Math 484   HW 1 Fall 2022, due Friday, September 2.
Meet in Lab, Neckers 258, Monday, August 29. Need a flash drive.

4 pages, Problems A)-E). Lab1 is useful.

Quiz of Friday, Sept. 2, 1 sheet of notes. Know residual plots, response plots, how to get $\hat{Y}$ given $\boldsymbol{x} = (1, x_2, ..., x_p)^T$, or for simple linear regression (SLR) given x.

See M484lab1 on (http://parker.ad.siu.edu/Olive/M484.html) for more instructions on how to do the homework. The computer lab login is like logging into salukinet: If necessary, hit Ctrl, enter your
AD\siu8... (dawg tag) and your password. Near the lower left icon, search for Arc, SAS, etc. Left double click the `ARC` icon.

To quit `ARC`, move cursor to the **x** in the northeast corner and click.

A) **2.19***. (Scatterplot in *Arc*.) Activate the *cbrain.lsp* dataset with the menu commands "File > Load > Removable Disk (G:) > cbrain.lsp." Scroll up the screen to read the data description.

a) Make a plot of *age* versus brain weight *brnweight*. The commands "Graph&Fit > Plot of" will bring down a menu. Put *age* in the **H** box and *brnweight* in the **V** box. Put *sex* in the **Mark by** box. Click *OK*. Make the **lowess bar** on the plot read .1. Open *Word*.

In *Arc*, use the menu commands "Edit > Copy." In *Word*, use the menu commands "Paste." This should copy the graph into the *Word* document.

b) For a given age, which gender tends to have larger brains?

c) At what age does the brain weight appear to be decreasing?

B) **2.20.** (SLR in *Arc*.) Activate *cbrain.lsp* as in Problem 2.19. Brain weight and the cube root of size should be linearly related. To add the cube root of size to the data set, use the menu commands "cbrain > Transform." From the window, select *size* and enter 1/3 in the **p:** box. Then click *OK*. Get some output with commands "Graph&Fit > Fit linear LS." In the dialog window, put *brnweight* in **Response,** and $(size)^{1/3}$ in **terms**.

a) Cut and paste the output (from *Coefficient Estimates* to *Sigma hat*) into *Word*. Write down the least squares equation $\hat{Y} = b_1 + b_2 x$.

b) If $(size)^{1/3} = 15$, what is the estimated brnweight?

c) Make a residual plot of the fitted values versus the residuals. Use the commands "Graph&Fit > Plot of" and put "L1:Fit-values" in **H** and "L1:Residuals" in **V**. Put sex in the **Mark by** box. Move the OLS bar to 1. Put the plot into *Word*. Does the plot look ellipsoidal with zero mean?

d) Make a response plot of the fitted values versus y = brnweight. Use the commands "Graph&Fit > Plot of" and put "L1:Fit-values in **H** and *brnweight* in **V**. Put *sex* in **Mark by. Move the OLS bar to 1.** Put the plot into *Word*. Does the plot look linear?

C) Read the information on Minitab on p. 86-87 (72-73). Then do problem **2.15**. **This information is at the end of this handout.**

2.15. Get the data set *prof.mtw*. Assign the response variable to be *instrucr* (the instructor rating from course evaluations) and the explanatory variable (predictor) to be *manner* (the manner of the instructor). Run a regression on these variables.

a) Place the computer output into *Word*.

b) Write the regression equation.

c) Predict *instrucr* if *manner* = 2.47.

d) To get residual and response plots you need to store the residuals and fitted values. Use the menu commands "Stat>Regression>Regression" to get the regression window. Put *instrucr* in the **Response** and *manner* in the **Predictors** boxes. The click on **Storage**. From the resulting window click on **Fits** and **Residuals**. Then click on **OK** twice.

To get a response plot, use the commands "Graph>Plot," double click on *instrucr*, double click on *Fits1* and click on *OK*. Include the response plot in *Word*.

e) To make a residual plot, use the menu commands "Graph>Plot" to get a window. Place "Resi1" in the **Y** box and "Fits1" in the **X** box. Then click on **OK.** Print the plot by clicking on the graph and then clicking on the printer icon.

D) **2.16.** a) Enter the following data on the *Minitab* worksheet:

```
 x   y
30  73
20  50
60  128
80  170
40  87
50  108
60  135
30  60
70  148
60  132
```

To enter the data click on the **C1** column header and enter **x**. Then click on the **C2** header and enter **y**. Then enter the data. Or copy the data from Problem 2.17 obtained from (http://parker.math.siu.edu/Olive/lreghw.txt).
Then in *Minitab*, use the menu commands "Edit>Paste Cells" and click on "OK." Obtain the regression output from *Minitab* with the menu commands
"Stat>Regression>Regression".

b) Place the output into *Word.*

c) Write down the least squares equation.

To save your output on your flash drive (J, say), use the *Word* menu commands "File > Save as." In the **Save in** box select "Removable Disk (J:)," and in the "File name

box" enter *HW2d16.doc*. To get a *Word* printout, click on the printer icon or use the menu commands "File>Print."

d) To get residual and response plots you need to store the residuals and fitted values. Use the menu commands "Stat>Regression>Regression" to get the regression window. Put Y in the **Response** and X in the **Predictors** boxes. The click on **Storage**. From the resulting window click on **Fits** and **Residuals**. Then click on **OK** twice.

To make a response plot, use the menu commands "Graph>Plot" to get a window. Place "Y" in the **Y** box and "Fits1" in the **X** box. Then click on **OK.** Print the plot by clicking on the graph and then clicking on the printer icon.

e) To make a residual plot of the fitted values versus the residuals, use the menu commands "Graph>Plot" to get a window. Place "Resi1" in the **Y** box and "Fits1" in the **X** box. Then click on **OK.** Print the plot by clicking on the graph and then clicking on the printer icon.

f) To save your *Minitab* data on your flash drive, use the menu commands "File>Save Current Worksheet as." In the resulting dialog window, the top box says **Save in** and there is an arrow icon to the right of the top box. Click several times on the arrow icon until the **Save in** box reads "My computer", then click on "Removable Disk (J:)." In the **File name** box, enter *H2d16.mtw*. Then click on **OK**.

Instead of entering the data in a), could copy the data from Problem 2.17 obtained from (http://parker.ad.siu.edu/Olive/lreghw.txt). The column headers should still be "x" and "y." Then in *Minitab*, use the menu commands "Edit>Paste Cells" and click on "OK."

For parts d) and e), may need "Fits1" instead of "Fits" and "Resi1" instead of "Residuals" as in Problem 2.15.

E) Read the information on SAS on p. 89-90 (75-76), then do **2.17.** The SAS program is at (http://parker.ad.siu.edu/Olive/lreghw.txt).

For part c), just want the Anova table. The data is the same as in Problem 2.16, so the SAS response and residual plots look like those of *Minitab*.

You could cut the Anova table from *Word* and paste it into *Notepad*.

See output for HW1 on the Math 484 website if SAS is not available.

2.17 a) Copy and paste the program for this problem from (http://parker.ad.siu.edu/Olive/lreghw.txt), or enter the *SAS* program in *Notepad* or *Word*. The *ls* stands for linesize so *l* is a lowercase *L*, not the number one.

When you are done entering the program, you may want to save the program as *h2d17.sas* on your flash drive (J: drive, say). (On the top menu of the editor, use the commands "File > Save as". A window will appear. Use the upper right arrow to locate "Removable Disk (J:)" and then type the file name in the bottom box. Click on OK.)

b) Get back into *SAS*, and from the top menu, use the "File> Open" command. A window will open. Use the arrow in the upper right corner of the window to navigate to "Removable Disk (J:)". (As you click on the arrow, you should see My Documents, C: etc, then Removable Disk (J:).) Double click on **h2d17.sas**. (Alternatively cut and paste the program into the *SAS* editor window.) To execute the program, use the top

menu commands "Run>Submit". An output window will appear if successful.

If you were not successful, look at the *log window* for hints on errors. A single typo can cause failure. Reopen your file in *Word* or *Notepad* and make corrections. Occasionally you can not find your error. Then find your instructor or wait a few hours and reenter the program.

c) To copy and paste relevant output into *Word* or *Notepad*, click on the output window and use the top menu commands "Edit>Select All" and then the menu commands "Edit>Copy".

In *Notepad* use the commands "Edit>Paste". Then use the mouse to highlight the relevant output. Then use the commands "Edit>Copy".

Finally, in *Word*, use the command "Paste". You can also cut output from *Word* and paste it into *Notepad*.

You may want to save your *SAS* output as the file *HW2d17.doc* on your flash drive.

d) To save your output on your flash drive, use the *Word* menu commands "File > Save as." In the **Save in** box select "Removable Disk (J:)" and in the "File name box" enter *HW2d17.doc*. To get a *Word* printout, click on the printer icon or use the menu commands "File>Print."

Save the output giving the least squares coefficients in *Word*.

e) Predict Y if $X = 40$.

f) What is the residual when $X = 40$?

Arc and *R* are on computers 11–25, Minitab is on computers 11–13, 18–20, 23–25, hopefully SAS is on computers 11-25 or 13, 16-19, 21, 23, and 25. The SAS license could expire soon. *Arc* and *R* are free software that can be downloaded on your personal computer. See text and syllabus for URLs.

Google my name, get to my website, click on the Linear Regression website, click on the lreghw.txt link, highlight the program for problem 2.17. Hit Ctrl–c. Click the lower left icon to see programs. Double click the SAS icon. The editor window is the lower window. Click on that window, then hit Ctrl–v to paste in the program. Then run>submit. Output will appear in a few minutes.

In Windows, when you want to log out, hit Ctrl-Alt-Delete and a menu will appear with the option to logout. You can also right click the lower left window icon and youll see a sign out or shut down option.

Minitab Problems

There appear to be at least 3 versions of Minitab in the computer lab, a few computers do not have easy access to "Sutdent Minitab." On a few computers, you may need to click on a "Open sample Minitab data" near the bottom of the screen.

"Double click" means press the rightmost "mouse" button twice in rapid succession. "Drag" means hold the mouse button down. This technique is used to select "menu" options.

After your computer is on, get into *Minitab*, often by searching programs and then double clicking on the icon marked "Student Minitab."

i) In a few seconds, the *Minitab* session and worksheet windows fill the screen. At the

top of the screen there is a menu. The upper left corner has the menu option "File." Move your cursor to "File" and drag down the option "Open Worksheet." A window will appear. Double click on the icon "Student." This will display a large number of data sets.

ii) In the middle of the screen there is a "scroll bar," a gray line with left and right arrow keys. Use the right arrow key to make the data file " Prof.mtw" appear. Double click on "Prof.mtw." A window will appear. Click on "OK."

iii) The worksheet window will now be filled with data. The top of the screen has a menu. Go to "Stat" and drag down "Regression." Another window will appear: drag down Regression (write this as Stat>Regression>Regression).

iv) A window will appear with variables to the left and the response variable and predictors (explanatory variables) to the right. Double click on "instrucrs" to make it the response. Double click on "manner" to make it the (predictor) explanatory variable. Then click on "OK."

v) The required output will appear in the session window. You can view the output by using the vertical scroll bar on the right of the screen.

vi) Copy and paste the output into *Word*, or to print your single page of output, go to "File," and drag down the option "Print Session Window." A window will appear. Click on "ok." Then get your output from the printer.

Use the **F3** key to clear entries from a dialog window if you make a mistake or want a new plot.

To get out of *Minitab*, move your cursor to the "x" in the upper right corner of the screen. When asked whether to save changes, click on "no."