Stat 101 – Lecture 13

Line of "Best Fit"

- There are lots of straight lines that go through the data.
- The line of "best fit" is the line for which the sum of squared residuals is the smallest – the least squares line.

1

Line of "Best Fit"

$$\hat{y} = b_0 + b_1 x$$

Least squares slope: $b_1 = r\frac{s_y}{s_x}$

intercept: $b_0 = \bar{y} - b_1\bar{x}$

2

Least Squares Estimates

Tar, x	Nicotine, y
$\bar{x} = 11.92\,\text{mg}$	$\bar{y} = 0.908\,\text{mg}$
$s_x = 4.636\,\text{mg}$	$s_y = 0.2812\,\text{mg}$
$r = 0.956$	

3

Least Squares Estimates

$$b_1 = 0.956\frac{0.2812}{4.636} = 0.058$$

$$b_0 = 0.908 - 0.058(11.92) = 0.217$$

$$\hat{y} = 0.217 + 0.058x$$

4

Interpretation

- Estimated slope – for every 1 mg increase in tar, the nicotine content increases, on average, 0.058 mg.
- The average change in nicotine for a 1 mg change in tar.

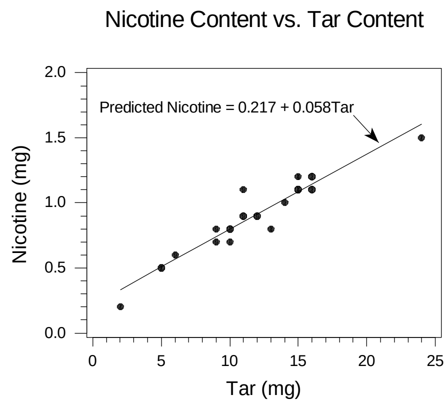
5

Interpretation

- Estimated intercept – there is not a reasonable interpretation of the intercept in this context because one wouldn't see a cigarette with 0 mg of tar.

6

Stat 101 – Lecture 13



Prediction

- Least squares line

$$\hat{y} = 0.217 + 0.058x$$

$$x = 13$$

$$\hat{y} = 0.217 + 0.058(13) = 0.97$$

Residual

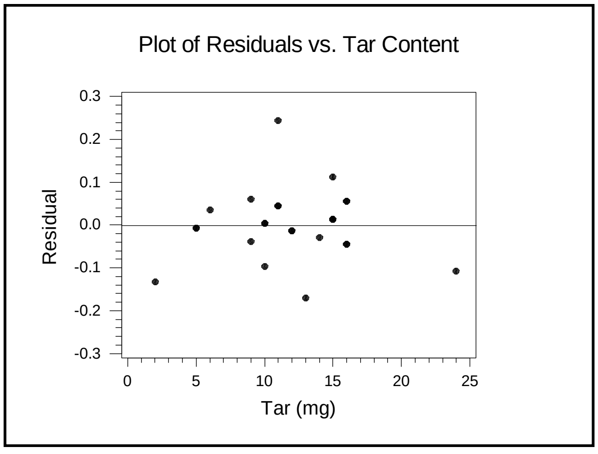
- Brand: Mustang
- Tar, x = 13 mg
- Nicotine, y = 0.8 mg
- Predicted, $\hat{y}$ = 0.97 mg
- Residual, $y - \hat{y}$ = 0.8–0.97
  = – 0.17 mg

Stat 101 – Lecture 13

Residuals

- Residuals help us see if the linear model makes sense.
- Plot residuals versus the explanatory variable.
  - If the plot is a random scatter of points, then the linear model is the best we can do.

10



Interpretation of the Plot

- The residuals are scattered randomly. This indicates that the linear model is an appropriate model for the relationship between tar and nicotine content of cigarettes.

12