STAT-S 631 **Assignment 3** **Due date: 9/15/17**

Instructions:

- Present the R command used for every question in addition to any output, if required.
- Submit your final solutions as a single PDF document in Canvas.

1. (5 points) Show that $\hat{\beta}_0$ and $\hat{\beta}_1$ can be written as linear combinations of $y_1, \ldots, y_n$.
2. (5 Points) From ALR 2.2
3. (10 Points) Simulation: Assume the simple linear regression model

$$y_i = \beta_0 + \beta_1 x_i + e_i, \quad i = 1, \ldots, n$$

where $e_i \sim N(0, \sigma^2)$ for $i = 1, \ldots, n$.

Let's set $\beta_0 = 10, \beta_1 = -2.5$, and $n = 30$.

a) Set $\sigma = 100$, and $x_i = i$ for $i = 1, \ldots, n$.

b) (1 point) Your simulation will have 10,000 iterations. Before you start your iterations, set a random seed using your birthday date (MMDD) and report the seed with your responses. For each iteration, obtain and store your linear regression parameter estimates: $\hat{\beta}_0, \hat{\beta}_1$, and $\hat{\sigma}^2$. (Include syntax. DO NOT include output)

c) (2 points) Obtain and present three histograms, one for each $\hat{\beta}_0$'s, $\hat{\beta}_1$'s, and $\hat{\sigma}^2$'s. Briefly describe the main characteristics of these histograms (shape of the estimated distributions). (Include syntax and output)

d) (1 points) Find the averages of $\hat{\beta}_0$'s, $\hat{\beta}_1$'s, and $\hat{\sigma}^2$'s. How do they compare with the true parameters? Briefly Explain. (Include syntax and output)

e) (1 point) Find the (sample) variance of $\hat{\beta}_0$'s and $\hat{\beta}_1$'s. How do they compare with the true variances? Briefly Explain. (Include syntax and output)

f) (5 points) Now set $\sigma = 100$, and $x_i = 100 \cdot i$ for $i = 1, \ldots, n$. Repeat parts b), d), and e). How does the (sample) variance of $\hat{\beta}_0$'s and $\hat{\beta}_1$'s compare with your previous results (in part e))? Briefly explain why.