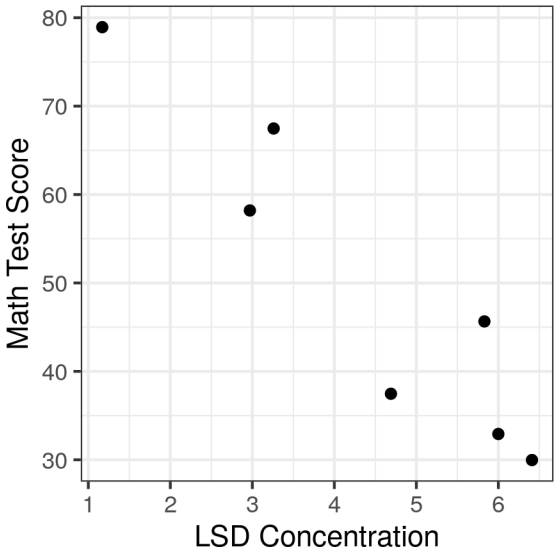
Chapter 10 Scenarios

Math on LSD

In the 1960s, there was considerable research into the effects of drugs such as LSD. In one experiment, researchers gave a group of 5 volunteers 2 micrograms of LSD intravenously, and then administered math tests to the participants at 7 timepoints (5, 15, 30, 60, 120, 240, 480 minutes) while measuring the concentration of LSD in the volunteers tissue. The average of the 5 scores, and the average concentration of LSD were recorded.



LSD conc.	Math Score
1.17	78.9
2.97	58.2
3.26	67.5
4.69	37.5
5.83	45.6
6.00	32.9
6.41	30.0

Wagner, Agahajanian, and Bing (1968). Correlation of Performance Test Scores with Tissue Concentration of Lysergic Acid Diethylamide in Human Subjects. Clinical Pharmacology and Therapeutics, Vol.9 pp635-638.

1. What is the explanatory variable? What is the response variable?

2. Is this an experiment? Does it have random sampling? Random assignment?

3. What conclusions can you make as a result of this experimental design? What conclusions can you not make? Why?

4. Describe the relationship between LSD concentration and math test score (form, direction, strength,

high influence points)

5. What do you know at this point about the correlation coefficient? What do you know about the value of b, the slope of the regression line?

6. Enter the data in the table above into the Two Quantitative Variables/regression applet. Get the equation of the fitted regression line and the sample correlation coefficient from the applet.
   - Regression equation:
   - Correlation coefficient:

7. Interpret the value of the intercept in the regression equation in the context of the problem.

8. Interpret the value of the slope in the regression equation in the context of the problem.

9. What is the null hypothesis, in words (you do not have to specify a specific statistic or parameter)? What is the alternative hypothesis?

10. Conduct a simulation study designed to test the hypothesis. Select the slope as your statistic of choice. Report your p-value and interpret the results. Can you reject the null hypothesis?

11. Without re-shuffling, change the statistic of interest to the correlation coefficient. Report your p-value and interpret the results. Can you reject the null hypothesis? How does your answer compare to the answer on the previous question?

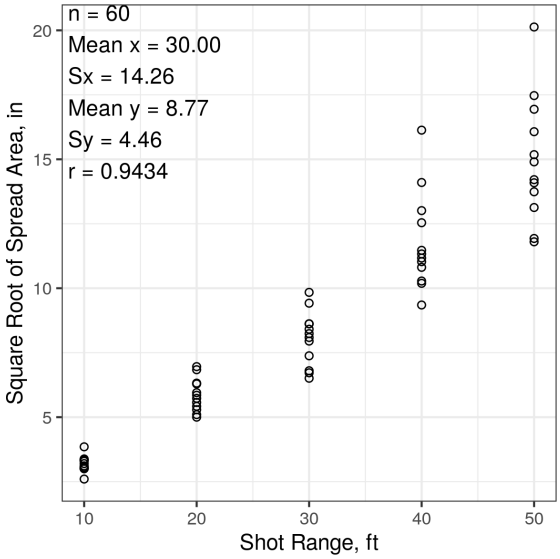
12. What are the validity conditions for theory-based inference on the slope? Are these conditions met?

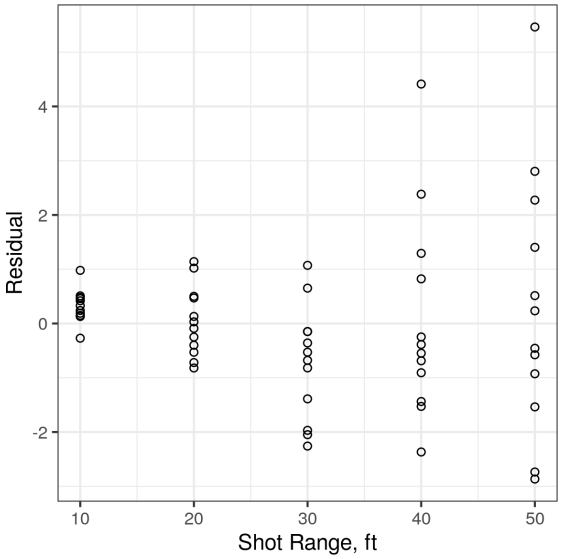
13. Check the box in the center-left of the applet that says "Regression Table". Using the table values, create and interpret a 2SD theory-based confidence interval for the slope. (Note: using the 95% interval provided by the applet will not get the correct answer - do the calculation by hand)

14. Calculate the coefficient of determination (R^2). Interpret it in the context of the problem.

Shotgun Scatter

Forensic firearms examiners often need to examine evidence at a crime scene to determine where the perpetrator was standing when a shot was fired. In one experiment, examiners measured the square root of the area spread of shotgun pellets to range of fire, for shotgun cartridge types, to provide data for estimation of firing distance from the spread of pellets at a crime scene.





1. What is the explanatory variable? What is the response variable?

2. Describe the association between shot range and the square root of spread area.

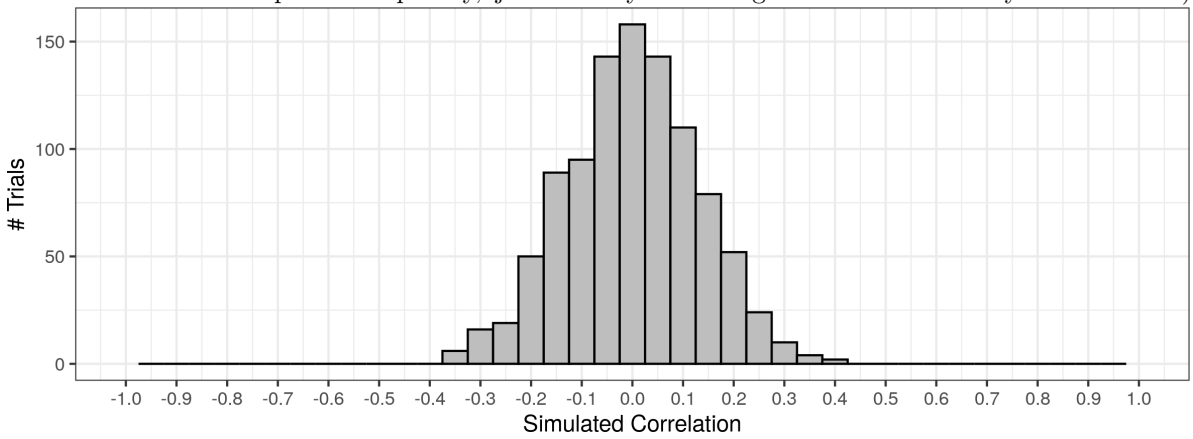
3. Calculate the value of the slope of the regression line.

4. Calculate the value of the intercept of the regression line.

5. What does the value you got for the slope mean in the context of the problem?

6. What does the value you got for the intercept mean in the context of the problem? Does this make sense?

7. To test the null hypothesis that there is no relationship between scatter area and shot range using the correlation coefficient, you conduct a simulation study using the correlation coefficient as the statistic. The simulated distribution is shown below. Draw one or more vertical lines indicating the cutoff for values considered "extreme" on the chart below. Shade in the extreme values and decide whether you think the p-value is low enough to reject the null hypothesis. (You do not have to calculate the p-value explicitly, just make your best guess from the area you shaded in.)



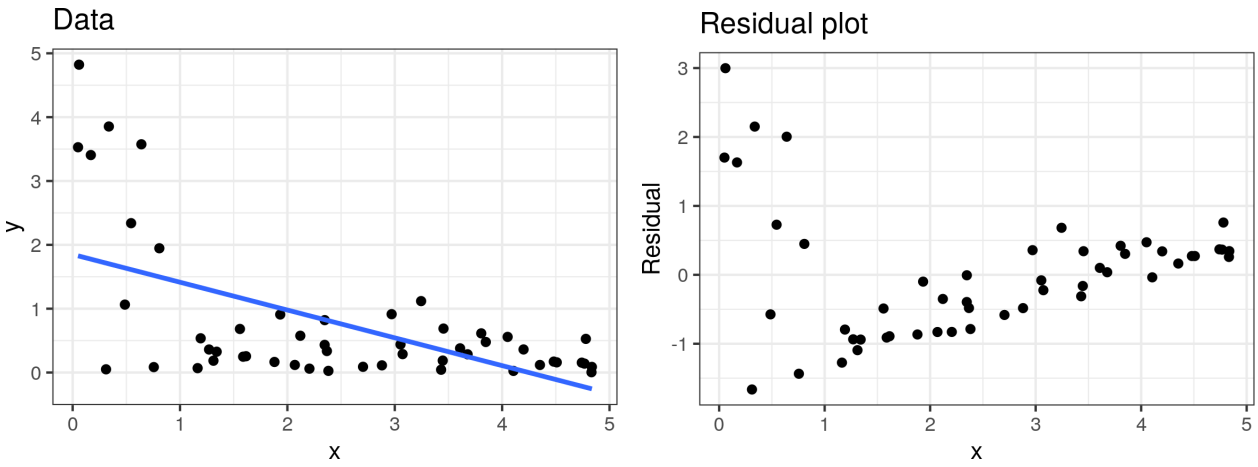
8. Using the p-value you estimated in the previous problem, what are your conclusions in the context of the problem?

9. What are the validity conditions for theory-based inference? Are they met? Why or why not?

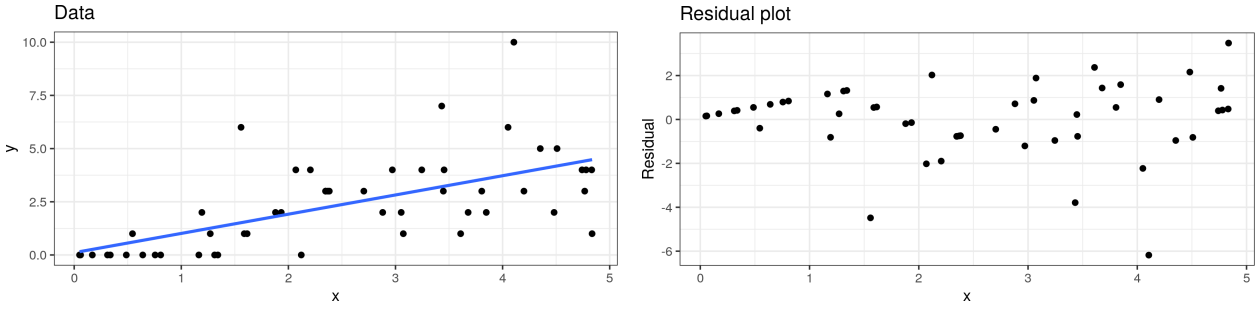
Describing plots

For each set of graphs below, describe the association between x and y and determine if theory based inference is appropriate using the corresponding residual plot.

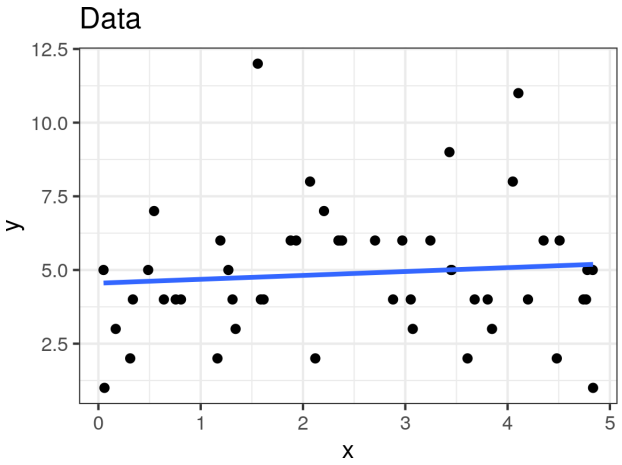
1.

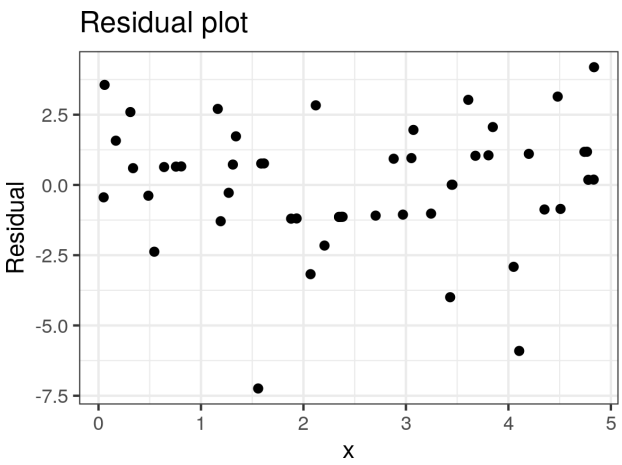


2.



3.


Data
y
x
12.5
10.0
7.5
5.0
2.5
0
1
2
3
4
5


Residual plot
Residual
x
2.5
0.0
-2.5
-5.0
-7.5
0
1
2
3
4
5