instruction. Students can learn programming logic, to read and write in a programming language, how to interpret statistics, data visualization or data mining. Until now, a major barrier to learning SAS has been the availability of a campus license. For some schools, SAS may not be in the budget. For others, software purchases are decided at an administrative level and either the powers that be have decided not to install SAS or by the time you work through the committees and levels of approval necessary, this semester will be a distant memory. What is a professor to do? Enter SAS On-Demand for Academics.

Several things you should know about SAS On-Demand:
- It comes in multiple flavors - JMP, Enterprise Guide, Enterprise Miner
- If all goes well, you can go from order to running SAS in less than a day.
- It's free.
- It can be installed on a Windows desktop or on a Mac using Boot Camp.
- Virtual machines on a Mac do not work.
- Your class will have a directory to which you (the professor) have write access and everyone will have read access.
- The program runs on the SAS server, which means that anyone using it will need access to an Internet connection.
- All of the students will need to register for SAS On-Demand
- SAS Enterprise Guide runs exactly the same on the server as it does on your desktop. This means that if your students learn using the On-Demand version, they will be able to use SAS Enterprise Guide.
- You can open a program window, write and run any SAS code.
- SAS On-Demand with SAS Enterprise Guide currently uses SAS EG 4.3 which is backward compatible but not forward compatible. That is, if you have SAS EG 4.2 on your desktop, you can upload those projects and run them using On-Demand, but you are not going to be able to go in the opposite direction. As long as you keep this fact in mind, it can actually be a positive, as you may now have access to a newer version of the software than that installed at your college or university.

So... in a nutshell, SAS On-Demand will do just about anything you could want in a statistics course. In this workshop, we'll cover examples of several exercises that can be done with a class, from basic to advanced statistics. We'll also discuss possible pitfalls with SAS On-Demand and how to avoid them. The session ends with instructions on how to get an account, register your students and upload your data to the SAS server.

Avoiding aggravation #1 - Use SAS Enterprise Guide OR SAS On-Demand

One disadvantage of SAS On-Demand is that it does run on the server, which means it is somewhat slower than running on your desktop. The speed can also be impacted by your Internet connection. You can avoid this aggravation by using SAS Enterprise Guide on your desktop to test and run a project, then, upload the project and data to the SAS server. However, there may be times when you only have access to SAS On-Demand running on your old Windows laptop or using boot camp on your Mac. All exercises in this workshop can be done 100% using SAS On-Demand. So, either one can help you avoid aggravation. You can run faster with SAS installed on your desktop or you can run any time anywhere with SAS On-Demand. You do need to have SAS On-Demand installed on the machine you will be using, but the space and time required is much less than for SAS for Windows installation

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Exercise 1 - Teaching Exploratory Data Analysis using SASHELP data

Both SAS On-Demand and SAS Enterprise Guide include a sashelp directory with a diverse array of datasets cleaned of the usual data problems. There are no clerical errors where someone entered 999 instead of 99 for a patient age, missing data only occurs here and there for illustrative purposes. In short, the kind of data set you rarely encounter in real life unless you have put in a lot of work cleaning it. This makes these data sets perfect for use the first day of class when you are just introducing students to the software and you haven't had time to get a data set of your own prepared for analysis.

CHARACTERIZE DATA TASK USING THE HEART DATA SET

Objective: Give students practice using SAS Enterprise Guide to explore data with the CHARACTERIZE DATA task.

1. Open SAS Enterprise Guide

2. Open Heart data set from Server List as follows
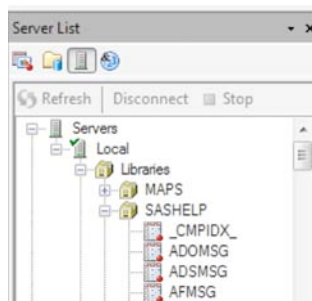
SERVERS > LOCAL > LIBRARIES > SASHELP

(Note servers list is in the bottom of the left window pane)

Double-click on the Heart dataset to open it

Your project should now look like the image below. In the top left window pane you see your Process Flow, with one icon, for the Heart dataset. In your bottom left pane you see the list of data sets in the library you had selected. Your main window shows the results of your most recent activity, which in this case was opening a data set.
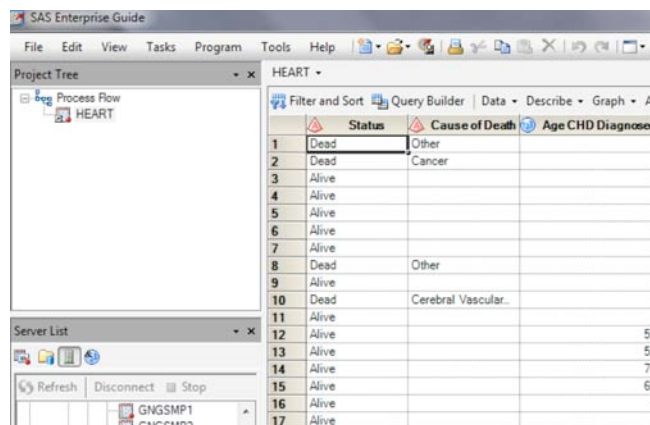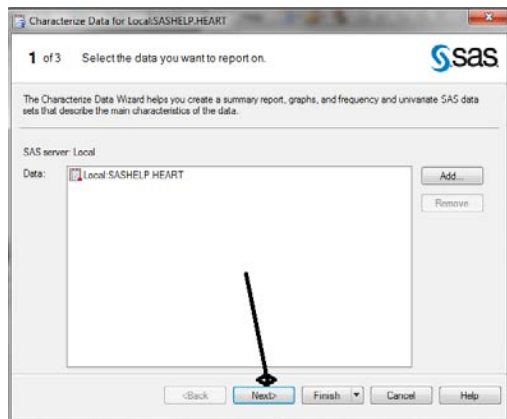

Now that we have data we're ready for our first statistical analysis.

3. Run the characterize data task

TASK > DESCRIBE > CHARACTERIZE DATA
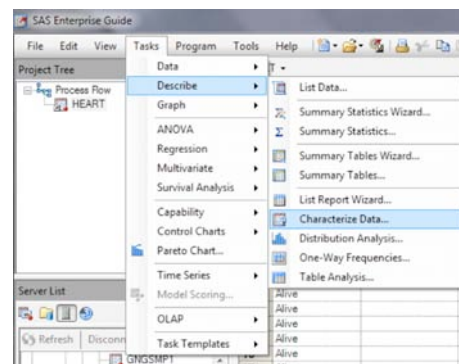
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4. Click NEXT to accept the default

5. Click the box next to SAS Data sets so that you do <u>not</u> have the frequencies and univariate statistics each saved as new data sets. (There may be times when you want that, but early on it usually just confuses students who find the new default data set is not the one they have been using but the univariate statistics from that data set.)

Next, click on the FINISH button.
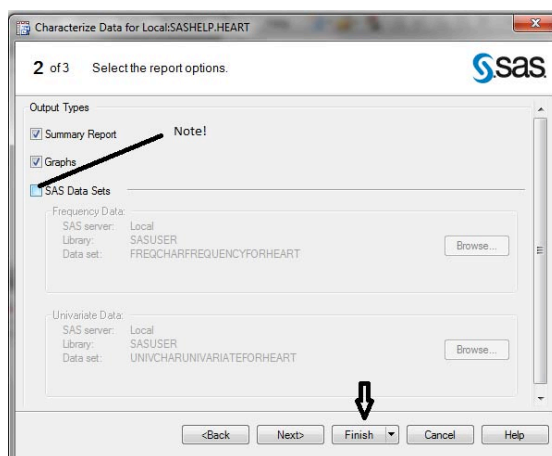
6. Take a look at the output produced - there should be a lot of it!

For each categorical variable, you'll get a frequency distribution of the 30 most frequent distinct values. A partial example is shown below.

Summary of Categorical Variables for SASHELP.HEART
Limited to the 30 Most Frequent Distinct Values per Variable

| Variable	Label	Value	Frequency Count	Percent of Total Frequency
BP_Status	**Blod Pressure Status**	High	2267	43.5208
		Normal	2143	41.1403
		Optimal	799	15.3388
Chol_Status	**Cholesterol Status**	Borderline	1861	35.7266
		High	1791	34.3828

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You'll get descriptive statistics for each numeric variable, as shown below.

Summary of Numeric Variables for SASHELP.HEART

Label	N	NMiss	Total	Min	Mean	Median	Max	StdMean
Age at Death	1991	3218	140438	36.0	70.536	71.0	93.0	0.23665
Age at Start	5209	0	229554	28.0	44.069	43.0	62.0	0.11881

For each variable, you'll get a histogram, with the mean and median in the footer, as in the example below.

Mean = 63.302967564
Median =   63
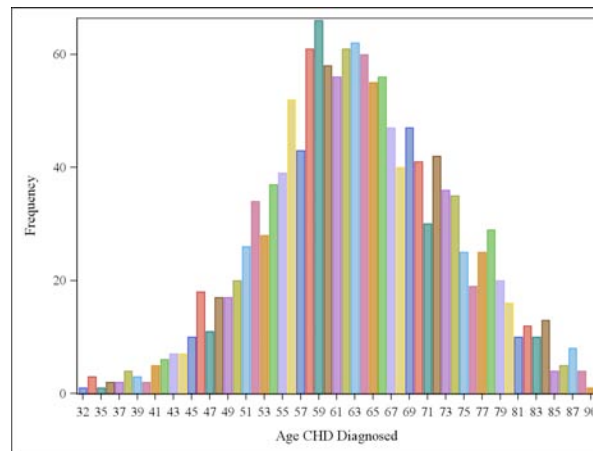
A FEW WORDS ABOUT THIS FIRST EXERCISE.

To see how easy it is for students who learn using SAS On-Demand to move to the desktop version, compare the views of SAS Enterprise Guide and SAS On-Demand below. The only difference is using On-Demand you click on SASAPP under SERVERS and using the desktop version of SAS Enterprise Guide you click on LOCAL. It's very possible that your students may not even notice as they click on it that the first-thing-under-SERVERS-grey-rectangle-with-a-green-check has a different label under SAS On-Demand.

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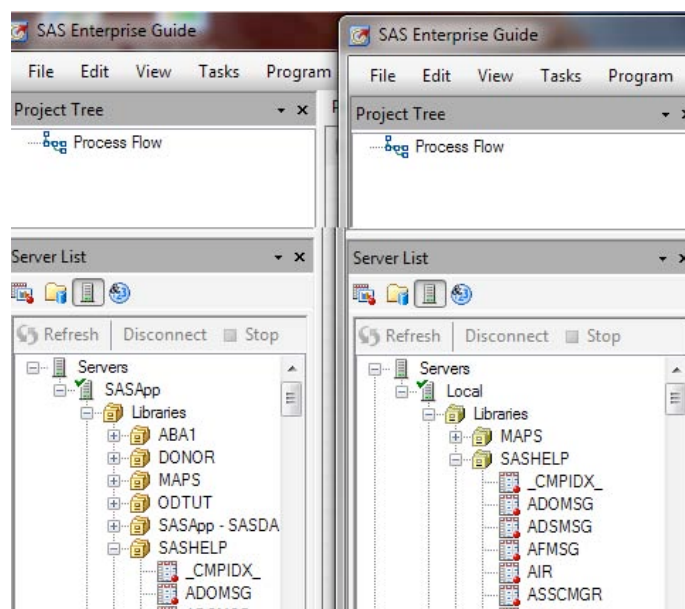
BEING A PROFESSOR MEANS MAKING THE MISTAKES FIRST

Speaking of the data sets in the SASHELP library, which are indeed identical under both versions of SAS Enterprise Guide, try clicking on a few of those data sets, open them up and see what other types of data are available. Now close the data sets. In my example, I opened the IRIS and OBJECTS data sets.

 My SAS Enterprise Guide project now looks like the figure at right.
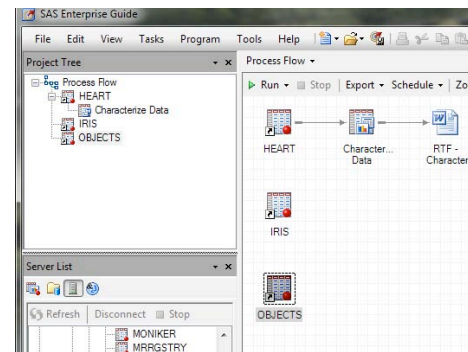
Notice several things. First, even though I closed the two data sets named "Iris" and "Objects" they show in both Process Flow windows - the tree structure on the left and the project window on the right. More importantly, though, notice that the 'Objects' data set is high-lighted. This is the last data set I used and just like with other SAS jobs, the default for any task will be the last-used data set.

What now? The simplest solution is simply to click on the HEART data set. To make any data set active, just click on it. A second option, would be, if you have already clicked on the CORRELATIONS(or any other task) to click on the EDIT button to select a different data set. You may not <u>see</u> an edit button, which makes this advice singularly unhelpful, no?

You just need to make your window bigger. The EDIT button is hidden off to the right. Click on the bottom right corner of the window and drag to make it bigger.
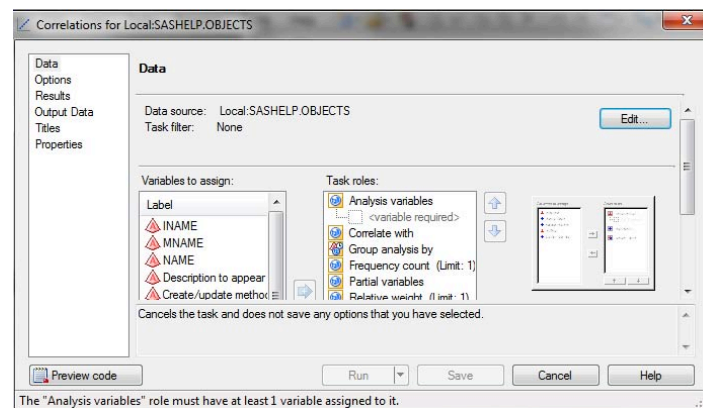
Then click on the EDIT button. The window below pops up.

Drag down on the box next to Data Source to the data set you want to use. In this case, the Heart data set. Click OK.
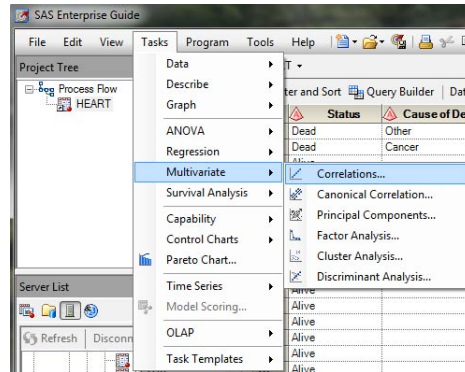
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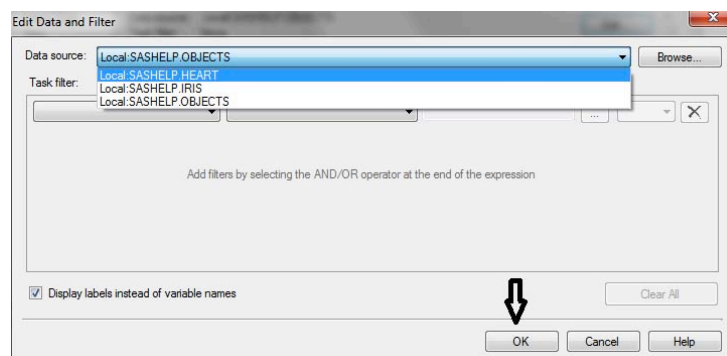
## EXERCISE 2: HOW TO GET CORRELATIONS IN SAS ENTERPRISE GUIDE

Speaking of correlations, let's move on to Exercise 2. Continuing with the Heart data set from Exercise 1 .....

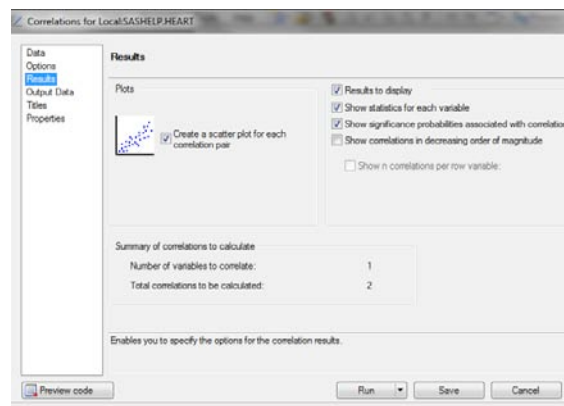### A. CORRELATING ONE VARIABLE WITH OTHERS

1.   Select TASKS > MULTIVARIATE > CORRELATIONS

2.   If it is not already selected, Click the EDIT button and pull down to select the SASHELP.HEART dataset

3.   Drag Weight under Analysis Variables
4.   Drag Height and AgeatStart under Correlate With
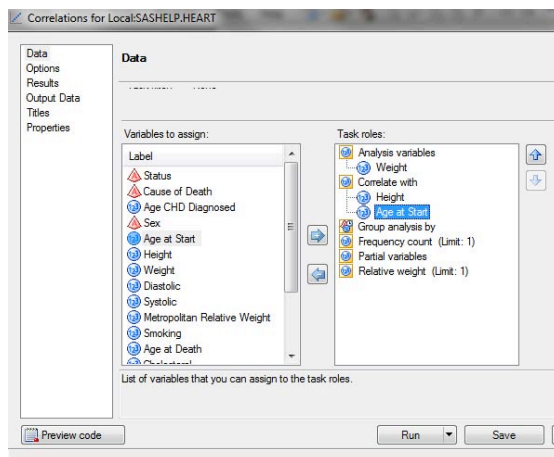
5.   Click Results
6.   Click the box next to Create a scatter plot for each correlation pair

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7. Click TITLES Give it a title and footnote
8. Click RUN

Your results will include a table of descriptive statistics

| Simple Statistics						
Variable	N	Mean	Std Dev	Sum	Minimum	Maximum
Height	5203	64.81318	3.58271	337223	51.50000	76.50000
AgeAtStart	5209	44.06873	8.57495	229554	28.00000	62.00000
Weight	5203	153.08668	28.91543	796510	67.00000	300.00000

A correlation matrix of weight by height and AgeAtStart

Pearson Correlation Coefficients Prob > |r| under H0: Rho=0 Number of Observations	
	Weight
Height	0.51739 <.0001 5199
AgeAtStart Age at Start	0.09352 <.0001 5203

and graphs such as the one below.

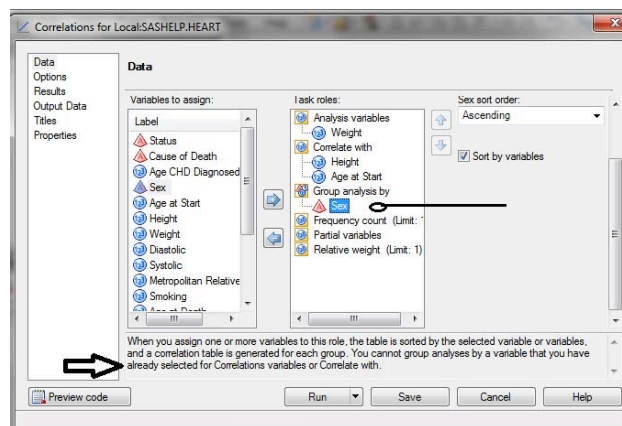SAS Enterprise Guide with SAS On-Demand
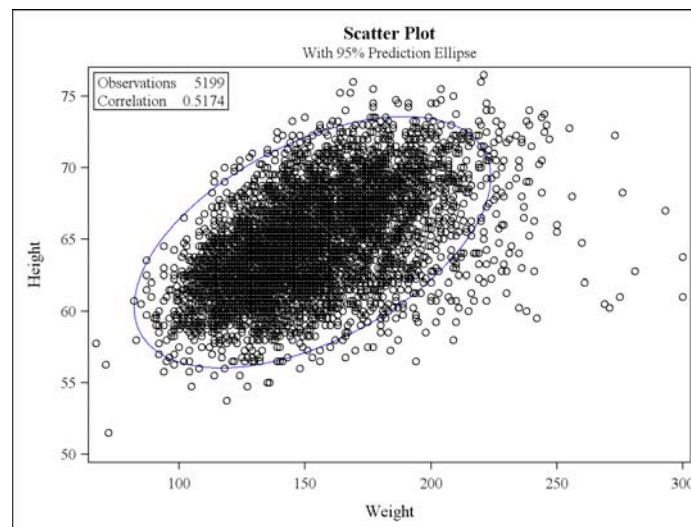
B. How to Modify a Task (Getting Correlations by Sex)

1. Click **MODIFY TASK** (You'll see it directly above your output)
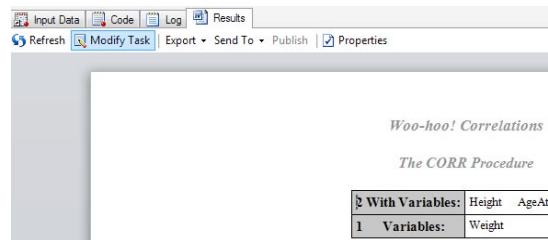
2. Try dragging, Sex, a categorical variable under Analysis variable just to see what happens
3. Drag Sex under "Group Analysis by"
4. Click RUN

Note the box in the bottom of the window. Information is provided here on the highlighted role, for example, that the table is sorted by the selected variable(s) and a table provided for each group. Unlike in a SAS program, in SAS Enterprise Guide, you do not need to sort your data set before running correlations by a variable.

5. After you click RUN a window below will pop up. Click "NO" to "Replace results from previous run"

C. CREATING A CORRELATION MATRIX

Since there are task roles for Analysis variables and Correlate With variables, you might wonder how you get a correlation matrix. The answer is simple - drag all of the variables under Analysis.

1. Click on Process Flow in the left window pane to get the process flow view
2. Click on the Heart dataset
3. Select TASKS > MULTIVARIATE > CORRELATIONS
4. Drag AgeatDeath , Smoking, Cholesterol and AgeCHDdiag under Analysis Variables

8

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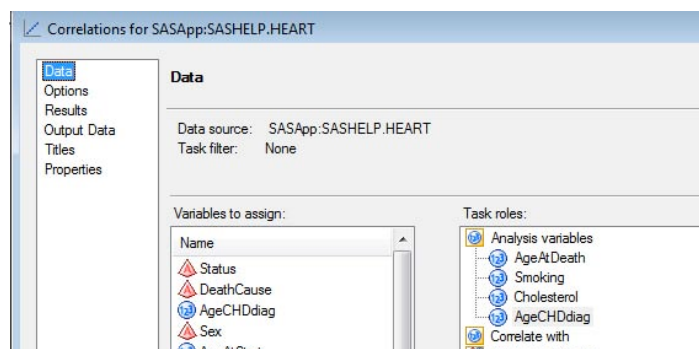
5.   Click Run

Results include descriptive statistics for all variables (not shown) and the correlation matrix partially shown below.

Pearson Correlation Coefficients Prob > |r| under H0: Rho=0 Number of Observations				
	AgeAtDeath	**Smoking**	**Cholesterol**	**AgeCHDdiag**
AgeAtDeath Age at Death	1.00000 1991	-0.28525 <.0001 1971	0.07844 0.0006 1922	0.74811 <.0001 894
Smoking	-0.28525 <.0001 1971	1.00000 5173	-0.01178 0.4027 5049	-0.28357 <.0001 1440

Exercise 3 - Running an Existing Project

Douglas Kranch (2010) gave an excellent description of how students learn computer science,
"Expertise develops in three stages. In the first stage, novices focus on the superficial and knowledge is poorly organized. During the end of the second stage, students mimic the instructor's mastery of the domain. In the final stage, true experts make the domain their own by reworking their knowledge to meet the personal demands that the domain makes of them."

Exercise 3 is an exercise at the beginning of a course that allows students to mimic the instructor's analysis in a research project by opening and running an existing project. It also gives them a view of the superficial, an understanding of what a completed project and the output from it looks like. Some of the output will be familiar, such as the bar charts and descriptive statistics from the CHARACTERIZE DATA task, while the logistic regression results may be completely new to students, but this exercise serves to give them a direction of where we will be going in the course.

1. Open Ex3marriage.egp by going to FILE > OPEN > PROJECT , opening the correct folder and selecting the project. For this workshop, it can be found in C:\HOW\DEMARS\DATA

The process flow for the project is shown below. This is what the students see when they open the project.

2. Click RUN > PROJECT

3. Examine the output from each of these results

4. Close the project

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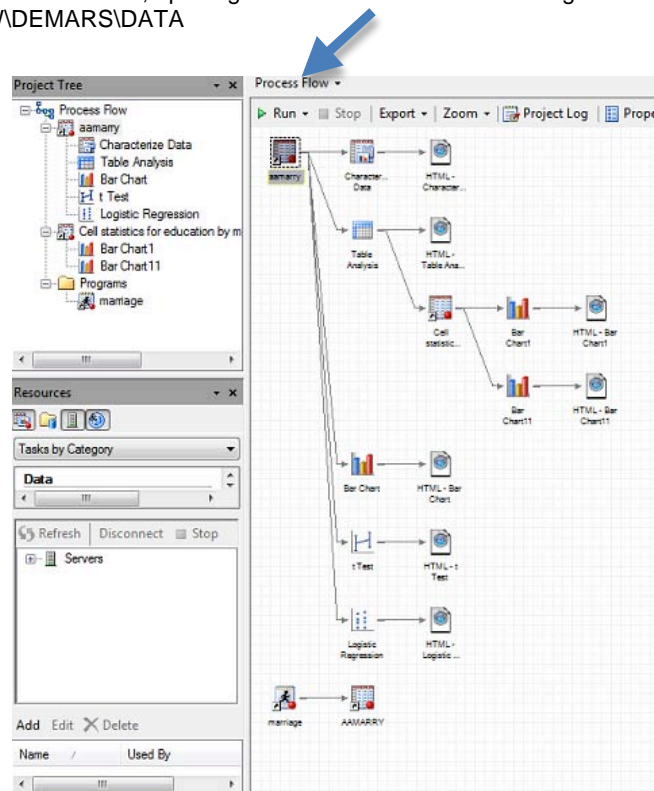
EXERCISE 4: RESEARCH PROJECT: DESCRIPTIVE STATISTICS - LOGISTIC REGRESSION

ABOUT THE PROJECT
This next exercise is completed over two or three class sessions. The objective is to introduce students to analysis using large-scale survey data. This example uses the 2009 American Community Survey Public Use Microdata Sample (U.S. Census, 2009). The Public Use Microdata Sample (PUMS) contains responses to the American Community Survey (ACS). There are 3,030,728 records in the complete data set. For this project, a subset of responses was used, consisting of African-American women in California, aged 16 and older.

The project was initiated by a discussion in a doctoral course on Advanced Quantitative Data Analysis. One student suggested the hypothesis that, for African-American women, there was a negative relationship between education and probability of marriage. Other students (primarily women) concurred, saying that a woman with more education was more able to support herself, thus less likely to "settle" for just any man and less likely to get married. Interestingly, the male students in the class disagreed. Their hypothesis was that African-American women with more education would be <u>more</u> likely to get married. One group of students decided to find the answer. The instructor downloaded the ACS file for California and created a data set for analysis. This data set was then uploaded to the SAS server in the directory for the course.

All analysis was done in SAS On-Demand.

MOVING FROM SAS ENTERPRISE GUIDE ON DESKTOP TO SAS ON-DEMAND

Using SAS On-Demand, the LIBNAME statement in this program will refer to the directory on the SAS server assigned to your class. The LIBNAME will look something like this:

LIBNAME mydata "/courses/u_2.edu1/i_123/c_2469/saslib"

The change in the LIBNAME statement is the only change that needs to be done in this entire exercise to move from SAS Enterprise Guide on a desktop to using SAS On-Demand. You can include any SAS statements in the opening program, not simply assign a directory and create a temporary data set. If you have any user-written formats to apply, want to compute test scores or do any other kind of data manipulation, you can have it all in this program, run it first in the project and now your students have a nice, clean data set to use.

PART A: CREATE AND RUN A PROGRAM TO BRING IN THE DATA

1. File > New > Program

Type the following statements into your program.

```
LIBNAME sgf12 "c:\how\de_mars\data" ;
DATA aamarry ;
      SET sgf12.aamarry ;
RUN ;
```

2. Click RUN

PART B: CHARACTERIZE DATA

This task is identical to Exercise 1.

Select **TASKS > DESCRIBE > CHARACTERIZE DATA**

Reality check! Students should get in the habit of doing this as the first task in any project and examining the results to check for the validity of the data, e.g., values are not out of range, means are within expected limits.

PART C: TABLE ANALYSIS

After running descriptive statistics and checking that the data are valid, the next step is to create a table of education by marital status. This uses the TABLE ANALYSIS task, with the following steps.

1. Start the TABLE ANALYSIS task
   **TASKS > DESCRIBE > TABLE ANALYSIS**

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2. In the left window pane, click the first tab, DATA
3. Drag Married and Education under Table variables to identify which variables will be used in the table
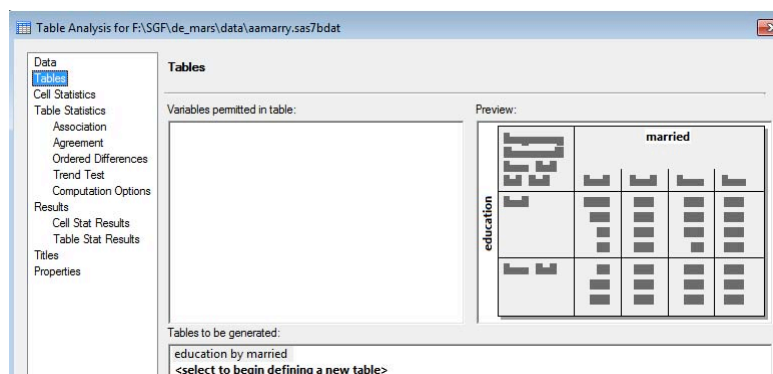4. Drag *pwgtp* under Frequency count.

Your window should now look like the example below.
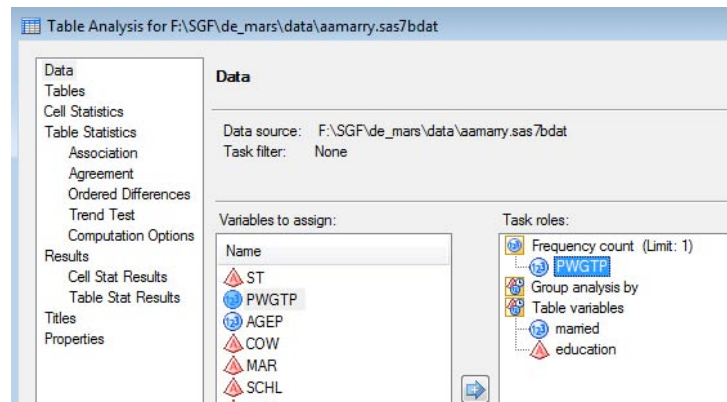
5. In the left window, click the second tab, TABLES
6. Drag Married and Education under variables permitted in the table
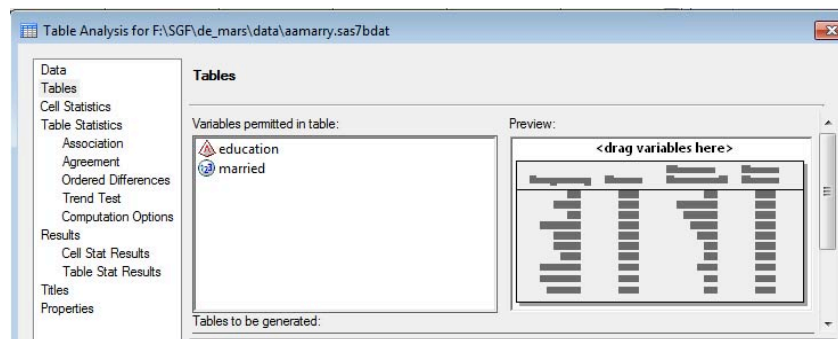
7. Drag Married from the Variables permitted in the table window to the top of the table at right and Education to the side.

8. In the left window pane, click the third tab, CELL STATISTICS
9. Click the boxes next to Row percentages, Cell frequencies and the last box Include percentages in the data set

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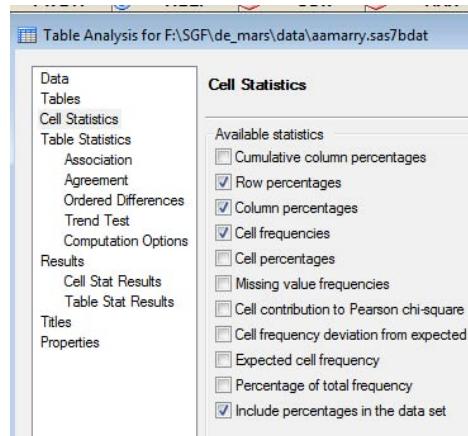
10. Under the fourth tab, TABLE STATISTICS, click on ASSOCIATION
11. Under Chi-square tests, click the button next to the first box (Include Pearson, likelihood ratio, etc.)
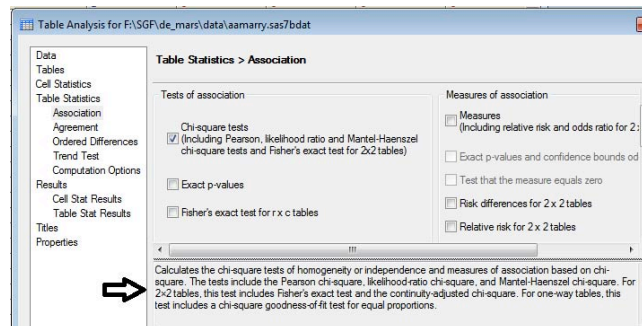

As mentioned previously, the bottom pane provides information on each choice within a task. This help may be particularly useful to students when they begin selecting statistical tests. These hints can reinforce information taught in the course, e.g., chi-square tests for independence.

12. Under Results, click Cell Stat Results
13. Click the button next to education by married
14. Click RUN
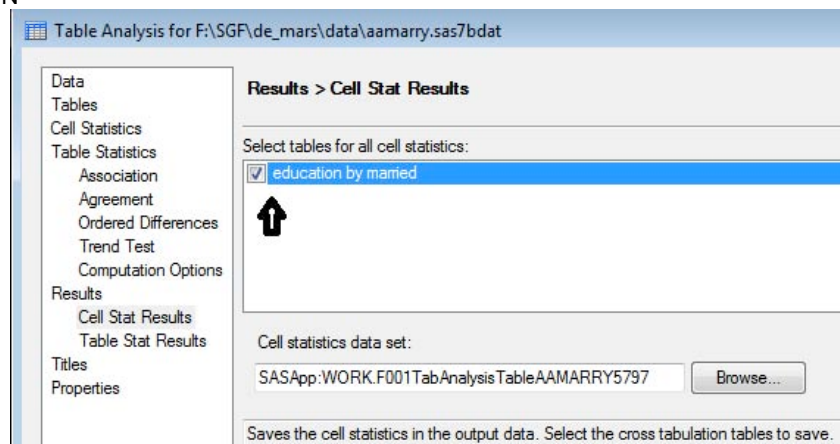
Below, you see the results, the cross-tabulation of Education by Married. These results tell us that African-American women in California are more likely to be married if they have more education. The next analyses look at the question from different perspectives.

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Table of education by married			
education(education)	**married(married)**		
Frequency **Row Pct** **Col Pct**	**0**	**1**	**Total**
1.< H.S.	67159 67.13 11.61	32885 32.87 11.28	100044
2.HS Gra	408575 67.87 70.61	193439 32.13 66.37	602014
3.CollGr	69814 62.59 12.06	41719 37.41 14.31	111533
4.GradDe	33120 58.60 5.72	23398 41.40 8.03	56518
Total	578668	291441	870109

Note: This analysis uses the weights from the American Community Survey. While these are appropriate for getting an estimate of the population distribution, they are not accurate for computing the chi-square. It is included not only as an example of how to compute these statistics but also as part of developing a habit I want students to acquire of running multiple analyses, of examining the impact of the decisions they make. In the course, I have students re-run the chi-square without the weights and compare results. One advantage of SAS Enterprise Guide is the ease with which students can re-run analyses with different options and see the effect their choices have on the results.

PART D: GRAPH THE PERCENTAGE MARRIED
In presenting our results, a graph would be helpful and since these data are from the U.S. Census and can be used to produce estimates for the population (hence the weights) we'd like to use the weighted results from our table. (The BAR GRAPH task does not have a weight or frequency option.)

HOW TO GET A WEIGHTED BAR GRAPH
Recall that we selected, "Include cell statistics in data set" under the CELL STATISTICS option. Since the default is to use the last created data set, the next task will use the data set we just created that includes the weighted statistics for frequency and percentage.

1. Select **TASKS > GRAPHS > BAR CHART**
2. The BAR CHART window (shown below) will pop up. Select Vertical Colored Bar Chart
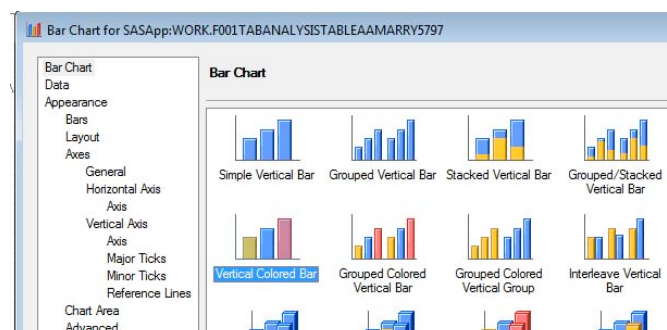
3. Click on the second tab, DATA
4. Click the Edit button (top right of the bar chart window)

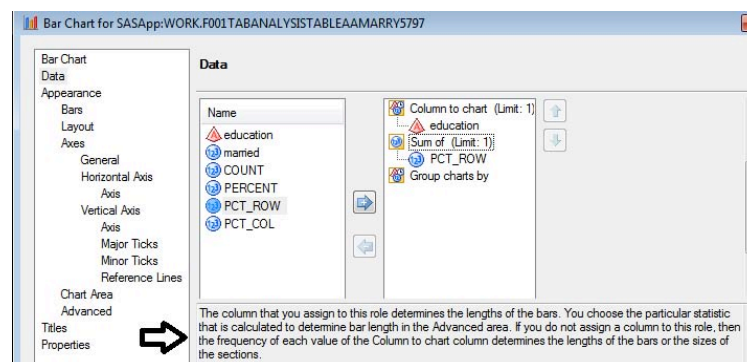SAS Enterprise Guide with SAS On-Demand
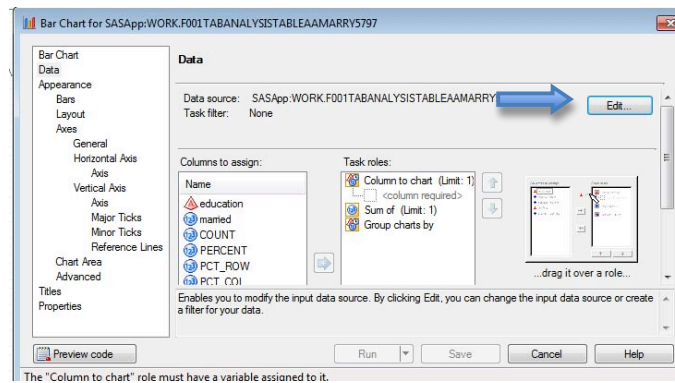
5. When you click EDIT, the window below will pop up
6. Under Task Filter, pull down the first menu to Married
7. Pull down the second menu to EQUAL TO
8. In the box type 1. Your window should now look like the example below.
9. Click OK
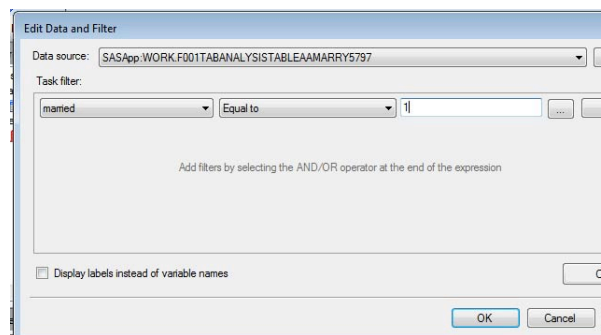
After you click OK, the EDIT window will close automatically and you will be back at the BAR CHART window below, with the DATA pane open, as shown.

10. Drag Education under Column to Chart
11. Drag Percent of Row Frequency under "Sum of" . Note that as in previous examples, the bottom pane gives a brief explanation of the effect of each option or role. In this case, you can see that the variable assigned to SUM OF will determine the height of the bars.

Your window should look like the example below.

12. Next, click on Advanced (left pane of the Bar Chart window)
13. Be sure that the "Statistic used to Calculate bar" is Sum
14. Click the box next to "Specify statistical value to show for bars"
15. Select Sum

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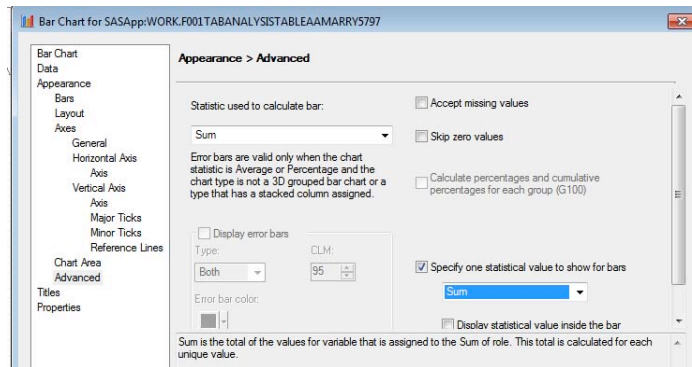
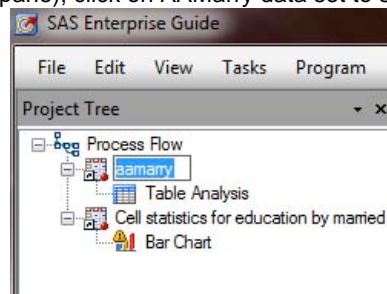

16. Click TITLES
17. Give the graph a Title
18. Click RUN

The result will be the graph below
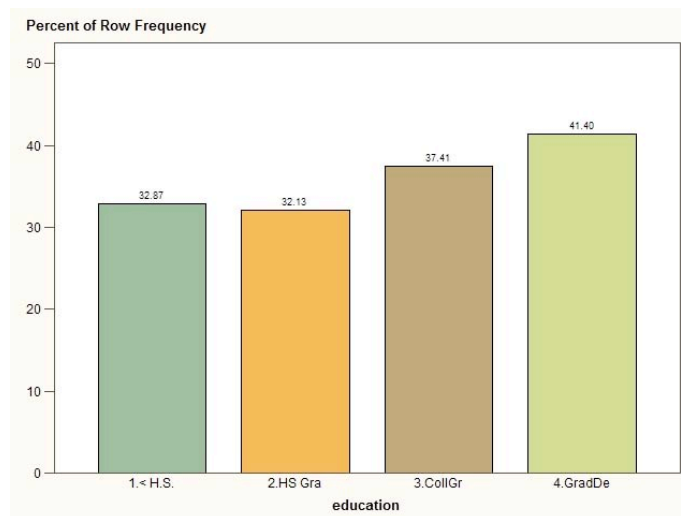
PART E : LOGISTIC REGRESSION

Logistic regression allows prediction of the dependent variable (married) from multiple independent variables, in this case, age and education.

1. Under Process Flow (in left pane), click on AAMarry data set to select the correct data set for analysis.
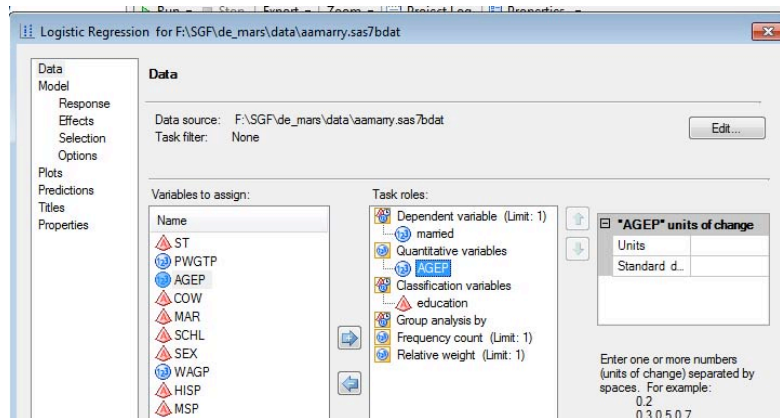

2. Select **TASKS > REGRESSION > LOGISTIC**

The window below should pop up. If you do not see this window, click on the first tab, DATA, in the left pane.

3. Drag Married under dependent

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4.   Drag AGEP under Quantitative
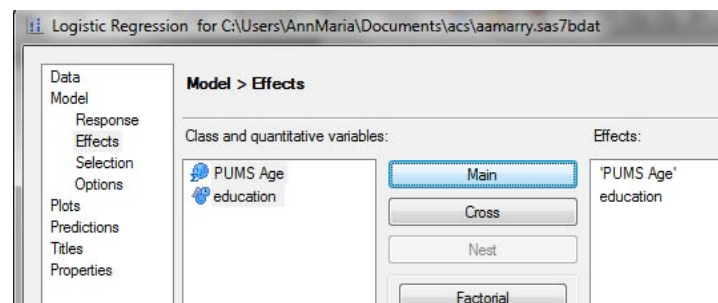5.   Drag Education under Classification variables

Your window should now look like the example below.

8. In the left pane, under the MODEL tab, click on EFFECTS. The window below will appear.
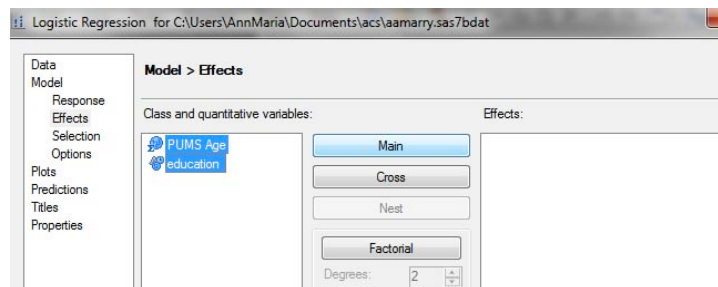
9. Shift-Click on AgeP and education
10. Click on Main. This sets age and education to be the two main effects in your logistic regression model.

11. Click RUN

This analysis will provide several pages of information, including tables of model fit statistics, regression coefficients and odds ratios. The parameter estimates, shown below are interpreted the same as regular regression coefficients - a negative coefficient for age means a lower probability - but a lower probability of what?
Hopefully, you noticed the note on the very first page of your logistic regression output:

Probability modeled is married=0.

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Analysis of Maximum Likelihood Estimates						
Parameter		DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept		1	2.9408	0.0885	1104.1281	<.0001
AGEP		1	-0.0504	0.00157	1030.7785	<.0001
education	1.< H.S.	1	0.3081	0.0667	21.3346	<.0001
education	2.HS Gra	1	0.00422	0.0425	0.0099	0.9208
education	3.CollGr	1	-0.2197	0.0619	12.6022	0.0004

So, the older you are, the less your probability of being single. The coefficient for less than a high school education is positive, so women who do not graduate high school are more likely to be single. Women who graduate college are less likely to be single. So, the hypothesis from our three African-American female doctoral students was not supported, which actually made the original poser happy because, as she said, "I'd like to get married, too!"

PART F: MODIFYING THE OUTPUT FORMAT & EXPORTING THE ROC CHART

SAS Enterprise Guide offers a variety of options for output. Particularly working with SAS On-Demand, since it is maintained on the SAS server and is only available to students for the few months they are in the course, I strongly encourage saving the output off-line. A major reason I encourage students to use SAS On-Demand is so that they can do original research and publish it. Export your output as an RTF file and you can just copy and paste into Word or OpenOffice. Since you have saved it, you can work on your paper any time.

SAS Enterprise Guide also gives options for saving output as PDF or HTML files. Let's say I want to save my logistic regression results as an HTML file and then export the ROC chart as a JPG file so I can upload it and use it in my explanation of logistic regression on the class blog.

1. To change the format, select **TOOLS > OPTIONS**

2. Click on GENERAL under RESULTS
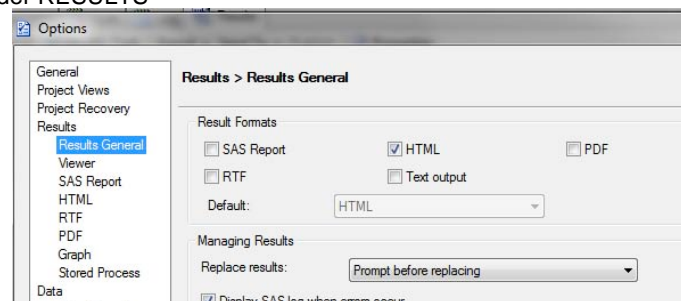
3. Click the box next to HTML. Click the box next to RTF to turn off production of RTF results. You can produce multiple types of results if you want, such as both RTF and HTML, but in this example, we only want one type.
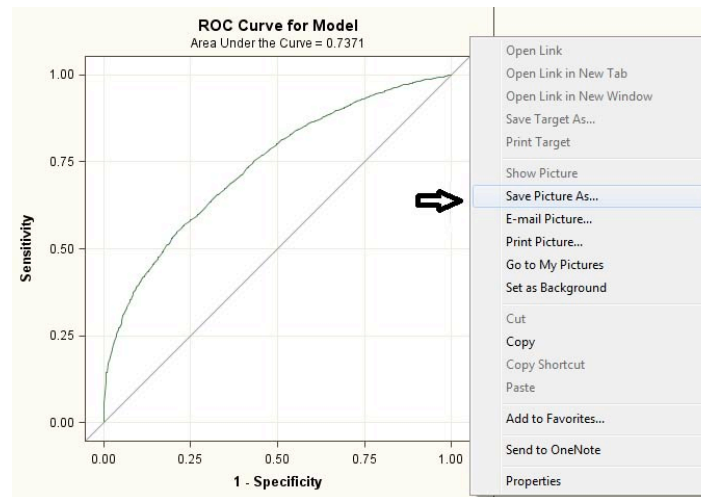
4. Click OK

5. To re-run the logistic regression, in the left window pane, right-click on LOGISTIC REGRESSION and select RUN LOGISTIC REGRESSION

6. When prompted whether to replace the results from the previous run click YES.
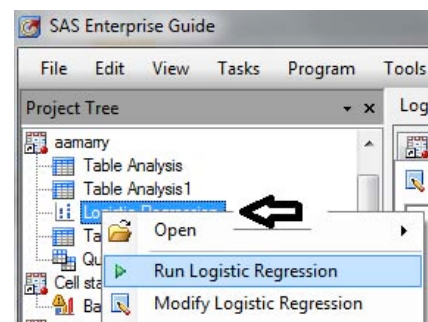
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7. Scroll down to the ROC chart, right-click on the picture and select SAVE PICTURE AS. I saved it as a png file.


EXERCISE 5 - SURVIVAL ANALYSIS

This last exercise comes at the end of the course. The mathematics of survival models can be a bit daunting and students are pleasantly surprised to find the analysis itself is easy. SAS Enterprise Guide offers two options for survival analysis, Life Tables and Proportional Hazards.

PART A: PERFORM A SURVIVAL ANALYSIS USING LIFE TABLES

1. Start a new project   **FILE > NEW > PROJECT**
2. Open the addicts dataset **FILE > OPEN > DATA ,** then select the data set ADDICTS

3. To run the analysis, select **TASKS > SURVIVAL ANALYSIS > LIFE TABLES**
4. Drag survival time in days under **Survival Time**
5. Drag Status under "**Censoring Variable**"
6. In the right pane, under right censoring values place a check next to 0
7. Drag Clinic under **Strata Variables**
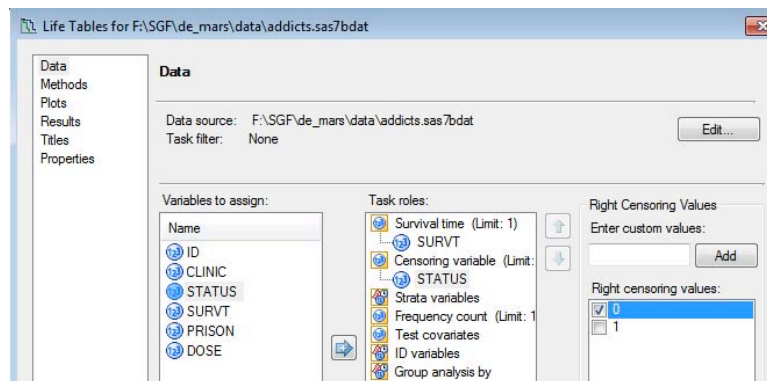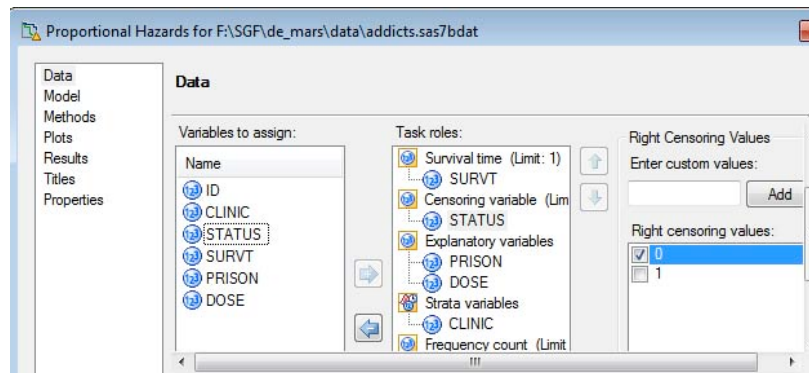

13. Click RUN
Note: If the RUN button is greyed out, double-check if you checked 0 under Censoring Variable

PART B: PROPORTIONAL HAZARDS MODEL

1.   To run the analysis, select **TASKS > SURVIVAL ANALYSIS > PROPORTIONAL HAZARD**s
2.   Drag survival time in days under **Survival Time**
3.   Drag Status under **Censoring Variable**
4.   In the right pane, under right censoring values place a check next to 0

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5. Drag Methadone Dose and Prison under **Explanatory Variables**
6. Drag Clinic under **Strata**

7. Click PLOTS (in the far left pane of the Proportional Hazards Window)
8. Click the buttons next to Survival Function Plot and Cumulative Hazard Function plot
9.Click RUN
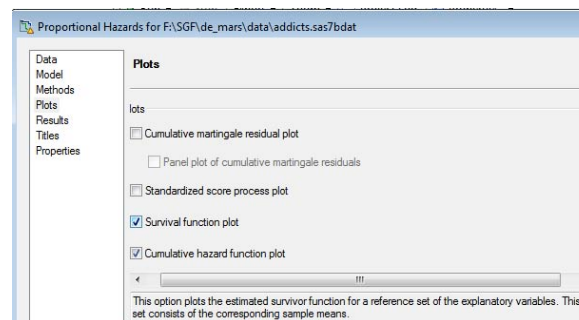
THE SAS ON-DEMAND PART - HOW TO GET IT

Now that you have seen what you can do with SAS On-Demand in your course, no doubt you are itching to get it. The good news (besides that it's free) is that it's very easy.

Step 1: Get a SAS Profile here: https://www.sas.com/profile/user/create.htm It's free.

Step 2: Create a SAS On-demand account, here: http://support.sas.com/ondemand/account.html It's also free, but you must be an instructor at a college or university.

Step 3: Go to the log in page. https://support.sas.com/ctx3/sodareg/ Notice the first option is REGISTER A COURSE. Click on that link.

Step 4: Once you have followed the steps to register your course, return to the login page. Click on the link that says INFO. This really will give you a lot of information you may need, such as the hostname to use when uploading data to your class directory.
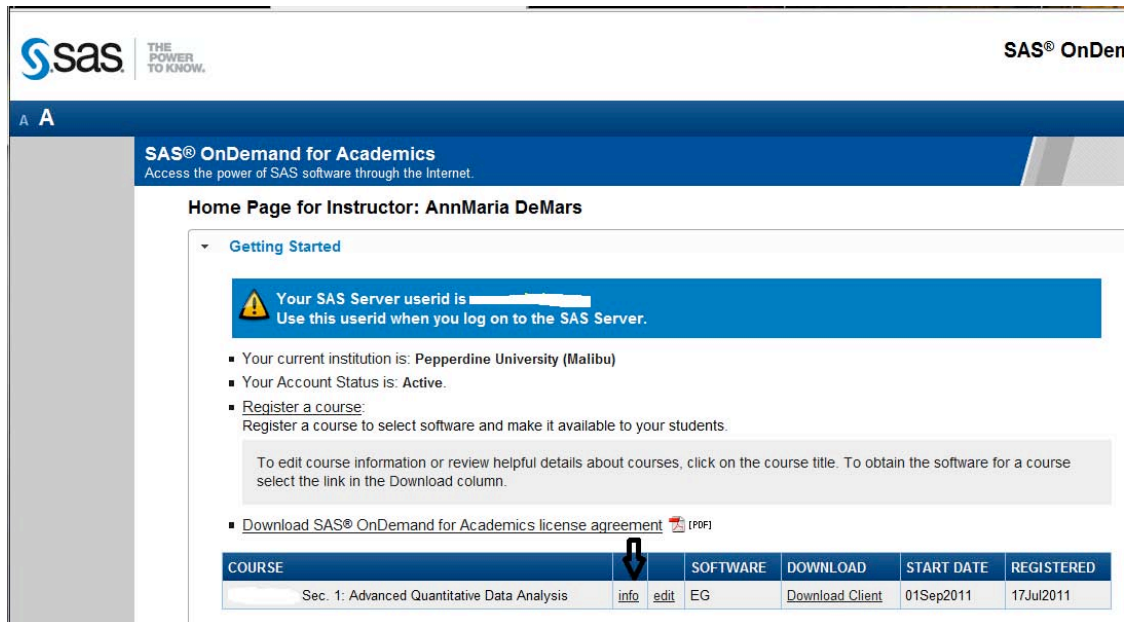
Step 5: Click on the link under DOWNLOAD and download the software to your computer. Your mileage may vary, but it took me two minutes to download and install SAS On-Demand. This is quite a departure from the experience of installing SAS.

That's it!

For a wealth of information on how to upload files, register a course, register students and more, check out the INFO link in the log in screen.

You can also read my blog post Ten Things about SAS On-Demand for Academics for a more random take on the subject.

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CONCLUSION

SAS Enterprise Guide, available free as part of SAS On-Demand is an effective teaching tool for statistics. Whether the analysis calls for simple basics such as descriptive statistics and graphs, or more advanced tools like logistic regression and survival analysis, SAS On-Demand is available. And free! How cool is that?

REFERENCES

De Mars, A. (2011). Ten things about SAS On-Demand for Academics. http://www.thejuliagroup.com/blog/?p=1625

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CONTACT INFORMATION

Your comments and questions are valued and encouraged. Contact the author at:

AnnMaria De Mars
The Julia Group
2111 7th St. #8
Santa Monica, CA 90405
(310) 717-9089
annmaria@thejuliagroup.com
http://www.thejuliagroup.com

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