

## inferences lab

Dr. Sarah's 1010: Introduction to Mathematics

Consumer Statistics and Probability: To recognize misrepresentations of studies and statistical data in the real world by applying statistical techniques and understanding the role of chance and probability goals:

- critically analyze the role of probability and chance in real world situations, in numerical data and graphical representations
- adapt and use key features in an Excel table to investigate real world data
- explore quantitative connections within geographical regions
- communicate statistics and probability information in written documents

**Egg Bungee Jump Regression:** Today we will let you decide how long to make the bungee cord for a fragile jumper—a raw egg. The goal is to make it exciting but not fatal for your jumper. A small prize will be given to the group that gets closest to the ground without harming their egg. There is only 1 egg per group.

**The Experimental Stage** Gather your data as follows:

1. Work in a group of 4 or 5, but each person should answer the questions on a separate piece of paper. Be very careful with your egg—protect it from hitting anything and make sure that it doesn't swing back and hit the meter stick. Accuracy is important, so the same person should drop the egg each time. Make 3 jumps each with 2, 3, 4, and 5 rubber bands from a height of 1 meter. You may use a pen and hold it perpendicular to the top of the stick so that you drop the egg sufficiently far away from the meter stick. Record how far the egg travels from the top of the meter stick to the point closest to the ground (12 data points).

number of rubber bands	distance dropped (cm)
2	
2	
2	
3	
3	
3	
4	
4	
4	
5	
5	
5	

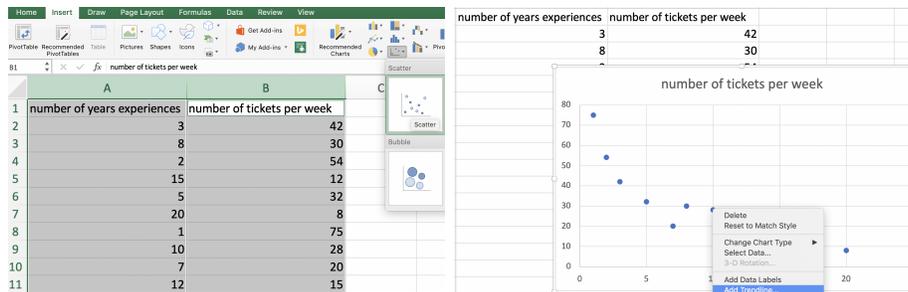
2. Enter your data in Excel as two columns in column A and column B.

3. To create a scatterplot, best fit line, and  $R^2$  value in Excel:

–Click on the grey A so the first column is highlighted

–Hold down the Command (cloverleaf) key on a Mac as you click on the grey B so both columns are highlighted. Something like the Windows key on a PC should work similarly.

–Under the Insert menu choose the scatterplot. Here is what this looks like for a different data set:



If it didn't come out correctly you may have an extra box selected and may need to repeat the above steps to make sure you didn't have anything else selected by mistake.

–Next use the control key as you click on one of the points on your graph and Add Trendline (see above pic on right).

–Under Format Trendline or Trendline Options select the bottom two options (**Display equation on chart** and **Display R-squared value on chart**). Click on the X to finish it, or OK. Back on the chart, you can drag the equation of the line or resize it if you need to see it better. You'll see the scatterplot, best fit line, and  $R^2$  value.

4. What is the  $R^2$  value, as a percent?

5. Even with the variability in rubber bands and possible measurement inconsistencies, the number of rubber bands should be a strong predictor of the distance traveled because inspector number 22 asserted the stretch ability and similarity of these rubber bands (according to my packaging!). Thus this shows almost a constant slope for the change in distance dropped / change in rubber bands:

$$\frac{\Delta y}{\Delta x} = \frac{\Delta \text{distance dropped}}{\Delta \text{rubber bands}}$$

Is inspector number 22 correct, i.e. what is the statistical strength of the regression relationship:

- 0 to 10% no
- 10% to 25% weak
- 25% to 65% moderate
- above 65% strong

6. What is the equation of the best fit line?

7. EXACTLY what prediction of the number of rubber bands required for 2.0 meters does the regression line give (plug in 200 cm as the  $y$ -value and solve for  $x$  using algebra)? SHOW WORK!

8. **Build and Bring Up Front** Using the predicted number of rubber bands, the  $R^2$  value, and anything else you want to factor into your decision, decide how many rubber bands you will use for the 2.0-meter bungee jump. You may be creative and fold a rubber band in half. The team that comes closest to the ground without any egg damage wins. Build, but **DO NOT TEST NOR BOUNCE** the bungee machine. Name your egg (Egger Allen Poe?) and put a slip of paper with
- your group name
  - your first names
  - your best fit line and  $R^2$  value, and
  - how many rubber bands you decided to use
- and bring the egg with the added rubber bands and the paper up front with the bowl as you continue to work below.

**The Contest** Your egg dropper will drop the egg when I bring us together, and I'll also need some volunteer judges!

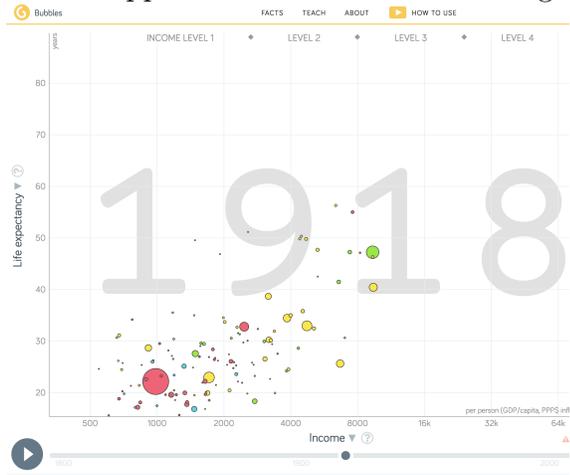
### Does Armspan Predict Height?—Open `classdata1.xlsx`

- Search the web to find information about Leonardo da Vinci's speculation about the relationship between armspan and height. Should we expect armspan to be correlated to height?
- Open `classdata1.xlsx` on ASULearn. Follow the Excel process for the Armspan and Height data. What is the  $R^2$  value, as a percent?
- What is the statistical strength of the regression relationship (see above in #5)?
- Examine the data. Is the data likely feasible for our class? Why or why not?
- Open `points removed` on ASULearn. Take a look at the graph of the same data, but where I removed some points that contradicted the related text that accompanied Leonardo da Vinci's Vitruvian Man: "The length of a man's outspread arms is equal to his height." What is the new  $R^2$  value written as a percent?
- How does the removal of the points affect the line (is the line steeper or more horizontal)?

**Gapminder:** Open **Gapminder Tools** from ASULearn.

- Even without  $R^2$  in front of us, we can visually inspect and categorize relationships and their statistical strength. Do you think the most recent Income graph shown is at least a statistically moderate predictor of Life expectancy (i.e. moderate/strong versus a no/weak correlation)?

16. Hit the play button at the bottom left of the graph. Is the statistical relationship similar across all time?
17. What happened in 1918 to cause the significant dips in life expectancy?



18. Click on and play “How to Use” on the top right (above Level 3 in my browser, it might be elsewhere or under the three line menu bars—what is called the hamburger menu icon— on yours). Next modify the variables on the  $x$  and/or  $y$  axis, i.e. change Income and/or Life expectancy to explore various relationships, and keep track of ones you found especially revealing. List one set here.

19. Name at least one item from Gapminder that you found interesting or surprising, or that you had a question on.

20. Collate your handwritten responses, preferably on this handout, into one full size multipage PDF for submission in the ASULearn assignment.

Continue exploring Gapminder until we come back together for the contest!