**Lab JMP Exercise and Assignment**

The goals of this assignment are to (1) give review for you the basic tools to statistically analyze quantitative data and to display it visually, and (2) expand your critical skills as a consumer of quantitative data and graphs by unpacking the process that generates them, and (3) explore some data that were collected previously, to allow you to focus on exploring, analyzing and graphing them.

You may work together with peers, but each of you must individually turn in the complete assignment.

Finally, this assignment requires you to answer specific questions that appear throughout the extensive prompt that follows. Please complete the assignment through Canvas, which follows the same numbering as this assignment. In the occasion that you are unable to submit the assignment on Canvas, please organize your answers into a single Word document, numbered to correspond to the question numbers in the prompt.

**Part I. OPTIONAL JMP tutorial**

To start the JMP tutorial:

* Launch JMP (available by free download to students at <http://its.ucsc.edu/software/student-software.html>)
* EITHER click the “Start Beginner’s Tutorial” in the Tip of the Day window that pops up, or
* Under the “Help” menu, choose Tutorials -> Beginners’ Tutorial

Walk through the tutorial to refresh your familiarity with the structure of menus and functions in JMP. This will take about 5-10 minutes.

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**Part II. Analyzing the relationship between wildfire and plant biodiversity**

At UCSC’s Big Creek Reserve in Big Sur, California (<http://bigcreek.ucnrs.org/>), seasonal wildfires occur every few to several years during the dry summer months as a result of lightning and occasional ignition accidents, such as escaped campfires. These fires have burned different areas of the reserve at different times, removing vegetation and releasing carbon and nutrients from the soil. In the extensive grasslands on the reserve, fires burn off both the living vegetation and the accumulated dead litter on the ground. Plants recolonize these grasslands rapidly following fire, changing over time in diversity and composition.

In this mini-study, you are investigating the effects of wildfire on the biodiversity of plants. Specifically, you are looking at areas on the reserve burned at different times in the past to ask about the effect of time elapsed (since the most recent fire) on grassland species density (the number of species per unit area). You have data from three areas burned 14, 9, and 5 years ago, respectively.

**Q1.** Write out a null hypothesis for the relationship between fire history (years since fire) and plant species richness.

**Q2.** Formulate a specific (alternate) biological hypothesis and a 1-3 sentence explanation of why you expect this relationship.

*a. Download Dataset #1 from CANVAS*

* Open and download the file to your computer, to a location you can find it in
* In JMP, choose File -> Open -> locate and select the “Lab 1 data (burn\_data)” file
* *Tip: If you do not see the data file you downloaded, change the file type (drop down menu) from “All JMP Files” to “All Files (\*.\*)”*
* JMP will (likely) open the “Excel Import Wizard” page with a data preview window. Click “Import”

The file has three columns: a column called “Sites” (site names are letters, A-DD), a column called “Years since burn”, and column called “Plant richness” that reports how many species were found per plot at the site in question.

*b. Make burn year a continuous variable:*

*- In the middle left of the data window, under “columns,” click on the red icon next to “years since burn.” (Some of you may find that the icon next to “years since burn” is already a “continuous” variable with a blue triangle and do not need to change anything here).*

*- When the window pops up, “nominal” is checked – the three burn years are being treated here as named categories. Choose “continuous.” The icon next to “years since burn” will change to a blue triangle.*

*You are going to test your hypothesized relationship between years since burn and richness.*

**Q3.** Which will be the independent variable in this test?

**Q4.** Which is the dependent variable in this test?

*c. Make a scatterplot of your data.*

* Select “JMP Starter” from under the “View” (PC) or “Window” (Mac) drop-down menu (along the top bar)
* Select “Basic” in the “Click Category” box on the left of that window,
* Select “Bivariate” in the “Bivariate Analysis” box in the center to look at the relationship between two continuous variables.

*Pay attention:* What does the description of “bivariate” say?

* Put your independent variable in the “x regressor” box by selecting the variable you want in the left box, then clicking the “x regressor” button. Put the dependent variable in the “y regressor” box in the same way
* (*Hint: you can also drag and drop your variables into the “x regressor” or “y regressor” boxes*)
* Click “OK.” You get a scatterplot with faint points.

*d. Perform a linear regression of richness on burn year.*

* *Click the red triangle next to “Bivariate Fit of Richness by Years Since Burn” to get a dropdown menu of options.*
* *Click “fit line” to fit a regression line to the points, and inspect the line that JMP fits and the data that it displays about the statistical test.*
* *Change the line color to black by clicking the red triangle next to the legend (“linear fit” and a line) beneath the graph, selecting “line color,” and clicking on black.*

**Q5.** What is your sample size? [This is the “observations” value.]

**Q6.** Write out a sentence reporting the value of your RSquare and describing what this number means.

**Q7.** Is the slope significantly different from zero?

**Q8.** Can you reject the null hypothesis (from Q1)?

**Q9.** Does the test support your alternate hypothesis? If not, do you have any ideas about why that could be, biologically speaking?

**Q10.** What is the value of the slope parameter in the regression equation?

**Q11.** Write out the linear equation that is the best fit to your line.

**Q12.** Write out your statistical result in the formal format of ecological findings: a single, precise sentence telling how time since wildfire affected the response variable, followed by a summary of statistical information in parentheses as follows:

*Concise sentence describing the relationship supported by the statistical test* (R2=XX, p=XX, linear regression equation).

*Note: To save the graph for use in a report or other document (not required at this stage for the assignment, but useful for future reference):*

1. *Click the selection tool (white cross in the toolbar at the top of the bivariate fit window).*
2. *Highlight the area that you want to save – you might need to highlight each area of the graph, such as the axes, plot area, and title, while holding the shift key.*
3. *Select* ***Edit > Save Selection As*** *(Windows) or select* ***File > Export*** *(Macintosh).*
4. *Select the graphics file format to which you want to save the selection (if you are unsure, .png or .jpeg are both good file extension choices).*

*e. Perform an ANOVA test on the relationship between burn year and richness*

**Q13.** Why does it make more sense to use an ANOVA test than a regression to evaluate the relationship between burn year and richness with this data set? (One detailed sentence is fine.)

*1. Change your data type for the test*

- In the middle left of the data window, under “columns,” click on the blue triangular icon next to “Years since burn.”

- When the window pops up, “continuous” is checked – the three burn years are being treated here as values from a continuous spectrum. Choose “ordinal.” This makes “burn year” a variable with categories that proceed from low to high values. The icon next to “Years since burn” will change to a green bar chart.

*2. Perform the ANOVA test.*

- Select “JMP Starter” from under the “View” (PC) or “Window” (Mac) drop-down menu (along the top bar).

* Select “Basic” in the “Click Category” box on the left of that window,
* then select “Oneway” in the “Bivariate Analysis” box in the center to look at the relationship between a continuous variable and one or more categorical factors.

*Pay attention:* What does the description of “Oneway” say?

* Put your independent variable in the “x grouping” box by selecting the variable you want in the left box, then clicking the “x grouping” button. Put the dependent variable in the “y response” box in the same way.
* Click “OK.” You get a graph with three years on the x-axis and points above each for your species richness data in each group.
* Click the small red triangle next to the graph title. Choose “Means/ ANOVA.”

**Q14.** What is your F value (ratio)?

**Q15.** What is the mean richness value for 5 years after the burn?

**Q16.** What is the mean richness value for 9 years after the burn?

**Q17.** What is the mean richness value for 14 years after the burn?

**Q18.** Are the mean richness levels significantly different among burn years?

**Q19.** Can you reject the null hypothesis (from Q1)?

**Q20.** Write out your statistical result in the formal format of ecological findings: a single, precise sentence telling how time since wildfire affected the response variable, followed by a summary of statistical information in parentheses as follows:

*Concise sentence describing the relationship supported by the statistical test* (F=XX, p=XX).

*3. Perform a post-hoc test of which means are significantly different from each other.*

- Click the red triangle next to the graph title. Choose “Compare Means” 🡪 “Each pair, Student’s t.”

**Q21.** Describe, in one or two sentences, which burn years differ significantly in their richness levels and which do not.

**Q22.** What is the p-value associated with the difference in richness between areas burned 14 and 9 years ago?

**Q23.** Does richness increase or decline with time since the last wildfire?

**Q24.** Propose an explanation for why richness levels differ among certain pairs of years and not others (1-2 sentences is fine).

*f. Make a bar chart of your data*

- Select “Graph Builder” from the “Graph” dropdown menu at the top of the page.

- Drag “Years since burn” from the left-hand list of column variables to the x-axis.

- Drag “richness” from the left-hand list of column variables to the y-axis.

- Click on the icon along the top for a bar chart (vertical bars): Icon

Description automatically generated

- Select “Standard Error” in the dropdown menu next to “Error Interval”.

Your left-hand options should look like this:

Graphical user interface, chart, application

Description automatically generated

Now let’s clean up the graph:

- Click directly on the y-axis label to edit and change it to “Species richness.”

- Right click or two-finger click on the right-hand legend icon showing blue (Mean) as the color for the y-axis variable. Choose “Fill Color” and change it to gray.

-Click on the title above the graph “Mean (Plant richness) vs. Years since burn” and delete all the text so there is no title.

*g. Export your graphic to put in a report.*

- Click “Done” in the top left area of the graph builder.

- Take a screenshot of the graph with axis labels (but excluding the legend “Mean” on the right; you don’t need it since there’s only one response variable).

- Open a word document and paste the graph there.

- *Alternate method to save your graphic*:

1. - *Click the selection tool (white cross in the toolbar at the top of the bivariate fit window).*
2. *Highlight the area that you want to save – for this graph, highlight the whole graph, (exclude the phrase “Each error bar is constructed…” at the bottom), include axis titles, axis numbers, plot area with bars and error bars, while holding the shift key.*
3. *Select* ***Edit > Save Selection As*** *(Windows) or select* ***File > Export*** *(Macintosh).*
4. *Select the graphics file format to which you want to save the selection (if you are unsure, .png or .jpeg are both good file extension choices).*
5. *You will need to crop out the legend with the gray color bar and "Mean" from the final image.*

**Q25.** Include your figure and add a descriptive figure caption to it in the Word document, directly below it. For examples, look at figure captions in the journal *Ecology*. Format should be, as concisely as possible, for example:

**Figure 1.** A phrase describing where (location) the data were collected and the relationship depicted. Information about what the error bars are. Information about the statistical significance of the relationship and the particular values that differ from each other.