Project 1

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2/19/2020

```
#loading libraries
library(dplyr)
```

```
##
## Attaching package: 'dplyr'

## The following objects are masked from 'package:stats':
##
##     filter, lag

## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```
library(tidyverse)
```

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

## v ggplot2 3.2.1     v purrr   0.3.3
## v tibble  2.1.3     v stringr 1.4.0
## v tidyr   1.0.0     v forcats 0.4.0
## v readr   1.3.1

## Warning: package 'stringr' was built under R version 3.6.2

## -- Conflicts ---------------------------------------------------------------------------- tidyverse_co
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

```
library(ggplot2)
library(data.table)
```

```
##
## Attaching package: 'data.table'

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

## The following objects are masked from 'package:dplyr':
##
##     between, first, last
```

```
library(stringr)
library(usmap)
```

```
## Warning: package 'usmap' was built under R version 3.6.2
```

```
library(class)
library(caret)
```

```
## Warning: package 'caret' was built under R version 3.6.2

## Loading required package: lattice
```

```
##
## Attaching package: 'caret'
## The following object is masked from 'package:purrr':
##
##     lift
```

```
library(e1071)
```

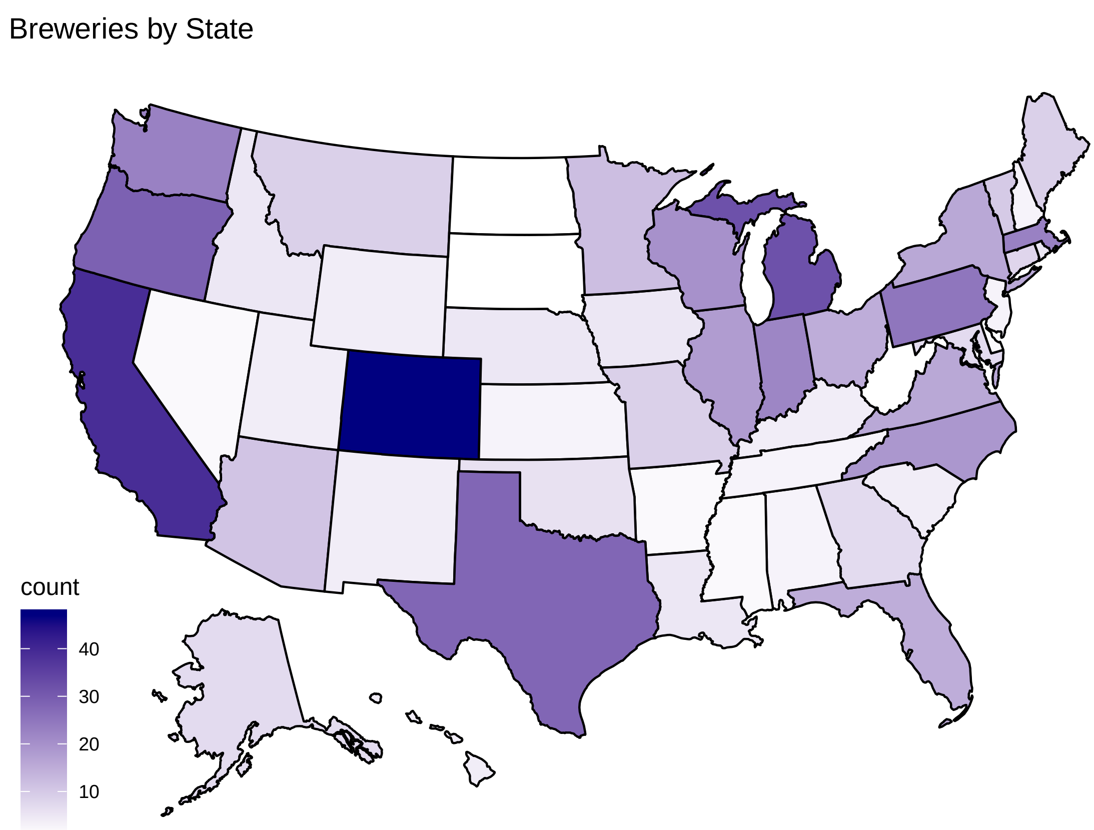
```
## Warning: package 'e1071' was built under R version 3.6.2
```

```
#Reading in the data
breweries <- read.csv(file.choose(),header=TRUE)
beer <- read.csv(file.choose(),header=TRUE)
```

```
#count of breweries by state
#CONSIDER - adding Group By Statement
breweries1 <- breweries %>% count(State)

#graphing counts
breweries1$fips <- fips(trimws(as.character(breweries1$State)))
#top 10 table
breweries1 %>% arrange(desc(n)) %>% slice(1:10)
```

```
## # A tibble: 10 x 3
##    State     n fips
##    <fct> <int> <chr>
##  1 " CO"    47 08
##  2 " CA"    39 06
##  3 " MI"    32 26
##  4 " OR"    29 41
##  5 " TX"    28 48
##  6 " PA"    25 42
##  7 " MA"    23 25
##  8 " WA"    23 53
##  9 " IN"    22 18
## 10 " WI"    20 55
```

```
#plotting the data
plot_usmap(data=breweries1, values = "n", color = "black") + labs(title = "Breweries by State") + scale_
```




```r
#assessing merge
head(beer)
```

```
##                  Name Beer_ID   ABV IBU Brewery_id
## 1            Pub Beer    1436 0.050  NA        409
## 2         Devil's Cup    2265 0.066  NA        178
## 3 Rise of the Phoenix    2264 0.071  NA        178
## 4            Sinister    2263 0.090  NA        178
## 5       Sex and Candy    2262 0.075  NA        178
## 6        Black Exodus    2261 0.077  NA        178
##                            Style Ounces
## 1            American Pale Lager     12
## 2        American Pale Ale (APA)     12
## 3                   American IPA     12
## 4 American Double / Imperial IPA     12
## 5                   American IPA     12
## 6                  Oatmeal Stout     12
```

```r
head(breweries)
```

```
##   Brew_ID                      Name          City State
## 1       1        NorthGate Brewing    Minneapolis    MN
## 2       2 Against the Grain Brewery    Louisville    KY
## 3       3  Jack's Abby Craft Lagers    Framingham    MA
## 4       4 Mike Hess Brewing Company     San Diego    CA
## 5       5   Fort Point Beer Company San Francisco    CA
## 6       6     COAST Brewing Company    Charleston    SC
```

```r
str(beer)
```

```
## 'data.frame':    2410 obs. of  7 variables:
##  $ Name      : Factor w/ 2305 levels "#001 Golden Amber Lager",..: 1638 577 1705 1842 1819 268 1160
##  $ Beer_ID   : int  1436 2265 2264 2263 2262 2261 2260 2259 2258 2131 ...
##  $ ABV       : num  0.05 0.066 0.071 0.09 0.075 0.077 0.045 0.065 0.055 0.086 ...
##  $ IBU       : int  NA NA NA NA NA NA NA NA NA NA ...
##  $ Brewery_id: int  409 178 178 178 178 178 178 178 178 178 ...
##  $ Style     : Factor w/ 100 levels "","Abbey Single Ale",..: 19 18 16 12 16 80 18 22 18 12 ...
##  $ Ounces    : num  12 12 12 12 12 12 12 12 12 12 ...
```

```r
str(breweries)
```

```
## 'data.frame':    558 obs. of  4 variables:
##  $ Brew_ID: int  1 2 3 4 5 6 7 8 9 10 ...
##  $ Name   : Factor w/ 551 levels "10 Barrel Brewing Company",..: 355 12 266 319 201 136 227 477 59 4
##  $ City   : Factor w/ 384 levels "Abingdon","Abita Springs",..: 228 200 122 299 300 62 91 48 152 136
##  $ State  : Factor w/ 51 levels " AK"," AL"," AR",..: 24 18 20 5 5 41 6 23 23 23 ...
```

```r
#merge by Brewery ID key
#Note:  All three join sequences produce the same dataset - using first one
beerbrew <- left_join(beer, breweries, by = c("Brewery_id" = "Brew_ID"))
str(beerbrew)
```

```
## 'data.frame':    2410 obs. of  10 variables:
##  $ Name.x    : Factor w/ 2305 levels "#001 Golden Amber Lager",..: 1638 577 1705 1842 1819 268 1160
##  $ Beer_ID   : int  1436 2265 2264 2263 2262 2261 2260 2259 2258 2131 ...
##  $ ABV       : num  0.05 0.066 0.071 0.09 0.075 0.077 0.045 0.065 0.055 0.086 ...
##  $ IBU       : int  NA NA NA NA NA NA NA NA NA NA ...
##  $ Brewery_id: int  409 178 178 178 178 178 178 178 178 178 ...
##  $ Style     : Factor w/ 100 levels "","Abbey Single Ale",..: 19 18 16 12 16 80 18 22 18 12 ...
##  $ Ounces    : num  12 12 12 12 12 12 12 12 12 12 ...
##  $ Name.y    : Factor w/ 551 levels "10 Barrel Brewing Company",..: 1 2 2 2 2 2 2 2 2 2 ...
##  $ City      : Factor w/ 384 levels "Abingdon","Abita Springs",..: 32 131 131 131 131 131 131 131 13
##  $ State     : Factor w/ 51 levels " AK"," AL"," AR",..: 38 16 16 16 16 16 16 16 16 16 ...
```

```r
#beerbrew <- left_join(breweries, beer, by = c("Brew_ID" = "Brewery_id"))
#str(beerbrew)
#beerbrew <- full_join(breweries, beer, by = c("Brew_ID" = "Brewery_id"))
#str(beerbrew)
```

```r
#rename Name column headers
names(beerbrew)[names(beerbrew) == "Name.x"] <- "Beer Name"
names(beerbrew)[names(beerbrew) == "Name.y"] <- "Brewery Name"
```

```r
#print top 6 & bottom 6
head(beerbrew, n=6)
```

```
##              Beer Name Beer_ID   ABV IBU Brewery_id
## 1             Pub Beer    1436 0.050  NA        409
## 2          Devil's Cup    2265 0.066  NA        178
## 3 Rise of the Phoenix    2264 0.071  NA        178
## 4             Sinister    2263 0.090  NA        178
## 5       Sex and Candy    2262 0.075  NA        178
## 6        Black Exodus    2261 0.077  NA        178
##                             Style Ounces              Brewery Name City
## 1             American Pale Lager     12 10 Barrel Brewing Company Bend
```

```
## 2        American Pale Ale (APA)     12       18th Street Brewery Gary
## 3                   American IPA     12       18th Street Brewery Gary
## 4 American Double / Imperial IPA     12       18th Street Brewery Gary
## 5                   American IPA     12       18th Street Brewery Gary
## 6                  Oatmeal Stout     12       18th Street Brewery Gary
##   State
## 1    OR
## 2    IN
## 3    IN
## 4    IN
## 5    IN
## 6    IN
```

```r
tail(beerbrew, n=6)
```

```
##                        Beer Name Beer_ID   ABV IBU Brewery_id
## 2405 Rocky Mountain Oyster Stout    1035 0.075  NA        425
## 2406                   Belgorado     928 0.067  45        425
## 2407                 Rail Yard Ale     807 0.052  NA        425
## 2408               B3K Black Lager     620 0.055  NA        425
## 2409            Silverback Pale Ale     145 0.055  40        425
## 2410           Rail Yard Ale (2009)      84 0.052  NA        425
##                         Style Ounces            Brewery Name   City State
## 2405           American Stout     12 Wynkoop Brewing Company Denver    CO
## 2406              Belgian IPA     12 Wynkoop Brewing Company Denver    CO
## 2407 American Amber / Red Ale     12 Wynkoop Brewing Company Denver    CO
## 2408              Schwarzbier     12 Wynkoop Brewing Company Denver    CO
## 2409  American Pale Ale (APA)     12 Wynkoop Brewing Company Denver    CO
## 2410 American Amber / Red Ale     12 Wynkoop Brewing Company Denver    CO
```

```r
#missing values - INCOMPLETE
is.na(beerbrew$Name)
```

```
## logical(0)
```

```r
summary(beerbrew)
```

```
##                  Beer Name       Beer_ID           ABV
##  Nonstop Hef Hop       :  12   Min.   :   1.0   Min.   :0.00100
##  Dale's Pale Ale       :   6   1st Qu.: 808.2   1st Qu.:0.05000
##  Oktoberfest           :   6   Median :1453.5   Median :0.05600
##  Longboard Island Lager:   4   Mean   :1431.1   Mean   :0.05977
##  1327 Pod's ESB        :   3   3rd Qu.:2075.8   3rd Qu.:0.06700
##  Boston Lager          :   3   Max.   :2692.0   Max.   :0.12800
##  (Other)              :2376                     NA's   :62
##       IBU           Brewery_id                              Style
##  Min.   :  4.00   Min.   :  1.0   American IPA                  : 424
##  1st Qu.: 21.00   1st Qu.: 94.0   American Pale Ale (APA)       : 245
##  Median : 35.00   Median :206.0   American Amber / Red Ale      : 133
##  Mean   : 42.71   Mean   :232.7   American Blonde Ale           : 108
##  3rd Qu.: 64.00   3rd Qu.:367.0   American Double / Imperial IPA: 105
##  Max.   :138.00   Max.   :558.0   American Pale Wheat Ale       :  97
##  NA's   :1005                     (Other)                       :1298
##      Ounces                         Brewery Name           City
##  Min.   : 8.40   Brewery Vivant             :  62   Grand Rapids:  66
##  1st Qu.:12.00   Oskar Blues Brewery        :  46   Portland    :  64
```

```
##  Median :12.00   Sun King Brewing Company  :  38   Chicago      :  55
##  Mean   :13.59   Cigar City Brewing Company:  25   Indianapolis:  43
##  3rd Qu.:16.00   Sixpoint Craft Ales       :  24   San Diego    :  42
##  Max.   :32.00   Hopworks Urban Brewery    :  23   Boulder      :  41
##                  (Other)                   :2192   (Other)      :2099
##      State
##   CO    : 265
##   CA    : 183
##   MI    : 162
##   IN    : 139
##   TX    : 130
##   OR    : 125
##  (Other):1406
```

```
str(beerbrew)
```

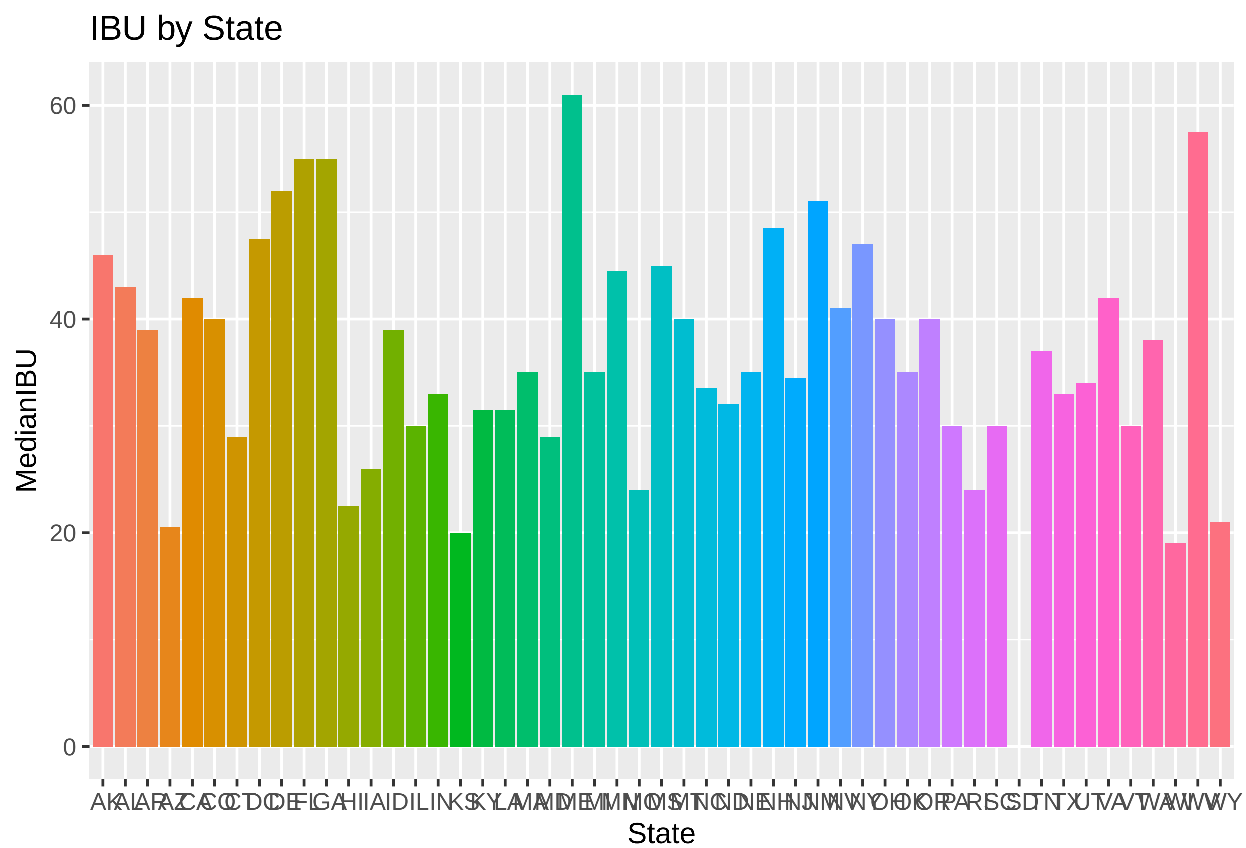
```
## 'data.frame':    2410 obs. of  10 variables:
##  $ Beer Name   : Factor w/ 2305 levels "#001 Golden Amber Lager",..: 1638 577 1705 1842 1819 268 116
##  $ Beer_ID     : int  1436 2265 2264 2263 2262 2261 2260 2259 2258 2131 ...
##  $ ABV         : num  0.05 0.066 0.071 0.09 0.075 0.077 0.045 0.065 0.055 0.086 ...
##  $ IBU         : int  NA NA NA NA NA NA NA NA NA NA ...
##  $ Brewery_id  : int  409 178 178 178 178 178 178 178 178 178 ...
##  $ Style       : Factor w/ 100 levels "","Abbey Single Ale",..: 19 18 16 12 16 80 18 22 18 12 ...
##  $ Ounces      : num  12 12 12 12 12 12 12 12 12 12 ...
##  $ Brewery Name: Factor w/ 551 levels "10 Barrel Brewing Company",..: 1 2 2 2 2 2 2 2 2 2 ...
##  $ City        : Factor w/ 384 levels "Abingdon","Abita Springs",..: 32 131 131 131 131 131 131 131
##  $ State       : Factor w/ 51 levels " AK"," AL"," AR",..: 38 16 16 16 16 16 16 16 16 16 ...
```

```
#barplot of alcohol content and international bitterness by state
#finding median values
beerbrew %>% group_by(State) %>% summarize(median(ABV, na.rm=TRUE))
```

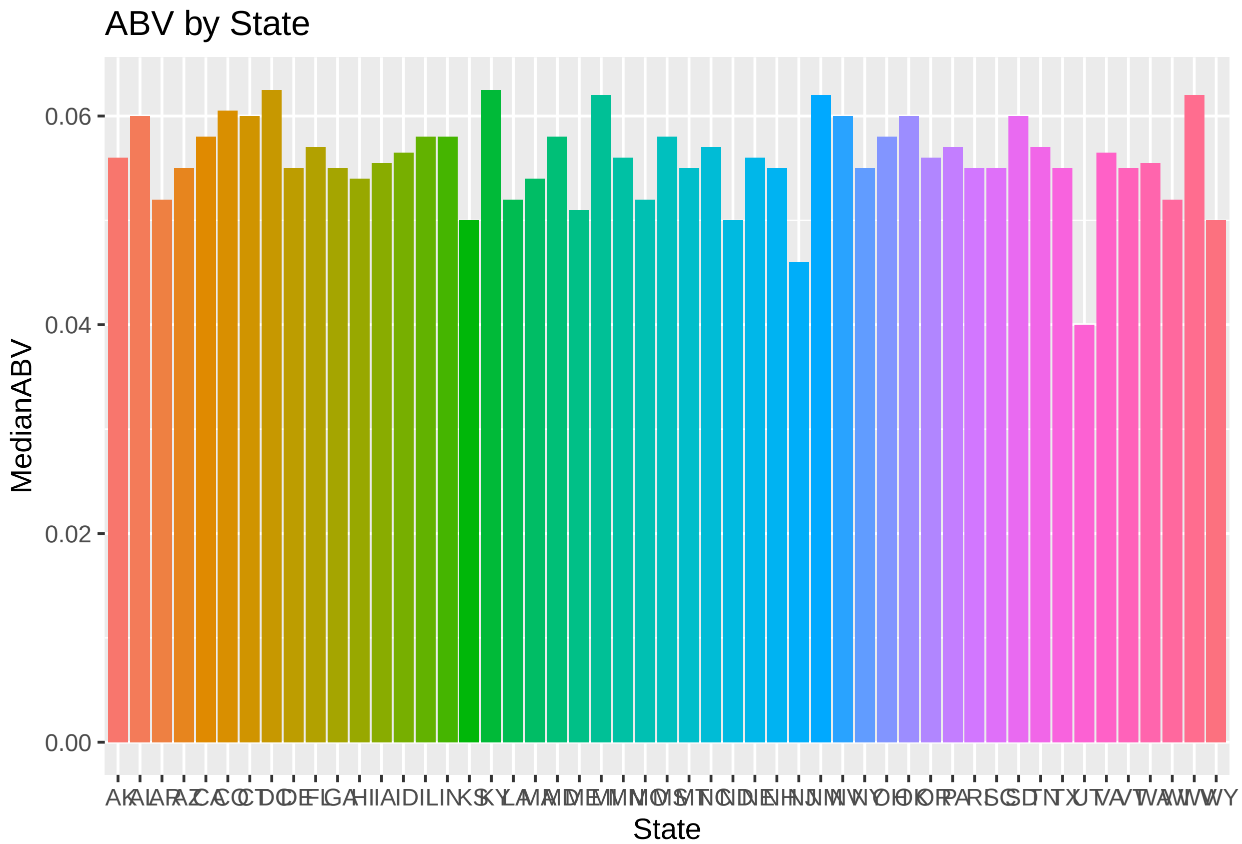
```
## # A tibble: 51 x 2
##    State `median(ABV, na.rm = TRUE)`
##    <fct>                        <dbl>
##  1 " AK"                       0.056
##  2 " AL"                       0.06
##  3 " AR"                       0.052
##  4 " AZ"                       0.055
##  5 " CA"                       0.058
##  6 " CO"                       0.0605
##  7 " CT"                       0.06
##  8 " DC"                       0.0625
##  9 " DE"                       0.055
## 10 " FL"                       0.057
## # ... with 41 more rows
```

```
medians <- setDT(beerbrew)[,list(MedianABV=as.numeric(median(ABV, na.rm=TRUE)),MedianIBU=as.numeric(medi

#barplots of median data
ggplot(data=medians, mapping = aes(x=State, y=MedianIBU, fill=State)) + geom_bar(stat = "identity") + gg
```

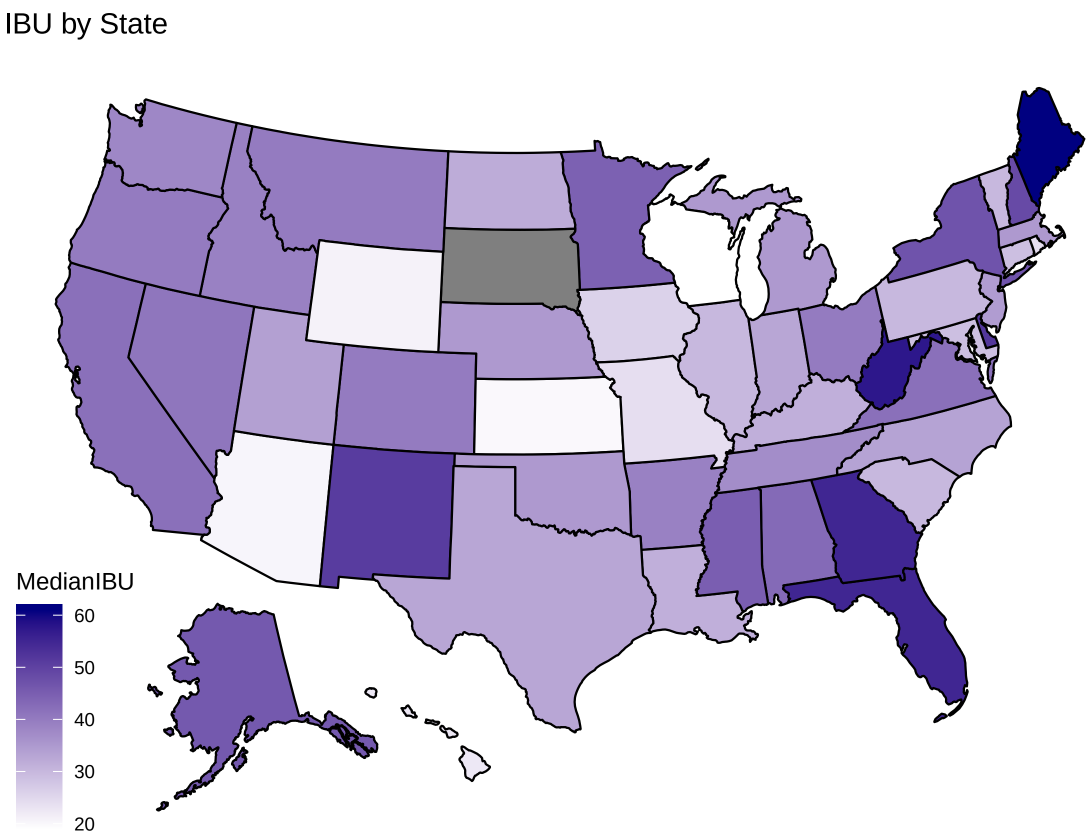
```
## Warning: Removed 1 rows containing missing values (position_stack).
```



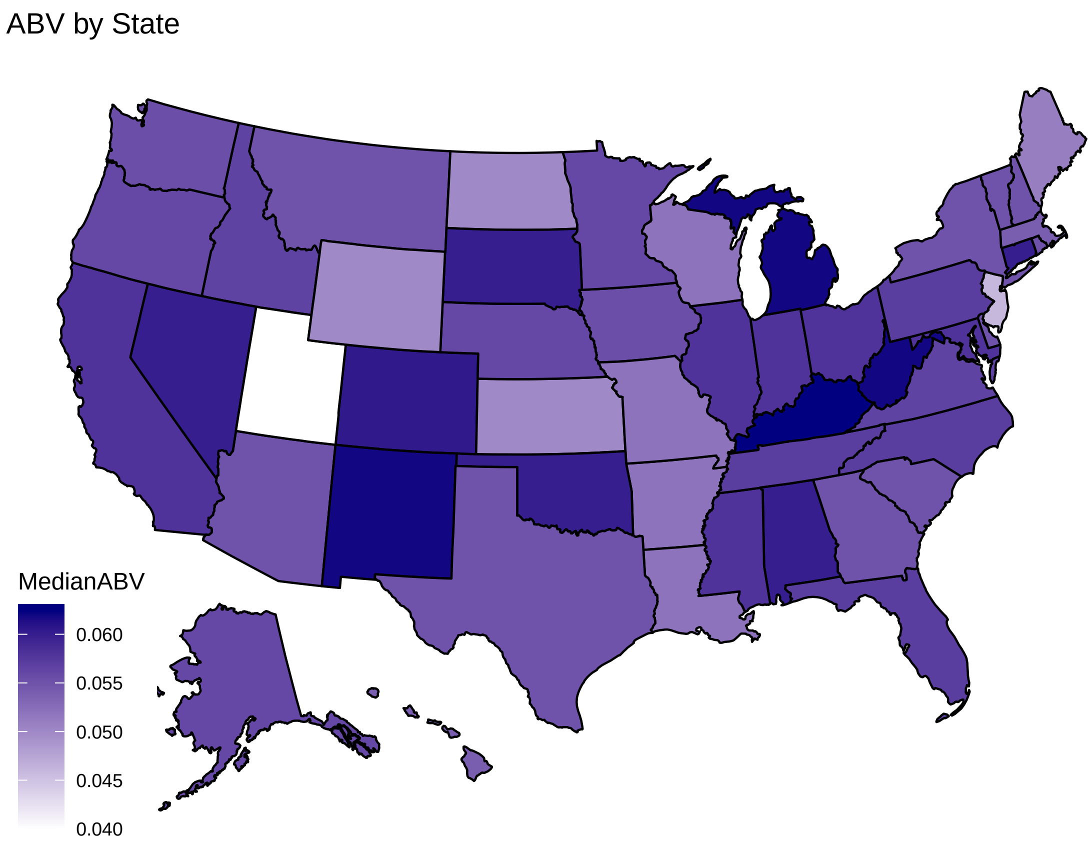

```
ggplot(data=medians, mapping = aes(x=State, y=MedianABV, fill=State)) + geom_bar(stat = "identity") + gg
```




```r
#graphing on maps - IBU
medians$fips <- fips(trimws(as.character(medians$State)))

plot_usmap(data=medians, values = "MedianIBU", color = "black") + labs(title = "IBU by State") + scale_
```




```r
#graphing on maps - ABV
plot_usmap(data=medians, values = "MedianABV", color = "black") + labs(title = "ABV by State") + scale_
```




```r
#finding state with max ABV and IBU
which.max(beerbrew$ABV)
```

```
## [1] 2279
```

```r
beerbrew[2279,]
```

```
##                                                Beer Name Beer_ID   ABV IBU
## 1: Lee Hill Series Vol. 5 - Belgian Style Quadrupel Ale    2565 0.128  NA
##    Brewery_id            Style Ounces             Brewery Name    City
## 1:         52 Quadrupel (Quad)   19.2 Upslope Brewing Company Boulder
##    State
## 1:    CO
```

```r
which.max(beerbrew$IBU)
```

```
## [1] 148
```

```r
beerbrew[148,]
```

```
##                    Beer Name Beer_ID   ABV IBU Brewery_id
## 1: Bitter Bitch Imperial IPA     980 0.082 138        375
##                              Style Ounces             Brewery Name    City
## 1: American Double / Imperial IPA     12 Astoria Brewing Company Astoria
##    State
## 1:    OR
```

```r
#confirming the max results
summary(beerbrew$ABV)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
## 0.00100 0.05000 0.05600 0.05977 0.06700 0.12800      62
```

```r
summary(beerbrew$IBU)
```

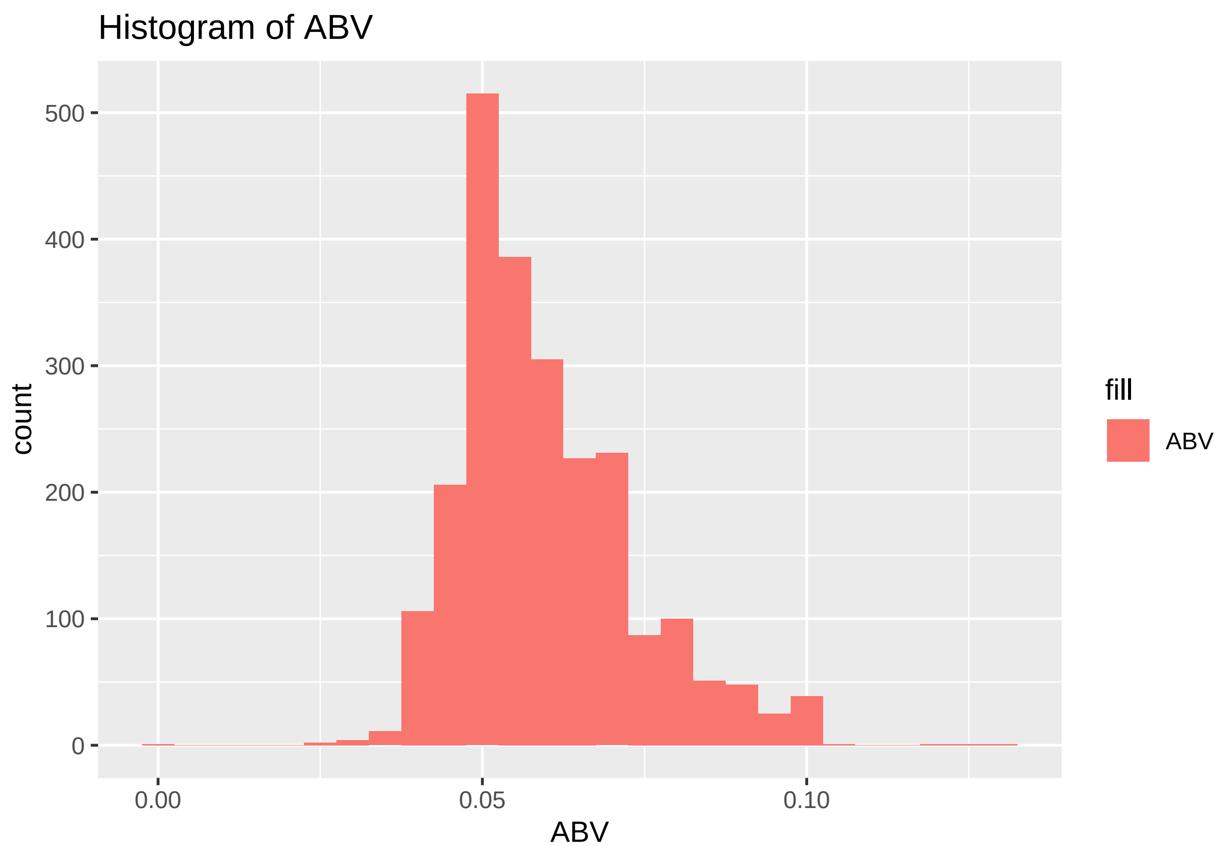
```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##    4.00   21.00   35.00   42.71   64.00  138.00    1005
```

```r
#summary statistics of ABV
summary(beerbrew$ABV)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
## 0.00100 0.05000 0.05600 0.05977 0.06700 0.12800      62
```

```r
ggplot(data = beerbrew) + geom_histogram(binwidth = .005, mapping = aes(x=ABV, fill="ABV"))+labs(title =
```

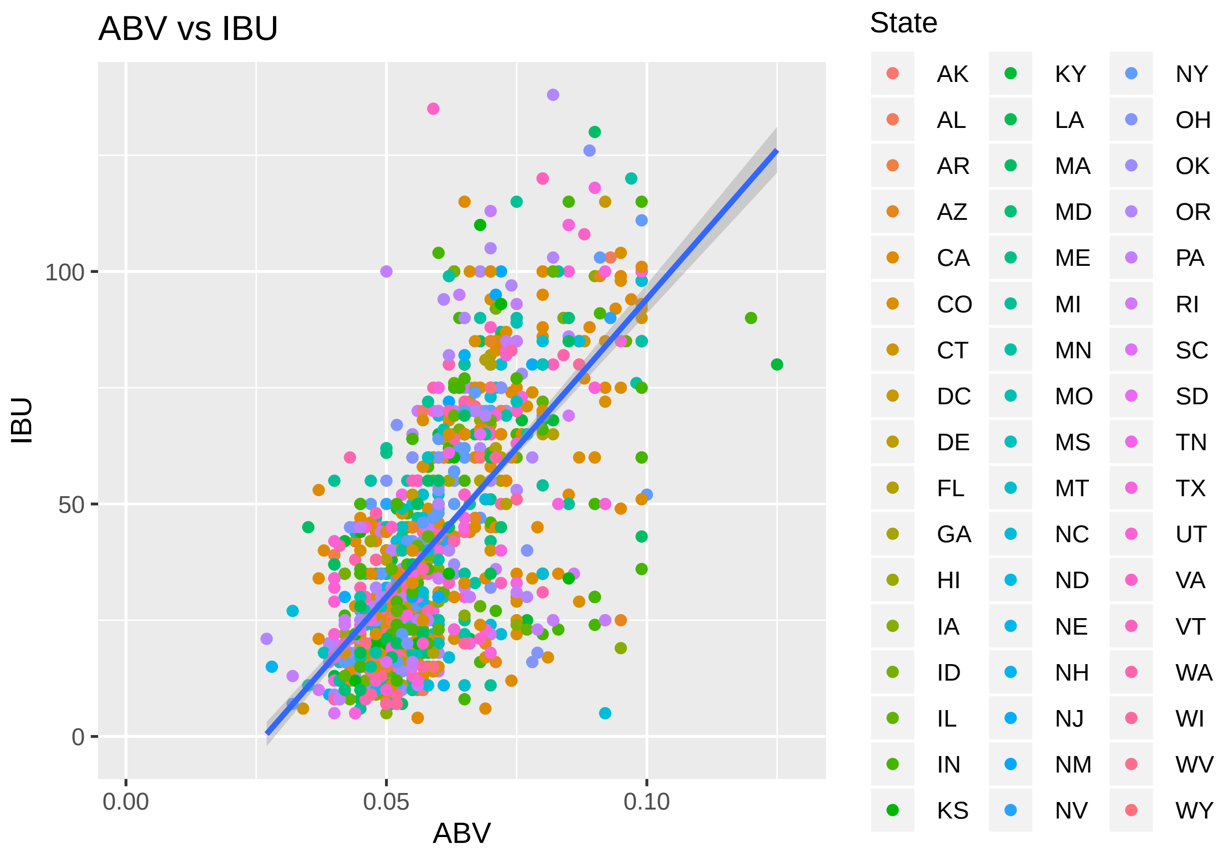
```
## Warning: Removed 62 rows containing non-finite values (stat_bin).
```




```r
#Scatterplot of ABV and Internationl bitterness to assess correlation
ggplot(data=beerbrew, mapping = aes(x=ABV, y=IBU)) + geom_point(mapping = aes(color = State)) + geom_sm
```

```
## Warning: Removed 1005 rows containing non-finite values (stat_smooth).
```

```
## Warning: Removed 1005 rows containing missing values (geom_point).
```



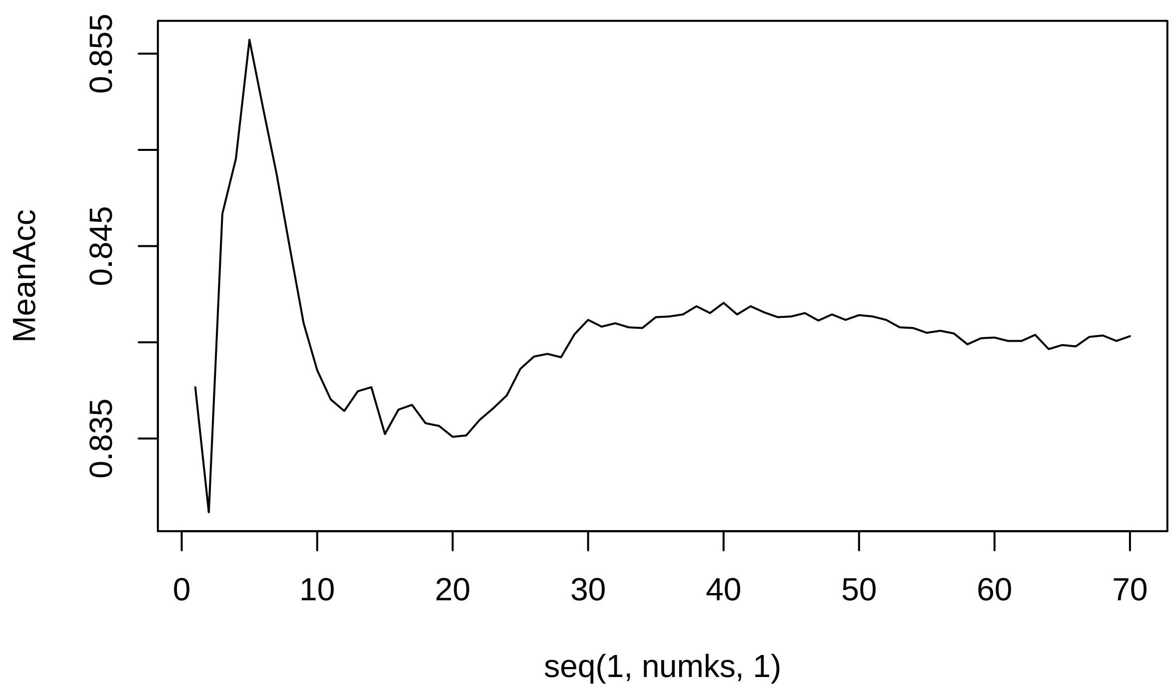

```
#Running KNN for IPA vs all other 'Ale's
#create groupings of the dataset

#group IPA separately from the rest of the Ales
beerbrew$type[grepl("IPA", beerbrew$Style, fixed = FALSE)] <- "IPA"
beerbrew$type[is.na(beerbrew$type) & grepl("Ale", beerbrew$Style)] <- "Other Ales"
beerbrew$type[is.na(beerbrew$type)] <- "Non Ales"

#filter dataset down to exclude Non Ales
beerbrew1 <- beerbrew %>% filter(type == "IPA" | type == "Other Ales")
```

```
#removing NA values
beerbrew1$type = as.factor(beerbrew1$type)
beerbrew1 <- beerbrew1 %>% filter(!is.na(beerbrew1$ABV))
beerbrew1 <- beerbrew1 %>% filter(!is.na(beerbrew1$IBU))
summary(beerbrew1$type)
```

```
##        IPA Other Ales
##        392        552
```

```
#creating KNN - 70/30 split
set.seed(4)
iterations = 100
numks = 70
splitPerc = .7

masterAcc = matrix(nrow = iterations, ncol = numks)
```

```r
for(j in 1:iterations)
{
  trainIndices = sample(1:dim(beerbrew1)[1],round(splitPerc * dim(beerbrew1)[1]))
  train = beerbrew1[trainIndices,]
  test = beerbrew1[-trainIndices,]
  for(i in 1:numks)
  {
    classifications = knn(train[,c(3,4)],test[,c(3,4)],train$type, prob = TRUE, k = i)
    table(classifications,test$type)
    CM = confusionMatrix(table(classifications,test$type))
    masterAcc[j,i] = CM$overall[1]
  }

}

MeanAcc = colMeans(masterAcc)

plot(seq(1,numks,1),MeanAcc, type = "l")
```




```r
which.max(MeanAcc)
```

```
## [1] 5
```

```r
max(MeanAcc)
```

```
## [1] 0.8557244
```

```r
CM
```

```
## Confusion Matrix and Statistics
##
##
## classifications IPA Other Ales
##      IPA         91         20
##      Other Ales  28        144
##
##                Accuracy : 0.8304
##                  95% CI : (0.7815, 0.8722)
##     No Information Rate : 0.5795
##     P-Value [Acc > NIR] : <2e-16
##
##                   Kappa : 0.6487
##
##  Mcnemar's Test P-Value : 0.3123
##
##             Sensitivity : 0.7647
##             Specificity : 0.8780
##          Pos Pred Value : 0.8198
##          Neg Pred Value : 0.8372
##              Prevalence : 0.4205
##          Detection Rate : 0.3216
##    Detection Prevalence : 0.3922
##       Balanced Accuracy : 0.8214
##
##        'Positive' Class : IPA
##
```

```r
#Using K=5
set.seed(4)
trainIndices = sample(1:dim(beerbrew1)[1],round(splitPerc * dim(beerbrew1)[1]))
train = beerbrew1[trainIndices,]
test = beerbrew1[-trainIndices,]
classifying <- knn(train[,c(3,4)],test[,c(3,4)],train$type, prob = TRUE, k = 5)
CM = confusionMatrix(table(classifying,test$type))
```

```r
#testing findings with Naive Bayes
#INCOMPLETE
iterations = 100

masterAcc = matrix(nrow = iterations)

splitPerc = .7 #Training / Test split Percentage

for(j in 1:iterations)
{

  trainIndices = sample(1:dim(beerbrew1)[1],round(splitPerc * dim(beerbrew1)[1]))
  train = beerbrew1[trainIndices,]
  test = beerbrew1[-trainIndices,]

  model = naiveBayes(train[,c(3,4)],(train$type))
  table(predict(model,test[,c(3,4)]),(test$type))
```

```r
  CM = confusionMatrix(table(predict(model,test[,c(1,2)]),(test$type)))
  masterAcc[j] = CM$overall[1]
}
```

```
## Warning in predict.naiveBayes(model, test[, c(1, 2)]): Type mismatch
## between training and new data for variable 'ABV'. Did you use factors with
## numeric labels for training, and numeric values for new data?

## Warning in predict.naiveBayes(model, test[, c(1, 2)]): Type mismatch
## between training and new data for variable 'IBU'. Did you use factors with
## numeric labels for training, and numeric values for new data?

## Warning in predict.naiveBayes(model, test[, c(1, 2)]): Type mismatch
## between training and new data for variable 'ABV'. Did you use factors with
## numeric labels for training, and numeric values for new data?

## Warning in predict.naiveBayes(model, test[, c(1, 2)]): Type mismatch
## between training and new data for variable 'IBU'. Did you use factors with
## numeric labels for training, and numeric values for new data?

## Warning in predict.naiveBayes(model, test[, c(1, 2)]): Type mismatch
## between training and new data for variable 'ABV'. Did you use factors with
## numeric labels for training, and numeric values for new data?

## Warning in predict.naiveBayes(model, test[, c(1, 2)]): Type mismatch
## between training and new data for variable 'IBU'. Did you use factors with
## numeric labels for training, and numeric values for new data?

## Warning in predict.naiveBayes(model, test[, c(1, 2)]): Type mismatch
## between training and new data for variable 'ABV'. Did you use factors with
## numeric labels for training, and numeric values for new data?

## Warning in predict.naiveBayes(model, test[, c(1, 2)]): Type mismatch
## between training and new data for variable 'IBU'. Did you use factors with
## numeric labels for training, and numeric values for new data?

## Warning in predict.naiveBayes(model, test[, c(1, 2)]): Type mismatch
## between training and new data for variable 'ABV'. Did you use factors with
## numeric labels for training, and numeric values for new data?

## Warning in predict.naiveBayes(model, test[, c(1, 2)]): Type mismatch
## between training and new data for variable 'IBU'. Did you use factors with
## numeric labels for training, and numeric values for new data?

## Warning in predict.naiveBayes(model, test[, c(1, 2)]): Type mismatch
## between training and new data for variable 'ABV'. Did you use factors with
## numeric labels for training, and numeric values for new data?

## Warning in predict.naiveBayes(model, test[, c(1, 2)]): Type mismatch
## between training and new data for variable 'IBU'. Did you use factors with
## numeric labels for training, and numeric values for new data?

## Warning in predict.naiveBayes(model, test[, c(1, 2)]): Type mismatch
## between training and new data for variable 'ABV'. Did you use factors with
## numeric labels for training, and numeric values for new data?

## Warning in predict.naiveBayes(model, test[, c(1, 2)]): Type mismatch
## between training and new data for variable 'IBU'. Did you use factors with
## numeric labels for training, and numeric values for new data?
```

```
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```

```
MeanAcc = colMeans(masterAcc)

MeanAcc
```

```
## [1] 0.5861484
```

```
CM
```

```
## Confusion Matrix and Statistics
##
##
##              IPA Other Ales
##   IPA          0          0
##   Other Ales 128        155
##
##                Accuracy : 0.5477
##                  95% CI : (0.4877, 0.6067)
##     No Information Rate : 0.5477
##     P-Value [Acc > NIR] : 0.5246
##
##                   Kappa : 0
##
##  Mcnemar's Test P-Value : <2e-16
##
##             Sensitivity : 0.0000
##             Specificity : 1.0000
##          Pos Pred Value :    NaN
##          Neg Pred Value : 0.5477
##              Prevalence : 0.4523
##          Detection Rate : 0.0000
##    Detection Prevalence : 0.0000
##       Balanced Accuracy : 0.5000
##
##        'Positive' Class : IPA
##
```

```
#final insights
#correlations?  ABV to IBU
cor.test(beerbrew1$ABV, beerbrew1$IBU)
```

```
##
##  Pearson's product-moment correlation
##
## data:  beerbrew1$ABV and beerbrew1$IBU
## t = 28.416, df = 942, p-value < 2.2e-16
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  0.6434676 0.7123089
## sample estimates:
```

```
##       cor
## 0.6793803
```