Stat Support Activity: Correlation Hypothesis Test

Notes: Review the Correlation Coefficient (r)

- If r is close to +1 (like r = +0.893) then there is a Strong, Positive Correlation (line going up from left to right (positive slope) and the points in scatterplot are close to line) ,
  (r ≈ +0.6, +0.7, +0.8 , +0.9 usually indicate pretty strong positive correlation)

- If r is close to −1 (like r = −0.916) then there is a Strong Negative Correlation (line going down from left to right (negative slope) and the points in the scatterplot are close to the line)
  (r ≈ −0.6, −0.7, −0.8 , −0.9 usually indicate pretty strong negative correlation)

- If r close to zero (like +0.037 or −0.009) then there is a No linear correlation. Points in the scatterplot do not follow any linear pattern. There still could be a nonlinear curved pattern though. (r ≈ ±0.1, ±0.0 usually indicate no linear correlation)

- If r ≈ ±0.4, ±0.5 usually indicate moderate linear correlation. There is a linear pattern and points are moderately close to the regression line.

- If r ≈ ±0.2, ±0.3 usually indicate weak linear correlation. There is some linear pattern but the points are not very close the regression line.

Problem Directions: For each correlation coefficient critical value(s), draw a picture of the normal r distribution. Does the sample correlation coefficient fall in a tail? Describe the strength (weak, moderate, strong, or no correlation) and the direction (negative, positive, or none) of the sample correlation.

	Correlation Coefficient (r)	Strength of Correlation (Weak, Moderate, Strong, or No Correlation)	Direction of Correlation (Positive, Negative, or None
1.	r = 0.123		
2.	r = −0.799		
3.	r = 0.921		
4.	r = −0.026		
5.	r = 0.483		
6.	r = −0.834		
7.	r = 0.112		
8.	r = −0.461		

Notes: Correlation Hypothesis Test Null and Alternative Hypothesis.

- Population Correlation Coefficient “rho” = ρ
- Population Slope “beta-one” = β_1
- If there is no correlation, ρ and β_1 will be zero.

Stat Support Activity: Correlation Hypothesis Test

- Two-tailed Correlation Test (Quantitative Relationship Test)
  H_0: $\rho = 0$ *or* $\beta_1 = 0$ (No correlation between the two quantitative variables.)
  H_A: $\rho \neq 0$ *or* $\beta_1 \neq 0$ (Is correlation between the two quantitative variables.)

- Right-tailed Positive Correlation Test (Direct Relationship)
  H_0: $\rho = 0$ *or* $\beta_1 = 0$ (No correlation between the two quantitative variables.)
  H_A: $\rho > 0$ *or* $\beta_1 > 0$ (Is positive correlation or direct relationship between two quantitative variables)
- Left-tailed Negative Correlation Test (Inverse Relationship)
  H_0: $\rho = 0$ *or* $\beta_1 = 0$ (No correlation between the two quantitative variables.)
  H_A: $\rho < 0$ *or* $\beta_1 < 0$ (Is negative correlation or inverse relationship between two quantitative variables)

Problem Directions: Write the null and alternative hypothesis in context for the following claims. Is the alternative hypothesis or the null hypothesis the claim?

9. "We claim that the age of a person (years) and the amount of money ($) in their savings accounts are directly related (positive correlation)."
10. "We claim there is no relationship between the resting heart rate (beats per minute) of a person and their cholesterol (mg per deciliter)."
11. "We claim there is an inverse relationship (negative correlation) between the costs and profits of a company in thousands of dollars."
12. "We claim that the gas mileage of a car (miles per gallon) is related to the time (seconds) it takes for the car to go from 0 mph to 60 mph.
13. "We claim there is not a direct relationship (positive correlation) between the time (months) this company has been in business and their revenue (thousands of dollars)."

Notes: Using T-test Statistic

- Most statisticians prefer to use the T-test statistic to see if the sample data significantly disagrees with the null hypothesis.

- Calculate the degrees of freedom (df = n – 2) where n is the number of ordered pairs of quantitative data.

- Use the correlation coefficient *r* to calculate $1 - r^2$.

- Use *df, r and* $1 - r^2$ to calculate the t-test statistic with the shortcut formula.

  T-test statistic for correlation = $\frac{(Sample\ Slope - 0)}{Standard\ Error} = r \times \sqrt{\frac{df}{(1-r^2)}}$

Stat Support Activity: Correlation Hypothesis Test

- Sentence: T-test statistic for correlation counts the number of standard errors that the sample slope is above (+) or below (−) zero.

Problems Directions: Fill out the following table using a calculator and StatKey.

	Sam-ple Size (*n*)	De-grees of Free-dom *n – 2*	Correl-ation Coeffi-cient *r*	$1 - r^2$	T test stat
14.	30		+0.123		
15.	50		−0.799		
16.	40		+0.921		
17.	45		−0.026		
18.	35		+0.483		
19.	55		−0.834		
20.	60		0.112		
21.	36		−0.461		