Prescriptive Models and Data Analytics
Problem Set #4

This homework explores the use of Lasso for ad targeting using experimental data.

1 Simple regressions

1.1 Regression without controls

Question 1. Load `ad_heterog` data and regress revenue on treatment without further controls. The data is from an A/B test. Interpret the intercept and the treatment coefficient.

Question 2. Assume that it costs 0.7 Dollars to show the ad. Based on the previous regression, should you show the ad (assuming you either show it to all consumers or to nobody, i.e. you are not able to target the ad)?

2 Lasso with interactions

Run the code below in order to generate a matrix of demographic variables as well as a matrix of interaction terms.

```
# extract columns pertaining to demographic information (all columns except first two)
demo_matrix = ad_heterog.iloc[:,2:]

# generate interactions of each demographic variable with the treatment variable
demo_treat_matrix = demo_matrix.multiply(ad_heterog['treatment'], axis="index")
demo_treat_matrix.columns = demo_treat_matrix.columns.str.replace("demographic", "treat_demo")

# generate treatment variable that is outside of data-frame (useful below)
treatment = ad_heterog['treatment']
```

Question 1. Run a lasso regression (not cross-validated yet) without standardization using treatment and the interaction term matrix as X variables (note that we are NOT also using the demographic variables as controls here). Plot how the coefficients behave when changing the penalty parameter. Why do you think the first line (from right to left) is non-monotonic (i.e. it first increases and then decreases)?

Question 2. Run the cross-validated lasso (without standardization) based on the same set of variables. Report the coefficient values for all non-zero coefficients at the optimal penalty value. What do the results suggest regarding the scope for targeting?

3 Lasso with baseline and interacted demographics

Question 1. Run a cross-validated lasso based on the same variables as above, but now also include the un-interacted demographic variables to the matrix of X variables to try for lasso. Make sure you know how to interpret the coefficients for the demographics that are selected as both slope and intercept dummies as opposed to the demographics that only show up as interaction dummies. For example, consider the case of demographics 3 and 7. Can you compute the treatment effect for both characteristics (i.e., the effect of the treatment on individuals with a certain characteristic vs. individuals with the same characteristic in the control group?).

Question 2. For each observation, compute predicted revenue without and with treatment. Use those two predictions to compute the expected profit per consumer when showing the ad to everybody versus when showing the ad only to consumers with positive expected profit.