STA363SecAProj2

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Abstract/ Executive Summary

Section 1: Data Cleaning

In this section, the data set is explored and cleaned in order to improve the quality of the data for a good prediction.

Section 1.1: Cleaning the missing data

First of all, any missing data are inspected. However there is no missing data in this college data set. Since the header for the first column which shows the names of colleges are missed, I add a header (*"College"*) to a copy of the original data set I created and use this copy for the analysis below.

Section 1.2: Adjusting variables

From the infromation provided, I learn that the number of student enrolled in the colleges are usually not easily to be collected, the column stored this information is deleted from our data set. Also, since the acceptance rate is a more appropriate varaible than the numebr of acceptance, a new collumn named *"Rate"* is created using the existing variables acceptance *"Accept"* to be divided by the number of applications per academic year *"Apps"*. After adding this new variable to our data, since it is perfectly correlated to the variable *"Accept"*, the old and incomparable variable *"Accept"* is deleted. After arranging the variables, I got the data set for the analysis in this project, which has 777 observations and 18 variables, and among them only the variable *"Private"* is a categorical variable with two levels. Since the goal of this project is to predict the number of applications received during an academic year, the variable *"Apps"* would be the response variable in this project, and all other variables except the names of universities would be the exploratory variables. For the convenience of the analysis, I removed the column storing the college names, and change the variable *"Private"* to *"PrivateYes"*, which is a variable with 1 indicating private school and 0 for not a private school.

Section 2: Selection Only

In order to have a comparatively precise prediction in the end, several models are fitted compared in this project. This section focuses on the selection-only Least Square Linear Regression (LSLR) model, which also implements the Best Subset Selection (BSS) technique to refine the variables we have.

Section 2.1: Best Subset Selection - Stage 1

In the first stage of the BSS, all possible models containing 1 variable, 2 variables, and all the way to the full models (with 16 exploratory variables here) is created. R^2 is used to determine the best models among the models using the same amount of variables.

Section 2.2: Best Subset Selection - Stage 2

Proceeding to the second stage, I compared how well models created in the stage 1 are using the R^2_{adj}.

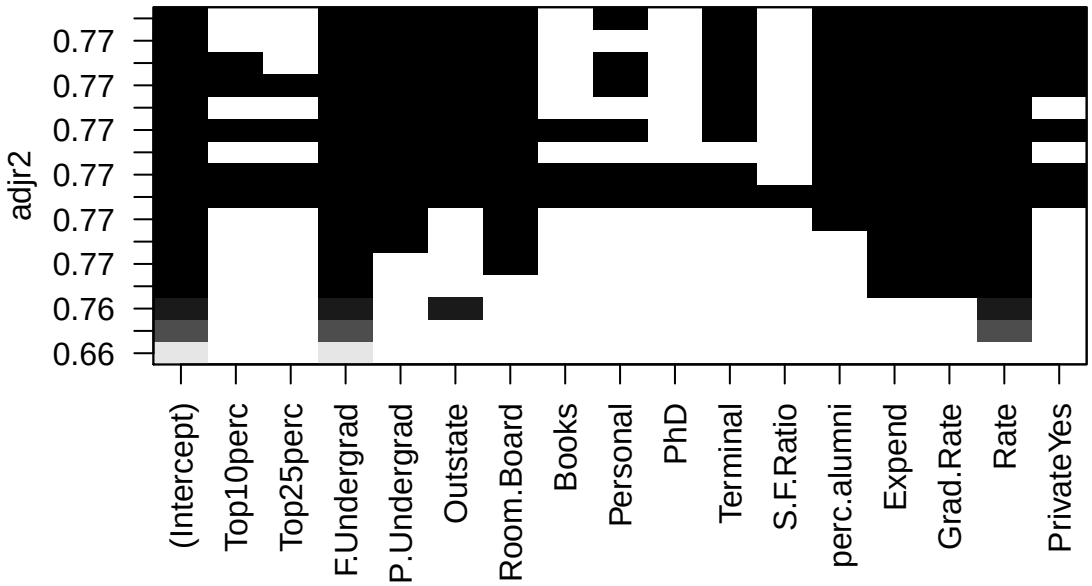

Figure 1: Adjusted R-squareds for the models created from the stage 1

Gathering the R^2_{adj} computed from the models, the Figure 1 is created to visualize the result. Since we want a model using less variables to explain the pattern in the data as much as possible, we prefer a model with a higher R^2_{adj} and less variables. The model with features *"PrivateYes", "F.undergrad", "P.Undergrad", "Outstate", "Room.Board", "Terminal", "perc.alumni", "Expend", "Grad.Rate", "Rate",* and the intercept with a R^2_{adj} of 0.7738017 is the best fit.

After the features for the LSLR model are chosen, the coefficients for these features can be calculated. In this LSLR model, the estimates are chosen by minimize the residual sum of squares (RSS), which is obtained by formula 1

$$RSS = (Y - X_D\hat{\beta})^T(Y - X_D\hat{\beta}) \tag{1}$$

As a result we get a model with coefficients as shown in the Table 1. Hence the final regression line gotten is $\widehat{Apps} = 1994.50 - 353.54PrivateYes + 0.66F.Undergrad - 0.16P.Undergrad + 0.08Outstate + 0.24Room.Board - 9.89Terminal - 20.15perc.alumni + 0.07Expand + 19.05Grad.Rate - 4812.59Rate$, which has an R^2_{adj} of 0.7738017

Table 1: The estimates for the LSLR model

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	1994.5038628	701.8798770	2.841660	0.0046072
PrivateYes	-353.5375145	240.8623931	-1.467799	0.1425694
F.Undergrad	0.6555742	0.0201696	32.503022	0.0000000
P.Undergrad	-0.1597435	0.0554461	-2.881058	0.0040742
Outstate	0.0838324	0.0328084	2.555209	0.0108046
Room.Board	0.2356826	0.0844043	2.792307	0.0053638
Terminal	-9.8869963	5.8877399	-1.679251	0.0935108
perc.alumni	-20.1480419	7.0000823	-2.878258	0.0041101
Expend	0.0689980	0.0187457	3.680732	0.0002489
Grad.Rate	19.0549834	5.0978967	3.737813	0.0001994
Rate	-4812.5857721	525.3775219	-9.160243	0.0000000

Section 3: Shrinkage Only

Section 4: Selection and Shrinkage

Section 5: Elastic Net