Logistic Regression: Analysis, Interpretation, and Visual Representation of Results

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Odds Ratio = $\mathcal{X}$

- For each variable, a member of the group is $\mathcal{X}$ times as likely to graduate as a member who is not in the group.

- If $\mathcal{X}$ is **less than one**, then members of the group are **less likely** to graduate.

- If $\mathcal{X}$ is **equal to one**, then members of the group are **as likely** to graduate as members not in the group.

- If $\mathcal{X}$ is **more than one**, then members of the group are **more likely** to graduate.
Model Fit for MU Community College Transfer Students

- 74% of the observations were predicted accurately, compared to a 65% graduation rate (Schmidtke, Eimers, & Jones-White, 2007).
Odds Ratios for Community College Transfer Students to MU

<table>
<thead>
<tr>
<th>Less Likely</th>
<th>Just as Likely</th>
<th>More Likely</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.10</td>
<td>1.00</td>
<td>10.00</td>
</tr>
</tbody>
</table>

- FGPACat *: 1.76
- FT/PT: 1.29
- Female: 0.84
- Minority: 0.77
- Interaction Fem/Min: 0.87
- Pell Grant *: 1.42
- Trad. Age *: 1.87

* Significant at p < 0.05
# Odds Ratios for Community College Transfer Students to MU

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<table>
<thead>
<tr>
<th>Field</th>
<th>Less Likely</th>
<th>Just as Likely</th>
<th>More Likely</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>1.00</td>
<td>2.30</td>
<td></td>
</tr>
<tr>
<td>Business</td>
<td>1.00</td>
<td>1.75</td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td>1.00</td>
<td>1.16</td>
<td></td>
</tr>
<tr>
<td>Engineering</td>
<td>1.00</td>
<td>1.10</td>
<td></td>
</tr>
<tr>
<td>Liberal Arts</td>
<td>1.00</td>
<td>1.23</td>
<td></td>
</tr>
<tr>
<td>Science</td>
<td>1.00</td>
<td>1.05</td>
<td></td>
</tr>
<tr>
<td>Social Science</td>
<td>1.00</td>
<td>1.34</td>
<td></td>
</tr>
</tbody>
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Odds Ratios for Community College Transfer Students to MU

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<tbody>
<tr>
<td>0.10</td>
<td>1.00</td>
<td>10.00</td>
</tr>
<tr>
<td>0.77</td>
<td></td>
<td>93 Cohort</td>
</tr>
<tr>
<td>0.98</td>
<td></td>
<td>94 Cohort</td>
</tr>
<tr>
<td>0.73</td>
<td></td>
<td>95 Cohort</td>
</tr>
<tr>
<td>0.80</td>
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<td>96 Cohort</td>
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<tr>
<td>0.86</td>
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<td>97 Cohort</td>
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<tr>
<td>0.92</td>
<td></td>
<td>98 Cohort</td>
</tr>
<tr>
<td>0.65</td>
<td></td>
<td>99 Cohort *</td>
</tr>
</tbody>
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Odds Ratios for Community College
Transfer Students to MU

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<tr>
<td>0.10</td>
<td>1.00</td>
<td>10.00</td>
</tr>
<tr>
<td>1.19</td>
<td>1.01</td>
<td>1.06</td>
</tr>
<tr>
<td>0.93</td>
<td>0.83</td>
<td>1.51</td>
</tr>
<tr>
<td>0.78</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Significant at p < 0.05

Transfer GPA *
Transfer Hours
Metropolitan
Suburban
AS Degree
AA Degree *
Other Degree
Predicted MU CC Transfer Graduation Rate by Transfer GPA Category

Graduation Rate

50.0% 55.0% 60.0% 65.0% 70.0%

< = 2.00 2.01-2.50 2.51-3.00 3.01-3.50 3.51-4.00

Transfer GPA Category

50.8% 55.2% 59.5% 63.7% 67.6%
Logistic Regression

• Odds ratio
  • Graduation rate is 65%

\[
\frac{.65}{1-.65} = 1.86
\]

• Odds of graduating are 1.86 to 1
Logistic Regression

• Odds ratio

\[ \frac{\hat{p}_i}{1 - \hat{p}_i} = e^{(\beta_1 X_i + \beta_0)} \]
Logistic Regression

- Logit Function

\[
\ln \left( \frac{\hat{p}_i}{1 - \hat{p}_i} \right) = \beta_1 X_i + \beta_0
\]
Predicted probability

- Predicted probability

\[ \hat{p}_i = \frac{1}{1 + e^{-(\beta_1 X_i + \beta_0)}} \]
Variables

- First Semester GPA Category
- Attendance Status (Full-time/Part-time)
- Gender
- Ethnicity
- Gender/Ethnicity Interaction
- Pell Grant Status
- Traditional Age
- Initial program at MU
- Entering Cohort
- Transfer GPA Category
- Transfer Hour Category
- Location of Community College
- Type of Associate’s Degree
SAS Program

```
proc logistic data=CCTran;
  model degreefix(event='1')= FGPAcat FHOURLcat TGPAcat THOURcat
                   ag bus  ed  eng  libart  sci  socsci  profess
                   metro  suburban
                   asdeg  aadeg  aodeg
                   female
                   minor
                   femmin
                   Pell
                   tradage
                   co93  co94  co95  co96  co97  co98  co99
 /
  clparm=pl
  lackfit;
  output out=pred2 p=phat lower=lcl upper=ucl
     predprob=(individual crossvalidate);
  title 'Regression on CC Data - new tran hour cat';
run;
```
SAS Output

• See Handout (page 1-3)
Odds Ratios for Community College Transfer Students to MU (Page 5)

Less Likely       Just as Likely       More Likely

0.10          1.00          10.00

FGPAcat * 1.76
FT/PT 1.29
Female
Minority
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Predicted Probabilities (page 4)

Insert SAS “Estimate” into Excel as log-odds regression coefficients

Equation for predicted probabilities

$$\hat{p}_i = \frac{1}{1 + e^{-(\beta_1 X_i + \beta_0)}}$$
Predicted Probabilities

Insert mean value (or chosen values) for all variables except the variable of interest (TranGPA category).

Equation for predicted probabilities

\[ \hat{p}_i = \frac{1}{1 + e^{-(\beta_1 X_i + \beta_0)}} \]
Solve for predicted probabilities for each transfer GPA category.

Equation for predicted probabilities

\[ \hat{P}_i = \frac{1}{1 + e^{-(\beta_i X_i + \beta_0)}} \]
Questions

• ????
Contact information

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- (573) 882-4078

Paper and handouts will be available: http://ir.missouri.edu/reports-presentations.html

References:

http://staff.washington.edu/glynn/predprob.pdf