Math-661: Assignment 4

1. **Exercise 1 – Agresti # 6.20**

   The following R output shows output from fitting a cumulative logit model to data from the US 2008 General Social Survey. For subject i, let

   - y_i = belief in existence of heaven (1 = yes, 2 = unsure, 3 = no),
   - x_{i1} = gender (1 = female, 0 = male) and
   - x_{i2} = race (1 = black, 0 = white).

```
> cbind(race, gender, y1, y2, y3)
     race gender  y1  y2 y3
[1,]    1      1  88  16  2
[2,]    1      0  54   7  5
[3,]    0      1 397 141 24
[4,]    0      0 235 189 39

> summary(vglm(cbind(y1,y2,y3) ~ gender+race, family=cumulative(parallel=T)))
              Estimate Std. Error z value Pr(>|z|)
(Intercept):1  0.07631    0.08963   0.851    0.395
(Intercept):2  2.32238    0.13522  17.175  < 2e-16 ***
gender         0.76956    0.12253   6.281 3.37e-10 ***
race           1.01645    0.21059   4.827 1.39e-06 ***
---
Residual deviance: 9.2542 on 4 degrees of freedom
Log-likelihood: -23.3814 on 4 degrees of freedom
```

   (a) State the model fitted here and interpret the race and gender effects.

   (b) Test goodness-of-fit and construct confidence intervals for the effects.

2. **Exercise 2 – Agresti # 6.21**

   Refer to the previous exercise. Consider the model

$$\log \frac{\pi_{ij}}{\pi_{i3}} = \alpha_j + \beta_j^G x_{i1} + \beta_j^R x_{i2}, \qquad j = 1, 2.$$

   (a) Fit the model and report prediction equations for

$$\log \frac{\pi_{i1}}{\pi_{i3}}, \ \log \frac{\pi_{i2}}{\pi_{i3}}, \ \log \frac{\pi_{i1}}{\pi_{i2}}.$$

   (b) Using the "yes" and "no" response categories, interpret the conditional gender effect using a 95% confidence interval for the odds ratio.

   (c) Conduct a likelihood ratio test of the hypothesis that opinion is independent of gender, given race. Interpret.