lab5

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```
library(arm)
```

```
## Warning: package 'arm' was built under R version 4.0.5
```

```
## Loading required package: MASS
```

```
## Warning: package 'MASS' was built under R version 4.0.3
```

```
## Loading required package: Matrix
```

```
## Loading required package: lme4
```

```
## Warning: package 'lme4' was built under R version 4.0.3
```

```
##
## arm (Version 1.11-2, built: 2020-7-27)
```

```
## Working directory is C:/Users/tanku/OneDrive/CodeRoot/RootRCode/ST518
```

```
library(Sleuth3)
```

```
## Warning: package 'Sleuth3' was built under R version 4.0.3
```

```
library(tidyverse)
```

```
## Warning: package 'tidyverse' was built under R version 4.0.3
```

```
## -- Attaching packages ---------------------------------------------------------------------------
```

```
## v ggplot2 3.3.3     v purrr   0.3.4
## v tibble  3.0.3     v dplyr   1.0.2
## v tidyr   1.1.2     v stringr 1.4.0
## v readr   1.4.0     v forcats 0.5.0
```

```
## Warning: package 'ggplot2' was built under R version 4.0.3
```

```
## Warning: package 'tidyr' was built under R version 4.0.3
```

```
## Warning: package 'readr' was built under R version 4.0.3

## Warning: package 'purrr' was built under R version 4.0.3

## Warning: package 'dplyr' was built under R version 4.0.3

## Warning: package 'forcats' was built under R version 4.0.3

## -- Conflicts ---------------------------------------------------------------------------------
## x tidyr::expand() masks Matrix::expand()
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
## x tidyr::pack()   masks Matrix::pack()
## x dplyr::select() masks MASS::select()
## x tidyr::unpack() masks Matrix::unpack()
```

```
library(vcdExtra)
```

```
## Warning: package 'vcdExtra' was built under R version 4.0.4

## Loading required package: vcd

## Warning: package 'vcd' was built under R version 4.0.4

## Loading required package: grid

## Loading required package: gnm

## Warning: package 'gnm' was built under R version 4.0.4

##
## Attaching package: 'vcdExtra'

## The following object is masked from 'package:dplyr':
##
##     summarise
```

```
library(magrittr)
```

```
##
## Attaching package: 'magrittr'

## The following object is masked from 'package:purrr':
##
##     set_names

## The following object is masked from 'package:tidyr':
##
##     extract
```

Lab 5 Assignment

Questions

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.

```
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 s
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)



mod_relig <- glm(data = marriage_tab, Freq ~ relig + educ + opinion + relig:educ + relig:opinion + educ

summ <- summary(mod_relig)
summ
```

```
##
## Call:
## glm(formula = Freq ~ relig + educ + opinion + relig:educ + relig:opinion +
##     educ:opinion, family = quasipoisson, 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 t value
## (Intercept)                                      2.5263     0.3397   7.437
## religModerate                                   -0.3176     0.4846  -0.655
## religFundamentalist                             -1.3054     0.6203  -2.105
## educAt least some college                        0.4938     0.4124   1.198
## opinionNeutral                                  -0.9123     0.5850  -1.560
## opinionDisagree                                 -1.0287     0.5907  -1.742
## religModerate:educAt least some college          0.2881     0.5450   0.529
## religFundamentalist:educAt least some college    0.1739     0.6356   0.274
## religModerate:opinionNeutral                    -0.2255     0.7578  -0.298
## religFundamentalist:opinionNeutral               0.4139     0.9064   0.457
## religModerate:opinionDisagree                    0.8969     0.6939   1.292
## religFundamentalist:opinionDisagree              2.3377     0.7469   3.130
## educAt least some college:opinionNeutral        -0.7272     0.6719  -1.082
## educAt least some college:opinionDisagree       -1.0634     0.5588  -1.903
```

```
##                                                Pr(>|t|)
## (Intercept)                                     0.00175 **
## religModerate                                   0.54794
## religFundamentalist                             0.10311
## educAt least some college                       0.29720
## opinionNeutral                                  0.19386
## opinionDisagree                                 0.15656
## religModerate:educAt least some college         0.62503
## religFundamentalist:educAt least some college   0.79793
## religModerate:opinionNeutral                    0.78089
## religFundamentalist:opinionNeutral              0.67163
## religModerate:opinionDisagree                   0.26581
## religFundamentalist:opinionDisagree             0.03519 *
## educAt least some college:opinionNeutral        0.34004
## educAt least some college:opinionDisagree       0.12980
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for quasipoisson family taken to be 1.643924)
##
##     Null deviance: 72.3623  on 17  degrees of freedom
## Residual deviance:  6.5821  on  4  degrees of freedom
## AIC: NA
##
## Number of Fisher Scoring iterations: 4
```

There is overdispersion present in the model with the dispersion parameter of 1.64. It also looks like the only significant value (excluding the intercept) is the interaction between religFundamentalist and opinionDisagree (pval 0.035). There also seems to be a fair amount of dependance in the model, as the pvalues change dirastically as terms are added and removed.

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

```r
mod_relig <- glm(data = marriage_tab, Freq ~ (relig + educ + opinion)^3, family = poisson)

summary(mod_relig)
```

```
##
## Call:
## glm(formula = Freq ~ (relig + educ + opinion)^3, 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: -2.2205e-16  on  0  degrees of freedom
## AIC: 100.5
##
## Number of Fisher Scoring iterations: 3
```

This model does not provide any p-values, std. errors, or t-statistics when using quasipoisson method, and has an undefined dispersion parameter (0 residual degrees of freedom). I belive this is because we have over-fit the model.