Math 160, Assignment #2 Assigned Nov 22, 2021
Due On Dec 6, 2021

Name: _____

1. Some archaeologists find a coin that is flat on one side, but convex on the other.
   a) They toss it 28 times, and observe that it comes up heads on only 12 of those tosses. Determine the best estimate of how often this coin comes up heads, as a percentage. You must include the uncertainty in the mean as a ± value, too (also written as a percentage).
   b) They then toss it an additional 44 times, observing that for these new trials, the coin shows heads another 17 times. Re-compute everything that you did in part a), using all 72 trials.

2. For a group of farms in Livingston County, the farmers notice that their average profits each year vary, as does the yearly rainfall as shown in this (faked) data table.

Year	Annual Rainfall (inches)	Profit per acre ($)
2010	33	768
2011	36	827
2012	28	575
2013	34	820
2014	35	874
2015	30	651
2016	31	783
2017	34	845
2018	29	683
2019	37	910
2020	32	760

   a) Find the slope m_1 and the intercept b_1 for the best-fit straight line that shows how profit depends on rainfall. Don't forget that both of these values require units to have a chance of making sense!
   b) Using "Linest" in Excel, find the "68% confidence interval" for m_1 and b_1. Remember to include units. For the rest of this problem, we'll call the value for the standard deviation that Linest gave us "the uncertainty".
   c) Determine the Sample Correlation Coefficient.
   d) Determine Pearson's Correlation Coefficient.
   e) Using your answer to part d, estimate how much farm profits depend on rainfall (as a percentage), as opposed to depending on other factors.
   f) Interpret: The intercept b_1 was negative… that means that there exists some amount of rainfall where a farmer would expect to earn no profit at all. Estimate this minimum rainfall value. Note: It's beyond the scope of this course, but this value has an uncertainty of about 4.3 inches of rainfall.
   g) Suppose that in 2021, the rainfall was 31 inches. Use your answer to part a) to estimate the "predicted" farm profits for 2021.
   h) Make an excellent plot of the data. If you can think of a way to make your plot look better, then do it. Hopefully, I won't be able to think of a way to make your plot look better!

3. This question uses the same data from problem 2. Suppose that we think that rainfall depends on farm profits, instead of the other way around (!).
   a) Find the slope m_2 and the intercept b_2 for the best-fit straight line that shows how rainfall depends on farm profits.
   b) Determine the new Sample Correlation Coefficient.
   c) Determine a new value of R^2 (using Pearson).
   d) This analysis gives us a somewhat different estimate for the minimum amount of rainfall needed to earn a profit. What is this new minimum rainfall value? Note: perhaps you already discovered that this value has an uncertainty of about 2.7 inches of rainfall.
   e) To what extent do you think that your answer to questions 2f) and 3d) agree or disagree? Use complete sentences that assume the reader has not examined any of your prior analyses.

f) In question 2a, you found a slope m_1 that had units of dollars of profit per inch of rainfall. Now, you have a "new" slope m_2 in units of inches of rainfall per dollar of profit. Convert m_2 into a new value (let's call it q) for dollars of profit per inch of rainfall. Note: It's beyond the scope of this course, but this value for q has an uncertainty of about 4.8 dollars per inch of rainfall.

g) Both m_1 and q tell us approximately how much "extra" profit the farmer would earn if there was one additional inch of rain that year. You can see that they're both in the ballpark of $30ish, but they're not exactly the same. Use complete sentences that assume the reader has not examined any of your prior analyses to explain what all the analyses together tell us about how profit depends on rainfall.

4. In a business meeting, six people are in attendance. The salary of each is shown (in thousands of dollars) in the table to the right. Then the CEO (who has a salary of ($1,300k) walks into the room.

Employee	Salary (k$)
1	66
2	123
3	57
4	88
5	104
6	72

a) What were the average salary and 95% confidence interval before the CEO entered?

b) What were the average salary and 95% confidence interval after the CEO entered?

c) How many of the original 6 employees earned more than $200k before the CEO entered?

d) How many of the original 6 employees earned more than $200k after the CEO entered?

e) If none of the employees' salaries increased when the CEO entered, write a (correct) interpretation of why the average salary increased so much compared to the standard deviation.

f) Re-computing the average salary was not reasonable in this example, but if a different person had entered, it might be. Under what circumstances would it be reasonable to compute a new average salary for a group like this? Hint: Your answer should use words like "normal", "sample", "population", etc.