Lab Assignment 5

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```
library(arm)
library(Sleuth3)
library(tidyverse)
library(vcdExtra)
library(magrittr)
```

```
marriage <- expand.grid(
  opinion = factor(c("Agree", "Neutral", "Disagree"), levels = c("Agree", "Neutral", "Disagree")),
  relig = factor(c("Fundamentalist", "Moderate", "Liberal"), c("Liberal", "Moderate", "Fundamentalist")),
  educ = factor(c("High school or less", "At least some college"), c("High school or less", "At least so
marriage$Freq <- c(  6,2,10,8,3,9,11,5,6,4,2,11,21,3,5,22,4,1)

marriage_tab <- xtabs(data = marriage, Freq ~ educ + relig + opinion)
```

Question 1: Fit a model to the gay marriage data that includes all two-way interactions. What do you conclude from this model? Be specific and try to address questions having to do with the association among the three variables.

```
mod_g_mar <- glm(data = marriage_tab, Freq ~ relig + educ + opinion + (relig * educ) + (relig * opinion)
summary(mod_g_mar)
```

```
##
## Call:
## glm(formula = Freq ~ relig + educ + opinion + (relig * educ) +
##     (relig * opinion) + (educ * opinion), family = poisson, data = marriage_tab)
##
## Deviance Residuals:
##        1         2         3         4         5         6         7         8
## -0.43505   0.32887  -0.37346   0.24511   1.27716  -1.09621  -0.01012   0.01135
##        9        10        11        12        13        14        15        16
##  0.04783  -0.04696  -0.04161   0.04244   0.68702  -1.09671   0.35421  -0.42886
##       17        18
## -0.74667   0.83808
##
## Coefficients:
##                                          Estimate Std. Error z value
## (Intercept)                                2.5263     0.2649   9.535
## religModerate                             -0.3176     0.3779  -0.840
## religFundamentalist                       -1.3054     0.4838  -2.699
## educAt least some college                  0.4938     0.3216   1.535
## opinionNeutral                            -0.9123     0.4562  -2.000
```

```
## opinionDisagree                                    -1.0287     0.4607  -2.233
## religModerate:educAt least some college             0.2881     0.4250   0.678
## religFundamentalist:educAt least some college       0.1739     0.4957   0.351
## religModerate:opinionNeutral                       -0.2255     0.5911  -0.381
## religFundamentalist:opinionNeutral                  0.4139     0.7069   0.585
## religModerate:opinionDisagree                       0.8969     0.5412   1.657
## religFundamentalist:opinionDisagree                 2.3377     0.5825   4.013
## educAt least some college:opinionNeutral           -0.7272     0.5241  -1.388
## educAt least some college:opinionDisagree          -1.0634     0.4359  -2.440
##                                                   Pr(>|z|)
## (Intercept)                                        < 2e-16 ***
## religModerate                                      0.40067
## religFundamentalist                                0.00697 **
## educAt least some college                          0.12467
## opinionNeutral                                     0.04554 *
## opinionDisagree                                    0.02556 *
## religModerate:educAt least some college            0.49791
## religFundamentalist:educAt least some college      0.72573
## religModerate:opinionNeutral                       0.70287
## religFundamentalist:opinionNeutral                 0.55823
## religModerate:opinionDisagree                      0.09750 .
## religFundamentalist:opinionDisagree                  6e-05 ***
## educAt least some college:opinionNeutral           0.16527
## educAt least some college:opinionDisagree          0.01469 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for poisson family taken to be 1)
##
##     Null deviance: 72.3623  on 17  degrees of freedom
## Residual deviance:  6.5821  on  4  degrees of freedom
## AIC: 99.078
##
## Number of Fisher Scoring iterations: 4
```

The main conclusion about this data that I can make is that Fundamentalists have significant evidence that at any level of education they disagree with gay marriage. I conclude this in several different ways with the most significant data being religFundamentalist:opinionDisagree (p-value = 6e-05). But we can also see that religFundamentalist and opinionDisagree show signs of significance. We can conclude that it's any level of education because all levels are included due to the association with the other two variables in the formula.

Question 2: Fit a model that includes all two-way and the three-way interactions. Is there anything problematic about this model? Please explain.

```
mod_two_three <- glm(data = marriage_tab, Freq ~ relig + educ + opinion + (relig * educ) + (relig * opi
summary(mod_two_three)
```

```
##
## Call:
## glm(formula = Freq ~ relig + educ + opinion + (relig * educ) +
##     (relig * opinion) + (educ * opinion) + (relig * educ * opinion),
```

```
##     family = poisson, data = marriage_tab)
##
## Deviance Residuals:
##  [1]  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
##
## Coefficients:
##                                                                Estimate
## (Intercept)                                                     2.39790
## religModerate                                                  -0.31845
## religFundamentalist                                            -0.60614
## educAt least some college                                       0.69315
## opinionNeutral                                                 -0.78846
## opinionDisagree                                                -0.60614
## religModerate:educAt least some college                         0.27193
## religFundamentalist:educAt least some college                  -1.09861
## religModerate:opinionNeutral                                   -0.19237
## religFundamentalist:opinionNeutral                             -0.31015
## religModerate:opinionDisagree                                   0.72392
## religFundamentalist:opinionDisagree                             1.11696
## educAt least some college:opinionNeutral                       -0.91629
## educAt least some college:opinionDisagree                      -2.48491
## religModerate:educAt least some college:opinionNeutral         -0.04879
## religFundamentalist:educAt least some college:opinionNeutral    1.32176
## religModerate:educAt least some college:opinionDisagree         0.93204
## religFundamentalist:educAt least some college:opinionDisagree   2.98568
##                                                                Std. Error
## (Intercept)                                                       0.30151
## religModerate                                                     0.46466
## religFundamentalist                                               0.50752
## educAt least some college                                         0.36927
## opinionNeutral                                                    0.53936
## opinionDisagree                                                   0.50752
## religModerate:educAt least some college                           0.55586
## religFundamentalist:educAt least some college                     0.74366
## religModerate:opinionNeutral                                      0.86559
## religFundamentalist:opinionNeutral                                0.97856
## religModerate:opinionDisagree                                     0.70263
## religFundamentalist:opinionDisagree                               0.72405
## educAt least some college:opinionNeutral                          0.76574
## educAt least some college:opinionDisagree                         1.14150
## religModerate:educAt least some college:opinionNeutral            1.19401
## religFundamentalist:educAt least some college:opinionNeutral      1.41528
## religModerate:educAt least some college:opinionDisagree           1.33669
## religFundamentalist:educAt least some college:opinionDisagree     1.38224
##                                                                z value Pr(>|z|)
## (Intercept)                                                      7.953 1.82e-15
## religModerate                                                   -0.685   0.4931
## religFundamentalist                                             -1.194   0.2324
## educAt least some college                                        1.877   0.0605
## opinionNeutral                                                  -1.462   0.1438
## opinionDisagree                                                 -1.194   0.2324
## religModerate:educAt least some college                          0.489   0.6247
## religFundamentalist:educAt least some college                   -1.477   0.1396
## religModerate:opinionNeutral                                    -0.222   0.8241
```

```
## religFundamentalist:opinionNeutral                                -0.317   0.7513
## religModerate:opinionDisagree                                      1.030   0.3029
## religFundamentalist:opinionDisagree                                1.543   0.1229
## educAt least some college:opinionNeutral                          -1.197   0.2315
## educAt least some college:opinionDisagree                         -2.177   0.0295
## religModerate:educAt least some college:opinionNeutral            -0.041   0.9674
## religFundamentalist:educAt least some college:opinionNeutral       0.934   0.3503
## religModerate:educAt least some college:opinionDisagree            0.697   0.4856
## religFundamentalist:educAt least some college:opinionDisagree      2.160   0.0308
##
## (Intercept)                                                      ***
## religModerate
## religFundamentalist
## educAt least some college                                         .
## opinionNeutral
## opinionDisagree
## religModerate:educAt least some college
## religFundamentalist:educAt least some college
## religModerate:opinionNeutral
## religFundamentalist:opinionNeutral
## religModerate:opinionDisagree
## religFundamentalist:opinionDisagree
## educAt least some college:opinionNeutral
## educAt least some college:opinionDisagree                         *
## religModerate:educAt least some college:opinionNeutral
## religFundamentalist:educAt least some college:opinionNeutral
## religModerate:educAt least some college:opinionDisagree
## religFundamentalist:educAt least some college:opinionDisagree     *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for poisson family taken to be 1)
##
##     Null deviance: 7.2362e+01  on 17  degrees of freedom
## Residual deviance: 6.6613e-16  on  0  degrees of freedom
## AIC: 100.5
##
## Number of Fisher Scoring iterations: 3
```

```
#mod_t_t <- glm(data = marriage_tab, Freq ~ relig + educ + opinion + (relig * educ) + (relig * opinion)
#summary(mod_t_t)
```

After running both poisson and quasipoisson I chose to go with poisson as it gave better output of the data.

Yes, there is something problamatc with this model. There are no deviance residuals looking at the resudual deviance on degrees of freedom there is an issue with calculating over-dispersion. Due to issues with both of those I would conclude that the data is over-dispersed.