"Sales" Example (Problem 4.13 in textbook)

Interest lies understand what influences annual sales for The GAP.

y = last year's sales (in \$100,000's)
x_1 = promotional expenditures (in \$1000's)
x_2 = number of active accounts in a given district
x_3 = number of competing brands in a given district
x_4 = district potential score

The model we fit is:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \varepsilon$$

The least squares estimate of $\vec{\beta}$ is:

$$\hat{\vec{\beta}} = \begin{bmatrix} \hat{\beta}_0 \\ \hat{\beta}_1 \\ \hat{\beta}_2 \\ \hat{\beta}_3 \\ \hat{\beta}_4 \end{bmatrix} = \begin{bmatrix} 177.23 \\ 2.17 \\ 3.54 \\ -22.16 \\ 0.20 \end{bmatrix}$$

The least squares estimate of σ is:

$$\hat{\sigma} = \sqrt{\frac{\sum_{i=1}^{\hat{}} e_i^2}{n-p-1}} = 5.12$$

Lets test the following hypothesis:

$$H_0: \beta_4 = 0 \quad \text{vs.} \quad H_A: \beta_4 \neq 0$$

The p-value associated with this hypothesis is 0.5376 which is much larger than any typical significance level. As such we do not reject $H_0: \beta_4 = 0$ and so we conclude that the district potential score does not significantly influence sales.

* note that the p-values associated with $H_0: \beta_1 = 0$, $H_0: \beta_2 = 0$ and $H_0: \beta_3 = 0$ are all smaller than $\alpha = 0.05$ and so in each case we reject H_0 and conclude that sales significantly depend on each of the other three explanatory variables.

Interpret $\hat{\beta}_1$: For every additional \$100 spent on promotions (and holding all else constant) we expect sales to increase by \$217,021

Interpret $\hat{\beta}_2$: For every additional active account (and holding all else fixed) we expect sales to increase by \$353,801.40

Interpret $\hat{\beta}_3$: For every additional competitor (and holding all else constant) we expect sales to decrease by \$2,215,834.