DAX3 – ANOVA – Updated Fall 2020 (NOTE YOUR NUMBERS MAY BE SIMILAR BUT NOT EXACT)

A video presentation on ANOVA can be viewed by clicking on the following link: DAX3 ANOVA Video

A video walking you through DAX can be viewed by clicking on the following link: DAX3 Instructions Video

1. When you are ready to work on DAX 3, download the "DAX 3 Report Example" from the DAX 3 Assignment. Open the example report in Word. Save the file as "LastName DAX 3" (e.g., Bohler DAX3.docx). You will need to replace and fill out in your own words the meanings to the paragraphs marked in red and change the font color to black.
2. Log into SAS Studio. You should already have the "IS3310.LaborF2020" dataset uploaded to SAS, you may have given it a different name, but it is the same dataset you used for DAX1 and DAX2. If you cannot find it, redo DAX1.
3. Click on "Tasks and Utilities" in the navigation area on the left side of the window.
4. Next, click on the icon arrow next to "Tasks" and then icon arrow next to "Statistics."
5. In the menu that opens, select the "Summary Statistics" task by double-clicking it.
6. In the new tab that opens (labeled "Summary Statistics"), click on "DATA" (below the word "Settings").
7. Using the "Select a Table" icon, locate the dataset you created in DAX 1. (IS3310.LaborF2020).
8. In the "Analysis variables" area, using the "Add Columns" icon (it looks like a big plus sign), select the dependent variable "$/H". In the Classification variables area, add the categorical variables "Location." Click on the "ADDITIONAL ROLES" area arrow, and when it opens up, in the "Group analysis by" area, click on the plus sign and add the categorical variable "Position." See **Figure 1.**
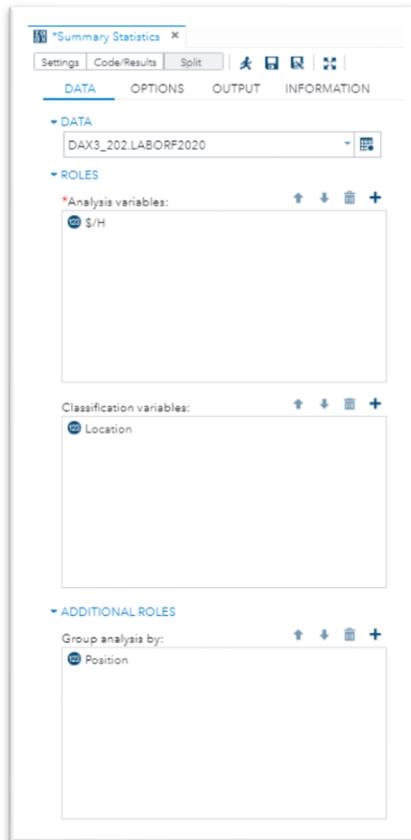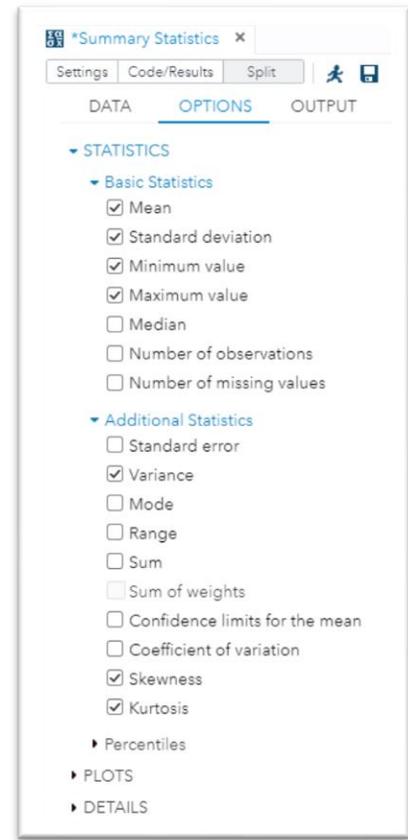

Figure 1 – Data Tab

Figure 2 – Options Tab

9. On the OPTIONS tab, under "Basic Statistics" you can deselect "Number of observations" and select "Number of missing values." Click on "Additional Statistics" and select "Variance," "Skewness," and "Kurtosis." See **Figure 2.**
10. Now click on the Run icon (it looks like a running person) or hit F3.
11. Remember to check the "LOG" for any "Errors" or "Warnings." If there are no errors or warnings, go to the next step and review the results.

12. Look at the results of the operation. You can scroll down using the scroll bar on the right-hand side of the Results window. Which of the charts, tables, plots are helpful to your understanding of this dataset?
    a. Looking at the first table, "Position 1," we see that there are 34 observations (employees) at each of ten locations. That meets our requirement to have at least 30 observations per group.
    b. The means for each location go from a low of $12.32/hour at Location 3 to a high of $14.56/hour for Location 9. Is that a significant difference?
    c. The standard deviation runs from a low of $1.33/hour for Location 6 to a high of $1.92/hour for Location 7
    d. Remember that standard deviation is the square root of variance. These measure the spread or distribution of the data. In conducting the ANOVA, we are trying to examine the **variance within each group** and compare it to the **variance between each group**, which is where we get the name for this type of analysis which is called an Analysis of Variance (ANOVA).
    e. Finally, for Position 1, for each Location, we see that the Skewness and Kurtosis measures are within our rules of thumb of -1 to +1 for skewness and -2 to +2 for kurtosis. Please note that these are only rough guidelines for determining if your data is normally distributed.
    f. The second table, "Position 2" also has employees at 10 locations, but there are only 3 or 4 employees at each location. While you can run an ANOVA on groups that have fewer than 30 observations, the results may be not be accurate due to the distribution of your data. Indeed, we can see that the skewness and kurtosis measures exceed the limits discussed earlier. If you do conduct an ANOVA on data that looks like this, there are additional items to consider which are outside the scope of this exercise.
13. Download the results as an RTF (little icon with the *W* on it). In your Downloads folder, you should have a file named "Summary Statistics-results.rtf." It will open in Word.   If you have issues with an RTF download view the following (Video).
14. Save this file so that you can return to it later in the assignment.
15. Click on the "Tasks" in the navigation area on the left side of the window.
16. Click on "Linear Models" in the navigation area on the left side of the window, under the "Tasks" list.
17. Next, double-click on the icon arrow next to "One-Way ANOVA."
18. In the new tab that opens (labeled "One-Way ANOVA"), click on "DATA" (below the word "Settings"). (The IS3310.LABOR F 2020 table will likely already appear if so, you may skip the next step).
19. Using the "Select a Table" icon, locate the dataset from DAX 1.
20. Click on the Filter icon (it looks like a funnel).
21. In the dialog box that opens type: Position = 1
22. Hit the blue "Apply" button below the text entry area.

Figure 3 – Filter Table Rows Dialogue Box

23. In the "ROLES" area, using the "Add Columns" icon (it looks like a big plus sign), select "$/HR" as your "Dependent variable." For your "Categorical variable" select the "Location" variable.
24. Click on the "OPTIONS" tab and confirm that under the "HOMOGENEITY OF VARIANCE" area, the "Levene" test is selected, under "COMPARISONS" the "Tukey" Comparisons method is selected, and for "Significance level" 0.05 is showing in the text box, since we determined that $\alpha = 0.05$ for this analysis.
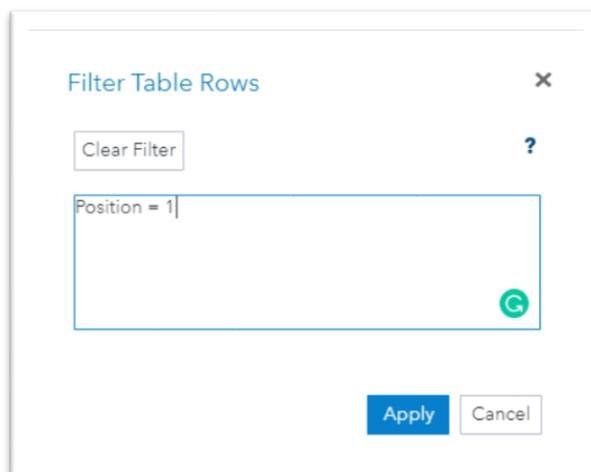25. Now click on the Run icon (it looks like a running man) or hit F3.

26. Remember to check the "LOG" for any "Errors" or "Warnings." If there are no errors or warnings, go to the next step and review the results. Tables and charts from the "RESULTS" that might be of interest to help you provide evidence of your analysis include Figures 4 through 9 on the next page.

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	9	121.992103	13.554678	4.65	<.0001
Error	330	962.572150	2.916885		
Corrected Total	339	1084.564253			

Figure 4 – ANOVA Results

Levene's Test for Homogeneity of $/H Variance ANOVA of Squared Deviations from Group Means					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Location	9	96.6054	10.7339	1.62	0.1088
Error	330	2189.2	6.6339		

Figure 5 – Levene's Test Results

Welch's ANOVA for $/H			
Source	DF	F Value	Pr > F
Location	9.0000	4.77	<.0001
Error	134.4		

Figure 6 – Welch's ANOVA results

Distribution of $/H

F 4.65
Prob > F <.0001

Figure 7 – Boxplot

Location	$/H LSMEAN	LSMEAN Number
1	12.8076471	1
2	12.9917647	2
3	12.3197059	3
4	13.0652941	4
5	12.6367647	5
6	12.4079412	6
7	13.2332353	7
8	13.3485294	8
9	14.5614706	9
10	12.9861765	10

Figure 8 – Least Squares Means Adjustment for Multiple Comparisons: Tukey
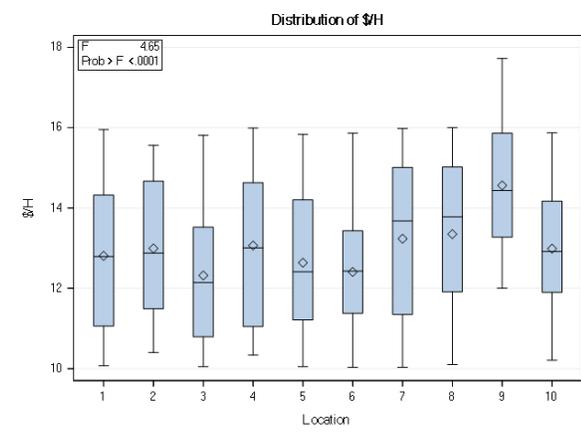
	Least Squares Means for effect Location Pr > |t| for H0: LSMean(i)=LSMean(j) Dependent Variable: $/H									
i/j	1	2	3	4	5	6	7	8	9	10
1		1.0000	0.9752	0.9998	1.0000	0.9939	0.9904	0.9519	0.0012	1.0000
2	1.0000		0.8364	1.0000	0.9975	0.9237	0.9999	0.9974	0.0068	1.0000
3	0.9752	0.8364		0.7349	0.9990	1.0000	0.4552	0.2811	<.0001	0.8431
4	0.9998	1.0000	0.7349		0.9899	0.8538	1.0000	0.9996	0.0128	1.0000
5	1.0000	0.9975	0.9990	0.9899		0.9999	0.9137	0.7845	0.0002	0.9978
6	0.9939	0.9237	1.0000	0.8538	0.9999		0.6050	0.4110	<.0001	0.9279
7	0.9904	0.9999	0.4552	1.0000	0.9137	0.6050		1.0000	0.0470	0.9999
8	0.9519	0.9974	0.2811	0.9996	0.7845	0.4110	1.0000		0.1020	0.9971
9	0.0012	0.0068	<.0001	0.0128	0.0002	<.0001	0.0470	0.1020		0.0065
10	1.0000	1.0000	0.8431	1.0000	0.9978	0.9279	0.9999	0.9971	0.0065	

Figure 9 – Location group means comparison

27. Note: The numbers in your results may differ. Download the results as an RTF (little icon with the W on it). In your Downloads folder, you should have a file named "One-Way ANOVA-results.rtf." It will open in Word. You can copy and paste tables and charts from this file, but you may need to edit them so that they are readable in your report.
28. Save this file so that you can return to it later.

Editing the Memo

29. Edit the date, your instructor's name, and your name to have the correct information.
30. Follow the instructions in the DAX3 Example Report that are provided in red text to add additional text.
31. Remove all the red text instructions from the memo.
32. Save your report as a PDF file.
33. Upload your file to the DAX3 Assignment in Canvas.