stsci4110hw6

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1.

a. $\pi+1$ - $\pi1+$ is the probability of Bryant making the second free throw minus the probability of Bryant making the first free throw. A larger absolute value of this number indicates dependance of the first on the second free throw.

b.

$H0: \pi12 = \pi21 \equiv H0: \pi+1 = \pi1+$ $HA: \pi12 \neq \pi21 \equiv H0: \pi+1 \neq \pi1+$

```
M = (33-37)^2/(33+37)
1-pchisq(M,1,lower.tail = T)

## [1] 0.6325851
```

p-value > .05, fail to reject the null.

Conclude: Table margins are homogeneous. $\pi12 = \pi21 \equiv H0: \pi+1 = \pi1+$ The probability of Bryant making the second free throw does not change based on the outcome of the first free throw

c.

```
library(PropCIs)
diffpropci.mp(33, 37, 230, conf.level = 0.95)

##
##
##
## data:
##
## 95 percent confidence interval:
##  -0.05390917  0.08839193
## sample estimates:
## [1] 0.01724138
```

0 is included in the 95% CI.Therefore, there is not enough evidence to prove non-homogeneity.

2.

a.

```
df = read.csv("C:/Users/Nick/Downloads/afterlife2.csv")

df$belief = factor(df$belief, ordered = F)
df$race = factor(df$race, ordered = F)
df$gender = factor(df$gender, ordered = F)
df$belief = relevel(df$belief, ref = "No")

library(tidyr)

df = uncount(df, count, .remove = TRUE, .id = NULL)

library(nnet)

## Warning: package 'nnet' was built under R version 4.2.2

bcl = multinom(belief ~ race+gender+religiosity, data = df)

## # weights:  15 (8 variable)
## initial  value 1231.544376
## iter  10 value 754.526566
## final  value 751.751592
## converged

summary(bcl)

## Call:
## multinom(formula = belief ~ race + gender + religiosity, data = df)
##
## Coefficients:
##           (Intercept) raceWhite genderMale religiosity
## Undecided  -0.6942144 0.1944430 -0.1445318  0.06299078
## Yes        -1.0998846 0.3690174 -0.4902732  0.89822127
##
## Std. Errors:
##           (Intercept) raceWhite genderMale religiosity
## Undecided   0.3194276 0.2635508  0.2306095  0.10141679
## Yes         0.2517191 0.2006170  0.1766465  0.07473111
##
## Residual Deviance: 1503.503
## AIC: 1519.503
```

b.

```r
# Undecided =  -0.6942144 + 0.1944430*raceWhite + -0.1445318*genderMale +
0.06299078*religiosity

# Yes = -1.0998846 + 0.3690174*raceWhite + -0.4902732*genderMale +
0.89822127*religiosity

#  odds of “yes” versus “no” for the two genders

odds = exp(-0.4902732)
odds

## [1] 0.612459

cat("being male has a 0.612459 multiplicative effect on odds of being 'yes'
belief over 'no'\n")

## being male has a 0.612459 multiplicative effect on odds of being 'yes'
belief over 'no'
```

c.

```r
#  odds of “yes” versus “no” for the two races

odds = exp(0.3690174)
odds

## [1] 1.446313

cat("being white has a 1.446313 multiplicative effect on odds of being 'yes'
belief over 'no'\n")

## being white has a 1.446313 multiplicative effect on odds of being 'yes'
belief over 'no'

# change in odds of “yes” versus “no” for a one unit increase in religiosity

odds = exp(0.89822127)
odds

## [1] 2.455232

cat("A one unit increase in religiosity has a 2.455232 multiplicative effect
on odds of being 'yes' belief over 'no'\n")

## A one unit increase in religiosity has a 2.455232 multiplicative effect on
odds of being 'yes' belief over 'no'
```

d.

```r
library(lmtest)

## Loading required package: zoo

##
## Attaching package: 'zoo'

## The following objects are masked from 'package:base':
##
##     as.Date, as.Date.numeric

#HO : gender is not significant in predicting belief
#H1 : gender is significant in predicting belief
bclg = multinom(belief ~ race+religiosity, data = df)

## # weights:  12 (6 variable)
## initial  value 1231.544376
## iter  10 value 756.011597
## final  value 756.008290
## converged

lrtest(bcl,bclg)

## Likelihood ratio test
##
## Model 1: belief ~ race + gender + religiosity
## Model 2: belief ~ race + religiosity
##   #Df  LogLik Df  Chisq Pr(>Chisq)
## 1   8 -751.75
## 2   6 -756.01 -2 8.5134    0.01417 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

# p-value<.05, reject null
```

e.

```r
#HO : race is not significant in predicting belief
#H1 : race is significant in predicting belief
bclrace = multinom(belief ~ gender+religiosity, data = df)

## # weights:  12 (6 variable)
## initial  value 1231.544376
## iter  10 value 753.442157
## final  value 753.432581
## converged

lrtest(bcl,bclrace)
```

```
## Likelihood ratio test
##
## Model 1: belief ~ race + gender + religiosity
## Model 2: belief ~ gender + religiosity
##   #Df  LogLik Df Chisq Pr(>Chisq)
## 1   8 -751.75
## 2   6 -753.43 -2 3.362     0.1862
```

```
# p-value>.05, fail to reject null
```

f.

```
#HO : religiosity is not significant in predicting belief
#H1 : religiosity is significant in predicting belief
bclr = multinom(belief ~ race+gender, data = df)
```

```
## # weights:  12 (6 variable)
## initial  value 1231.544376
## iter  10 value 882.187101
## final  value 882.187030
## converged
```

```
lrtest(bcl,bclr)
```

```
## Likelihood ratio test
##
## Model 1: belief ~ race + gender + religiosity
## Model 2: belief ~ race + gender
##   #Df  LogLik Df  Chisq Pr(>Chisq)
## 1   8 -751.75
## 2   6 -882.19 -2 260.87  < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
# p-value<.05, reject null
```

g.

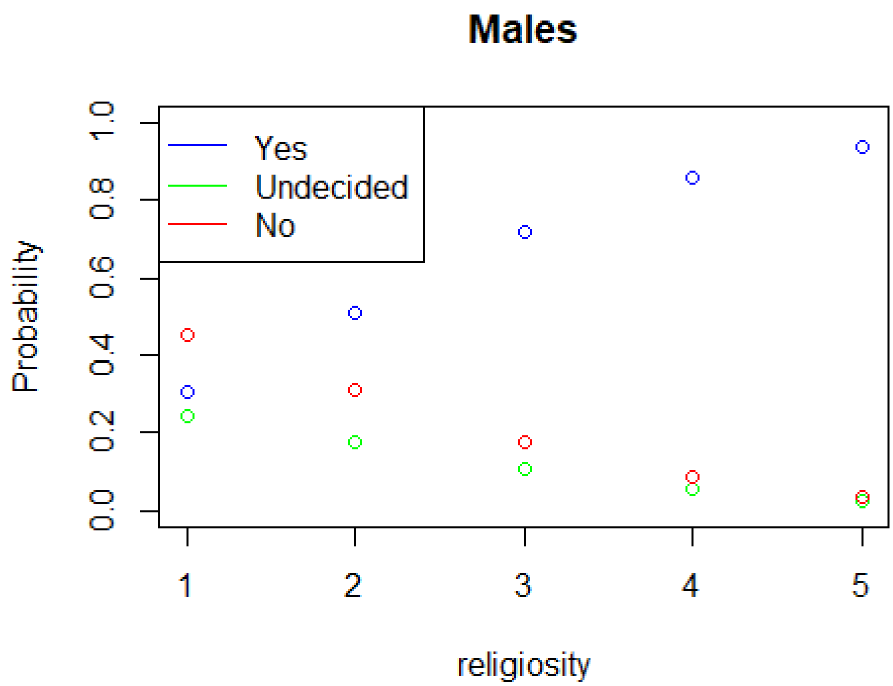
```
bclrace = multinom(belief ~ gender+religiosity, data = df)
```

```
## # weights:  12 (6 variable)
## initial  value 1231.544376
## iter  10 value 753.442157
## final  value 753.432581
## converged
```

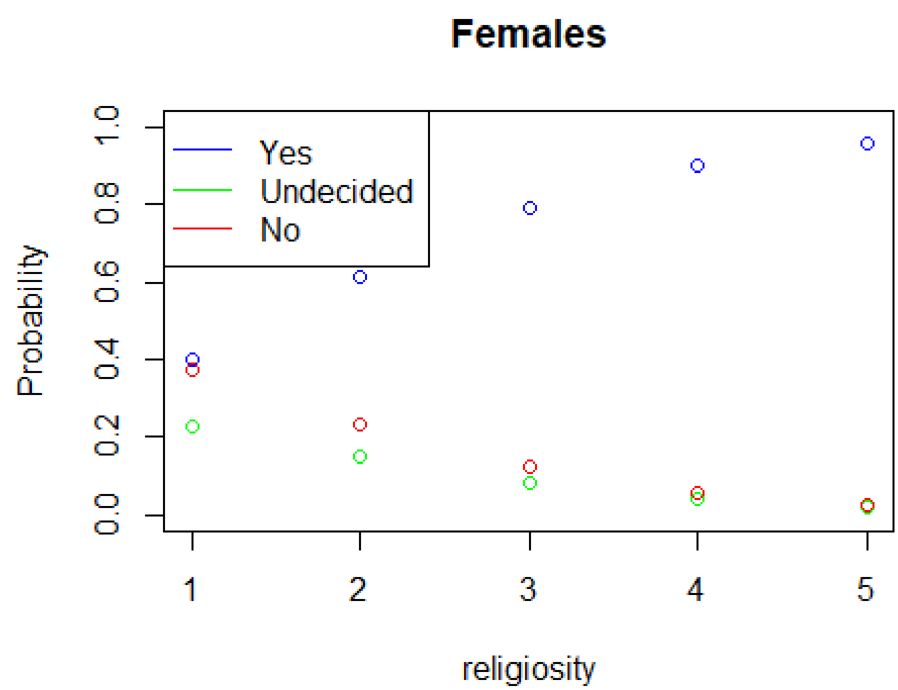
```
summary(bclrace)
```

```
## Call:
## multinom(formula = belief ~ gender + religiosity, data = df)
##
```

```
## Coefficients:
##           (Intercept) genderMale religiosity
## Undecided  -0.5578253 -0.1295137  0.06309689
## Yes        -0.8341452 -0.4617498  0.89802444
##
## Std. Errors:
##           (Intercept) genderMale religiosity
## Undecided   0.2591456  0.2296061  0.10138932
## Yes         0.2049019  0.1754738  0.07460479
##
## Residual Deviance: 1506.865
## AIC: 1518.865

# Undecided =   -0.5578253 -0.1295137*genderMale  + 0.06309689*religiosity
# Yes =        -0.8341452 -0.4617498*genderMale  + 0.89802444* religiosity



h.

newdf = data.frame(df$religiosity, fitted(bclrace), df$gender)

plot(newdf$df.religiosity[newdf$df.gender=="Male"],
newdf$Yes[newdf$df.gender=="Male"], type = "p", col="blue", xlab =
"religiosity", ylab = "Probability", xlim = c(1,5), ylim = c(0,1), main =
"Males")

legend("topleft", lty = c(1,1,1), pch = c(-1,-1,-1), col = c("blue", "green",
"red"), legend = c("Yes","Undecided", "No"))

points(newdf$df.religiosity[newdf$df.gender=="Male"],
newdf$Undecided[newdf$df.gender=="Male"], col="green")

points(newdf$df.religiosity[newdf$df.gender=="Male"],
newdf$No[newdf$df.gender=="Male"], col="red")
```




```r
plot(newdf$df.religiosity[newdf$df.gender=="Female"],
newdf$Yes[newdf$df.gender=="Female"], type = "p", col="blue", xlab =
"religiosity", ylab = "Probability", xlim = c(1,5), ylim = c(0,1), main =
"Females")

legend("topleft", lty = c(1,1,1), pch = c(-1,-1,-1), col = c("blue", "green",
"red"), legend = c("Yes","Undecided", "No"))

points(newdf$df.religiosity[newdf$df.gender=="Female"],
newdf$Undecided[newdf$df.gender=="Female"], col="green")

points(newdf$df.religiosity[newdf$df.gender=="Female"],
newdf$No[newdf$df.gender=="Female"], col="red")
```



Non reiligious males are less likely to believe than non religious females. At levels of high religiosity, both males and females are very likely to believe.

i.

```
#sample(newdf[newdf$df.religiosity == 3,])
```

	Belief in Afterlife		
Gender	Yes	Undecided	No
Male	.72	.11	.18
Female	.79	.09	.12

3.

a. $logit\ (P\ Y \leq 1) = \alpha 1 + \beta 1$*therapyseq + $\beta 2$*genderm
$logit\ (P\ Y \leq 2) = \alpha 2 + \beta 1$*therapyseq + $\beta 2$*genderm
$logit\ (P\ Y \leq 3) = \alpha 3 + \beta 1$*therapyseq + $\beta 2$*genderm

$logit\ (P\ Y \leq 1)$ = -2.3652 + 0.5587*therapyseq + 0.5299 *genderm
$logit\ (P\ Y \leq 2)$ = -1.3041 + 0.5587*therapyseq + 0.5299 *genderm
$logit\ (P\ Y \leq 3)$ = 0.1582 + 0.5587*therapyseq + 0.5299 *genderm

b. e^.5587 = 1.748
Using sequential treatment over alternating will have a 1.748 multiplicative effect on the severity outcome.

c. In this model, therapy type is a significant predictor in severity outcome, while gender is not. There is lower severity among those who use the alternating treatment method.

d.

11/29/22, 5:30 PM Desmos | Scientific Calculator

$p(y=1)$ *Alternating*

$$\frac{e^{-2.3652+0.5587*0+0.5299*1}}{1+e^{-2.3652+0.5587*0+0.5299*1}} = 0.1376081021$$

$p(y=2)$

$$\frac{e^{-1.3041+0.5587*0+0.5299*1}}{1+e^{-1.3041+0.5587*0+0.5299*1}} - \frac{e^{-2.3652+0.5587*0+0.5299*1}}{1+e^{-2.3652+0.5587*0+0.5299*1}} = 0.1779631609$$

$p(y=3)$

$$\frac{e^{.1582+0.5587*0+0.5299*1}}{1+e^{.1582+0.5587*0+0.5299*1}} - 0.1779631609 = 0.4875809682$$

$p(y=4)$

$$1 - 0.4875809682 = 0.5124190318$$

$p(y=1)$ *Sequential*

$$\frac{e^{-2.3652+0.5587*1+0.5299*1}}{1+e^{-2.3652+0.5587*1+0.5299*1}} = 0.2181295346$$

$p(y=2)$

$$\frac{e^{-1.3041+0.5587*1+0.5299*1}}{1+e^{-1.3041+0.5587*1+0.5299*1}} - \frac{e^{-2.3652+0.5587*1+0.5299*1}}{1+e^{-2.3652+0.5587*1+0.5299*1}} = 0.2282029991$$

$p(y=3)$

$$\frac{e^{.1582+0.5587*1+0.5299*1}}{1+e^{.1582+0.5587*1+0.5299*1}} - 0.2282029991 = 0.5485424353$$

$p(y=4)$

$$1 - 0.5485424353 = 0.4514575647$$

4.

a.

```
Northeast = c(266,10,8,7)
Midwest = c(15,414,22,6)
South = c(61,50,578,27)
West = c(28,40,22,301)

df = data.frame(Northeast,Midwest,South,West, row.names = c("Northeast",
"Midwest", "South", "West"))

mat = data.matrix(df)
mat

##           Northeast Midwest South West
## Northeast       266      15    61   28
## Midwest          10     414    50   40
## South             8      22   578   22
## West              7       6    27  301

sixteen = c()
for (i in 1:4){
    sixteen[i] = (sum(mat[i,]))/(sum(mat))
}

twentyten = c()
for (i in 1:4){
    twentyten[i] = (sum(mat[,i]))/(sum(mat))
}

sixteen

## [1] 0.1994609 0.2770889 0.3396226 0.1838275

twentyten

## [1] 0.1568733 0.2463612 0.3859838 0.2107817
```

b.

```
#H0: πi+ = π+i
#for all i = 1, … ,4.
#HA: For at least one pair, πi+ ≠ π+i

library(coin)

## Warning: package 'coin' was built under R version 4.2.2
```

```
## Loading required package: survival

library(mvtnorm)
library(modeltools)

## Loading required package: stats4

mh_test(as.table(mat))

##
##  Asymptotic Marginal Homogeneity Test
##
## data:  response by
##   conditions (Var1, Var2)
##   stratified by block
## chi-squared = 86.236, df = 3, p-value < 2.2e-16

# p - value is less than .05, reject the null. The marginal probabilities are
not all the same. That is, region
# preferences have shifted from age 16 to 2010.
```

5.

a.

```
ten2 = read.csv("C:/Users/Nick/Downloads/tennis-18-20v2.csv")

library(BradleyTerry2)

## Warning: package 'BradleyTerry2' was built under R version 4.2.2

tennisModel <- BTm(outcome = cbind(win1,win2), as.factor(first.player),
as.factor(second.player),
formula = ~ player, id = "player", data=ten2, refcat = "Kenin")
tennisModel

## Bradley Terry model fit by glm.fit
##
## Call:  BTm(outcome = cbind(win1, win2), player1 = as.factor(first.player),
##     player2 = as.factor(second.player), formula = ~player, id = "player",
##     refcat = "Kenin", data = ten2)
##
## Coefficients:
##     playerBarty      playerHalep      playerOsaka  playerSWilliams
##          0.3771           1.2245           0.6105           0.9643
##
## Degrees of Freedom: 10 Total (i.e. Null);  6 Residual
## Null Deviance:       6.565
## Residual Deviance: 4.491     AIC: 23.84
```

```r
cat("\nPlayers ranked:\n 1. Halep - 1.2245\n 2. Williams - .9643\n 3. Osaka - .6105\n 4. Barty - .3771\n 5. Kenin - 0(ref)")
```

```
##
## Players ranked:
##  1. Halep - 1.2245
##  2. Williams - .9643
##  3. Osaka - .6105
##  4. Barty - .3771
##  5. Kenin - 0(ref)
```

b.

```r
# P(Halep beats Barty)

p = (exp(1.2245-.3771))/(1+exp(1.2245-.3771))
p
```

```
## [1] 0.7000214
```

```r
cat("There is a 70% chance that Halep beats Barty")
```

```
## There is a 70% chance that Halep beats Barty
```

c.

```r
# P(Kenin beats Williams)

p = (exp(0-.9643))/(1+exp(0-.9643))
p
```

```
## [1] 0.2760181
```

```r
cat("There is a 27.6% chance that Kenin beats Williams")
```

```
## There is a 27.6% chance that Kenin beats Williams
```