STAT-S 632 **Assignment 6** **Due date: 4/16/18**

If R is used, present the required output and the (relevant) syntax.

1. The `denim` dataset in the package `faraway` concerns the amount of waste in material cutting for a jeans manufacturer due to five suppliers (run `help(denim)` for more details).

   a) Plot the data and comment your results.

   b) Fit the linear fixed effects model. Is `supplier` significant?

   c) Show the model when `supplier` is consider a random effect. using the Laird-Ware model (i.e., show what are $\mathbf{X}, \boldsymbol{\beta}, \mathbf{Z}, \boldsymbol{\gamma}$, and $\boldsymbol{epsilon}$ with the corresponding dimensions).

   d) Using the model with `supplier` as a random effect, is the variance of `supplier` significant? Use two test for this, LRT with parametric bootstrapping and any other appropriate test of your choice. In addition, obtain a confidence intervals for the `supplier` effect standard deviation.

   e) Estimate the effect of each supplier. If only one supplier will be used, choose the best.

2. An experiment was conducted to select the supplier of raw materials for production of a component. The breaking strength of the component was the objective of interest. Four suppliers were considered. The four operators can only produce one component each per day. A latin square design is used and the data is presented in the `breaking` in the package `faraway` .

   a) Run the follow syntax, obtain, and interpret the plot: `ggplot(breaking, aes(y=y, x=operator, color=day, shape=supplier)) +geom_point()`

   b) Using the Laird-Ware notation for a mixed effects model with operators and days as random effects but the suppliers as fixed effects.

   c) Fit a fixed effects model for the main effects. Determine which factors are significant.

   d) Fit a mixed effects model with operators and days as random effects but the suppliers as fixed effects. Why is this a natural choice of fixed and random effects? Which supplier results in the highest breaking point?

   e) Test the operator and days effects.