Bayesian Stats HW3[redacted]

Exercise4.1.

In your write-up, include each line above and its results. Explain what each line does (in a bit more detail than the inline comments).

```
# display the table class object
show(HairEyeColor) # Show data
```

```
## , , Sex = Male
##
##        Eye
## Hair    Brown Blue Hazel Green
##   Black    32   11    10     3
##   Brown    53   50    25    15
##   Red      10   10     7     7
##   Blond     3   30     5     8
##
## , , Sex = Female
##
##        Eye
## Hair    Brown Blue Hazel Green
##   Black    36    9     5     2
##   Brown    66   34    29    14
##   Red      16    7     7     7
##   Blond     4   64     5     8
```

```
# use apply function to sum the frequency by eye color and then by hair color
EyeHairFreq = apply( HairEyeColor, c("Eye","Hair"), sum ) # Sum across sex
# calculate the joint proportions by eye and by hair-color
EyeHairProp = EyeHairFreq / sum( EyeHairFreq )  # joint proportions, Table 4.1
# round the proportion to 2 decimal points and then display it
show( round( EyeHairProp , 2 ) )
```

```
##        Hair
## Eye     Black Brown  Red Blond
##   Brown  0.11  0.20 0.04  0.01
##   Blue   0.03  0.14 0.03  0.16
##   Hazel  0.03  0.09 0.02  0.02
##   Green  0.01  0.05 0.02  0.03
```

```
# use apply function to sum the frequency by hair-color
HairFreq = apply( HairEyeColor , c("Hair") , sum ) # Sum across sex and eye
# calculate marginal proportions by hair-color
HairProp = HairFreq / sum( HairFreq ) # marginal proportions, Table 4.1
# round the proportion to 2 decimal points and then display it
show( round( HairProp , 2 ) )
```

```
## Black Brown   Red Blond
##  0.18  0.48  0.12  0.21
```

```
# use apply function to sum the frequency by eye-color
EyeFreq = apply( HairEyeColor , c("Eye") , sum ) # Sum across sex and eye
# calculate marginal proportions by eye-color
```

```
EyeProp = EyeFreq / sum( EyeFreq ) # marginal proportions, Table 4.1
# round the proportion to 2 decimal points and then display it
show( round( EyeProp , 2 ) )
```

```
## Brown  Blue Hazel Green
##  0.37  0.36  0.16  0.11
```

```
# calculate the conditional probability of hair color when eye color is blue
EyeHairProp["Blue",] / EyeProp["Blue"] # conditional prob, Table 4.2
```

```
##      Black      Brown        Red      Blond
## 0.09302326 0.39069767 0.07906977 0.43720930
```

Extend the above commands by also computing the probabilities of the hair colors given Brown eyes, and the probabilities of the eye colors given Brown hair.

```
#the probabilities of the hair colors given Brown eyes
EyeHairProp["Brown",] / EyeProp["Brown"]
```

```
##      Black      Brown        Red      Blond
## 0.30909091 0.54090909 0.11818182 0.03181818
```

```
# the probabilities of the eye colors given Brown hair.
EyeHairProp[,"Brown"] / HairProp["Brown"]
```

```
##     Brown      Blue     Hazel     Green
## 0.4160839 0.2937063 0.1888112 0.1013986
```

Ex 4.3

A) There are 48/6 = 8 cards for value 10. The probability of getting a 10 is 8/48 = .167
B) The probability of getting a 10 or a Jack is 8/48 * 2 = .333 because these two events are independent (mutually exclusive)

Ex 4.6

```
# marginal prob for grade
PropGrade = c(.2, .2,  .6) # prob for 1st, 6th, and 11th grades respectively
PropGrade
```

```
## [1] 0.2 0.2 0.6
```

```
# conditional prob table
condProp = data.frame("ice cream" = c(.3,.6,.3),
                      "fruit" = c(.6,.3,.1),
                      "french fries" = c(.1,.1,.6))
rownames(condProp) = c("p1st","p6th","p11th")
condProp
```

```
##       ice.cream fruit french.fries
## p1st        0.3   0.6          0.1
## p6th        0.6   0.3          0.1
## p11th       0.3   0.1          0.6
```

```
# joint prob is marginal prob * conditional prob
# p(food,grade) = p(food|grade) * p(grade)
```

```
jointprob = PropGrade*condProp
jointprob
```

```
##       ice.cream fruit french.fries
## p1st       0.06  0.12         0.02
## p6th       0.12  0.06         0.02
## p11th      0.18  0.06         0.36
```

To see if grade and food are indepedent:

```
# marginal prob for food
PropFood = colSums(jointprob)
PropFood
```

```
##    ice.cream        fruit french.fries
##         0.36         0.24         0.40
```

any cell in the joint probability table is not a product of their respective marginal probability. For instance, $p(Icecream) * p(1stgrade) = .36 \times 0.2 = 0.072$
which is not 0.06