Confidence Intervals

- We can also get confidence intervals for the parameter estimates.
- These can be obtained either by profiling the likelihood function or by using the standard errors and assuming a normal distribution.
- Note that profiled CIs are not symmetric (although they are usually close to symmetric).
- If the 95% CI does not cross 0, the parameter estimate is statistically significant.

Ordered Logistic Regression with R

```
(ci <- confint(m))
# default method gives profiled CIs

 Waiting for profiling to be done...
             2.5 %    97.5 %
 pared    0.5282    1.5722
 public -0.6522    0.5191
 gpa      0.1076    1.1309
```

Ordered Logistic Regression with R

```
# CIs assuming normality

confint.default(m)

             2.5 %   97.5 %
 pared      0.5268    1.569
 public    -0.6426    0.525
 gpa        0.1051    1.127
```

Confidence Intervals

- The CIs for both pared and gpa do not include 0; but the CI for public does.
- The estimates in the output are given in units of ordered logits, or ordered log odds.
- For pared, we would say that for a one unit increase in pared (i.e., going from 0 to 1), we expect a 1.05 increase in the expect value of apply on the log odds scale, given all of the other variables in the model are held constant.

Confidence Intervals

- For gpa, we would say that for a one unit increase in gpa, we would expect a 0.62 increase in the expected value of apply in the log odds scale, given that all of the other variables in the model are held constant.

Ordered Logistic Regression with R

- The coefficients from the model can be somewhat difficult to interpret because they are scaled in terms of logs.
- Another way to interpret logistic regression models is to convert the coefficients into odds ratios.
- To get the Odds Ratios and confidence intervals, we just exponentiate the estimates and confidence intervals.

Ordered Logistic Regression with R

Odds Ratios

```
exp(coef(m))
  pared public    gpa
 2.8511 0.9429 1.8514


 # Odds Ratios and CIs
exp(cbind(OR = coef(m), ci))
             OR  2.5 % 97.5 %
 pared  2.8511 1.6958  4.817
 public 0.9429 0.5209  1.681
 gpa    1.8514 1.1136  3.098
```

Ordered Logistic Regression with R

- These coefficients are called **proportional odds ratios** and we would interpret these pretty much as we would odds ratios from a binary logistic regression.
- For pared, we would say that for a one unit increase in parental education, i.e., going from 0 (*Low*) to 1 (*High*), the odds of "*very likely*" applying versus "*somewhat likely*" or "*unlikely*" applying combined are 2.85 greater, given that all of the other variables in the model are held constant.

Ordered Logistic Regression with R

- Similarly, the odds "*very likely*" or "*somewhat likely*" applying versus "*unlikely*" applying is 2.85 times greater, given that all of the other variables in the model are held constant.
- For gpa (and other continuous variables), the interpretation is that when a student's gpa moves 1 unit, the odds of moving from "*unlikely*" applying to "*somewhat likely*" or "*very likely*" applying (or from the lower and middle categories to the high category) are multiplied by 1.85.