

Ordered Logistic Regression with R

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.

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```
(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

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```
# 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

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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 expected value of `apply` on the log odds scale, given all of the other variables in the model are held constant.

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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.

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- ▶ 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.

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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
```

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- ▶ 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.

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- ▶ 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.