3.2 Least-Squares Regression

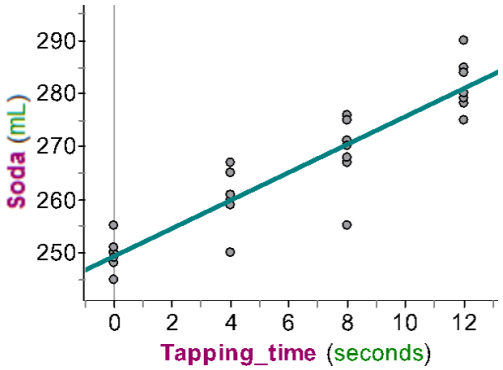
Learning Objectives

1. Interpret the slope and y intercept of a least –squares regression line.
2. Use the least-squares regression line to predict y for a given x. Explain the dangers of extrapolations.
3. Calculate and interpret residuals.
4. Explain the concept of least squares.
5. Determine the equations of a least-squares regression line using technology or computer output.
6. Construct and interpret residual plots to assess whether a linear model is appropriate.
7. Interpret the standard deviation of the residuals and r^2 and use these values to assess how well the least-squares regression line models the relationship between two variables.
8. Describe how the slope, y intercept, standard deviation of the residuals, and r^2 are influenced by outliers.
9. Find the slope and y intercept of the least-squares regression line from the means and standard deviations of x and y and their correlation.

Vocabulary: regression line, predicted value, slope, y intercept, extrapolation, least-squares regression line, residual plot, coefficient of determination,
Read 164–168

What is the general form of a regression equation? What is the difference between y and $\hat{y}$?

Alternate Example: *Tapping on cans*
Don't you hate it when you open a can of soda and some of the contents spray out of the can? Two AP Statistics students, Kerry and Danielle, wanted to investigate if tapping on a can of soda would reduce the amount of soda expelled after the can has been shaken. For their experiment, they vigorously shook 40 cans of soda and randomly assigned each can to be tapped for 0 seconds, 4 seconds, 8 seconds, or 12 seconds. Then, after opening the can and cleaning up the mess, the students measured the amount of soda left in each can (in ml). Here is a scatterplot with the least-squares regression line $\widehat{soda} = 248.6 + 2.63(tapping\ time)$.



a) Interpret the slope and y intercept of a regression line.

b) Predict the amount remaining for a can that has been tapped 10 seconds.

c) Predict the amount remaining for a can that has been tapped for 60 seconds. How confident are you in this prediction?

What is extrapolation? Is it a good idea to extrapolate?

HW page 193 (35–41 odd)

3.2 Residuals

Read 168–172
What is a residual? How do you interpret a residual?

Calculate and interpret the residual for the can that was tapped for 4 seconds and had 260 ml of soda remaining.

Example: McDonald's Beef Sandwiches

Carbs (g)	31	33	34	37	40	40	45	37	38
Fat (g)	9	12	23	19	26	42	29	24	28

(a) How can we determine the "best" regression line for a set of data?

(b) Is the least-squares regression line resistant to outliers?

(c) Calculate the equation of the least-squares regression line using technology. Make sure to define variables! Sketch the scatterplot with the graph of the least-squares regression line.

(d) Interpret the slope and *y*-intercept in context.

(e) Calculate and interpret the residual for the Big Mac, with 45g of carbs and 29g of fat.

CHROMEBOOK ACTIVITY: P. 170-171 *Investigating properties of the LSRL*

Read 172–176*) How can we know a line is the right model to use?*

What is a residual plot? What is the purpose of a residual plot?

What do you look for in a residual plot? How can you tell if a linear model is appropriate?

Construct and interpret a residual plot for the McDonald's data.

HW: page 193 (40, 42, 44, 46, 47, 49, 51)