Logistic Regression Project

Sean Burke, Danny Chau, Edem Ketika

Agnes Nyagami, Carly Watkins

The Procedure

For our model, we decided to use the spec sheet we created in class. As for the data, we scaled any variables that had a percentage up by 100 (GrantRate, PellRate, LoanRate) and scaled any variables that represented money down by 1000 (GrantAvg, LoanAvg, AvgSalary, all the fees and tuition variables) for ease of interpretation. We also removed room and board as well as StuFacRatio variables because of the large number of missing values. We wanted to give the model as much data as possible to train on. For selection, we used stepwise with a value of 0.1 for entry/exit.

1. Odds Ratio Table for Model with all Cohorts

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
cohort	1.001	1.000	1.001
control Private for-profit vs Public	6.849	1.336	35.113
control Private not-for-profit vs Public	14.146	6.571	30.452
GrantAvg	1.088	1.059	1.118
PellRate	0.922	0.908	0.936
InStateF	1.181	1.043	1.338
OutStateTDiff	1.068	1.021	1.118
AvgSalary	1.045	1.032	1.059

Cohort*: An increase of 1 student in each cohort increases the odds of the university having an above median graduation rate by 0.1%

Control: The default control value for the model is for public universities. For private for-profit institutions, it is 6.849 times more likely that the graduation rate will be above the median compared to public universities. For private not-for-profit institutions, it is 14.146 times more likely.

GrantAvg: For an increase of 1% in students receiving grant aid, the odds of a university having an above median graduation rate increases by 8.8%.

PellRate: For an increase of 1% in students receiving pell grant aid, the odds of a university having an above median graduation rate decreases by 7.2%.

InStateF: For an increase of $1000 in in-state fees, the odds of a university having an above median graduation rate increases by 18.1%.

OutStateTDiff: For an increase of $1000 in out-state tuition difference, the odds of a university having an above median graduation rate increases by 6.8%.

AvgSalary: For an increase of $1000 in average faculty salary, the odds of a university having an above median graduation rate increase by 4.5%

2. Odds Ratio Table for Model with Cohorts of at least 200 Students

Odds Ratio Estimates			
Effect	Point Estimate	95% Wald Confidence Limits	
cohort	1.001	1.000	1.001
control Private for-profit vs Public	<0.001	<0.001	>999.999
control Private not-for-profit vs Public	11.510	4.144	31.970
GrantAvg	1.133	1.091	1.175
PellRate	0.871	0.850	0.892
InStateF	1.203	1.040	1.390
OutStateTDiff	1.054	0.999	1.113
AvgSalary	1.059	1.041	1.078

Cohort*: An increase of 1 student in each cohort increases the odds of the university having an above median graduation rate by 0.1%

Control:** The default control value for the model is for public universities. For private for-profit institutions, it is almost certain that the graduation rate will be below the median compared to public universities. For private not-for-profit institutions, it is 11.51 times more likely to have an above median graduation rate compared to public institutions.

GrantAvg: For an increase of 1% in students receiving grant aid, the odds of a university having an above median graduation rate increases by 13.3%.

PellRate: For an increase of 1% in students receiving pell grant aid, the odds of a university having an above median graduation rate decreases by 12.9%.

InStateF: For an increase of $1000 in in-state fees, the odds of a university having an above median graduation rate increases by 20.3%.

OutStateTDiff: For an increase of $1000 in out-state tuition difference, the odds of a university having an above median graduation rate increases by 5.4%.

AvgSalary: For an increase of $1000 in average faculty salary, the odds of a university having an above median graduation rate increase by 5.9%

3. Odds Ratio Table for Model with Cohorts of at least 400 Students

Effect	Point Estimate	95% Wald Confidence Limits	
cohort	1.001	1.001	1.001
control Private for-profit vs Public	<0.001	<0.001	>999.999
control Private not-for-profit vs Public	14.995	3.789	59.345
hloffer Bachelor^s degree vs Post-master^s certificate	6.228	1.102	35.209
hloffer Doctor^s degree vs Post-master^s certificate	1.214	0.465	3.171
hloffer Master^s degree vs Post-master^s certificate	2.954	0.913	9.554
GrantAvg	1.164	1.107	1.224
PellRate	0.862	0.835	0.890
OutStateTDiff	1.142	1.065	1.225
AvgSalary	1.025	1.004	1.046

Cohort*: An increase of 1 student in each cohort increases the odds of the university having an above median graduation rate by 0.1%

Control:** The default control value for the model is for public universities. For private for-profit institutions, it is almost certain that the graduation rate will be below the median compared to public universities. For private not-for-profit institutions, it is 14.995 times more likely to have an above median graduation rate compared to public institutions.

Hloffer: The default hloffer for the model is post-master's certificate. A university with an hloffer of a bachelor's degree is 6.228 times more likely to have an above median graduation rate than a university with an hloffer of a post-master's certificate. A university with an hloffer of a Doctoral degree is 1.214 times more likely to have an above median graduation rate than a university with an hloffer of a post-master's certificate. A university with an hloffer of a Master's degree is 2.954 times more likely to have an above median graduation rate than a university with an hloffer of a post-master's certificate.

GrantAvg: For an increase of 1% in students receiving grant aid, the odds of a university having an above median graduation rate increases by 16.4%.

PellRate: For an increase of 1% in students receiving pell grant aid, the odds of a university having an above median graduation rate decreases by 13.8%.

OutStateTDiff: For an increase of $1000 in out-state tuition difference, the odds of a university having an above median graduation rate increases by 14.2%.

AvgSalary: For an increase of $1000 in average faculty salary, the odds of a university having an above median graduation rate increase by 2.5%

*In hindsight, the interpretation of the model would have benefited from us scaling cohort size down by a factor of 10 or so

**A brief inspection of the data reveals that there are only a handful of schools that are private for profit with cohort sizes of above 200 and 400. Most of these schools have below median graduation rates which led to the abnormal value.

4. Comparisons

Some observations from comparing all 3 models:

- As cohort size gets larger, in-state fees become less important as a predictor and fall out while hloffer becomes more important.
- The odds ratios for control indicates that as cohort sizes get larger, institutions that are private for-profit almost all have a below median graduation rate. This also means that a private for-profit university with an above median graduation rate most likely has a smaller cohort size
- As cohort size increases, the amount of grant aid students receive has a larger positive effect on the likelihood of a university having an above median graduation rate. Conversely, the amount of pell grant aid students receive will have a larger negative effect on the chances that a university will have an above median graduation rate
- Out-state tuition difference and average salary as predictors seem to not trend one way or another as cohort sizes increase