DDS Group beer analysis for Q8 and Q9

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Note that the `echo = FALSE` parameter was added to the code chunk to prevent printing of the R code that generated the plot. # Data Analysis for questions 8 and 9

```
beers2 <- beers
colnames(beers2)
```

```
## [1] "Name"       "Beer_ID"    "ABV"        "IBU"        "Brewery_id" "Style"
## [7] "Ounces"
```

```
names(beers2) <- c("beername", "beerID", "beerABV", "beerIBU", "beer.brewery.id", "beerstyle", "beerOun
head(beers2)
```

```
##              beername beerID beerABV beerIBU beer.brewery.id                      beerstyle
## 1            Pub Beer   1436   0.050      NA             409            American Pale Lager
## 2         Devil's Cup   2265   0.066      NA             178        American Pale Ale (APA)
## 3 Rise of the Phoenix   2264   0.071      NA             178                  American IPA
## 4            Sinister   2263   0.090      NA             178 American Double / Imperial IPA
## 5       Sex and Candy   2262   0.075      NA             178                  American IPA
## 6        Black Exodus   2261   0.077      NA             178                 Oatmeal Stout
##   beerOunce
## 1        12
## 2        12
## 3        12
## 4        12
## 5        12
## 6        12
```

```
brew2 <- breweries
colnames(brew2)
```

```
## [1] "Brew_ID" "Name"    "City"    "State"
```

```
names(brew2) <- c("brewery.id", "brewery.name", "brewery.city", "brewery.state.abb")

brew2 <- brew2 %>%
  mutate(brewery.state.abb = trimws(brewery.state.abb))

head(brew2)
```

```
##   brewery.id              brewery.name  brewery.city brewery.state.abb
## 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
```

#Insert State name and region

```
#makes a data frame with State abbreviation, name  and region
stateinf= data.frame(state.abb, state.name, state.region, state.x77, stringsAsFactors=FALSE)
head(stateinf[1:5])
```

```
##            state.abb state.name state.region Population Income
## Alabama           AL    Alabama        South       3615   3624
## Alaska            AK     Alaska         West        365   6315
## Arizona           AZ    Arizona         West       2212   4530
## Arkansas          AR   Arkansas        South       2110   3378
## California        CA California         West      21198   5114
## Colorado          CO   Colorado         West       2541   4884
```

#Merge data brew2 with data stateinf and calculate breweries numbers are present in each state

```
brewstate<- merge(brew2, stateinf[1:5], by.x = "brewery.state.abb", by.y = "state.abb", all.x = TRUE)

head(brewstate)
```

```
##   brewery.state.abb brewery.id                  brewery.name brewery.city state.name
## 1                AK        494  Broken Tooth Brewing Company    Anchorage     Alaska
## 2                AK        224  Midnight Sun Brewing Company    Anchorage     Alaska
## 3                AK        459   Kenai River Brewing Company     Soldotna     Alaska
## 4                AK        454        Denali Brewing Company    Talkeetna     Alaska
## 5                AK        558 Sleeping Lady Brewing Company    Anchorage     Alaska
## 6                AK        271       Alaskan Brewing Company       Juneau     Alaska
##   state.region Population Income
## 1         West        365   6315
## 2         West        365   6315
## 3         West        365   6315
## 4         West        365   6315
## 5         West        365   6315
## 6         West        365   6315
```

```
beermerged <- merge(beers2, brewstate, by.x = "beer.brewery.id", by.y = "brewery.id")
```

```
beermerged$beeripaale<- ''

head(beermerged)
```

```
##   beer.brewery.id      beername beerID beerABV beerIBU                          beerstyle
## 1               1  Get Together   2692   0.045      50                       American IPA
```

```
## 2               1 Maggie's Leap   2691   0.049      26                  Milk / Sweet Stout
## 3               1    Wall's End   2690   0.048      19                   English Brown Ale
## 4               1       Pumpion   2689   0.060      38                         Pumpkin Ale
## 5               1    Stronghold   2688   0.060      25                      American Porter
## 6               1   Parapet ESB   2687   0.056      47 Extra Special / Strong Bitter (ESB)
##   beerOunce brewery.state.abb       brewery.name brewery.city state.name  state.region
## 1        16                MN NorthGate Brewing   Minneapolis  Minnesota North Central
## 2        16                MN NorthGate Brewing   Minneapolis  Minnesota North Central
## 3        16                MN NorthGate Brewing   Minneapolis  Minnesota North Central
## 4        16                MN NorthGate Brewing   Minneapolis  Minnesota North Central
## 5        16                MN NorthGate Brewing   Minneapolis  Minnesota North Central
## 6        16                MN NorthGate Brewing   Minneapolis  Minnesota North Central
##   Population Income beeripaale
## 1       3921   4675
## 2       3921   4675
## 3       3921   4675
## 4       3921   4675
## 5       3921   4675
## 6       3921   4675
```

```
#Get all different beers styles' numbers
beermerged %>%count(beerstyle)
```

```
##                              beerstyle   n
## 1                                        5
## 2                     Abbey Single Ale   2
## 3                              Altbier  13
## 4                American Adjunct Lager  18
## 5              American Amber / Red Ale 133
## 6            American Amber / Red Lager  29
## 7                  American Barleywine   3
## 8                   American Black Ale  36
## 9                  American Blonde Ale 108
## 10                  American Brown Ale  70
## 11              American Dark Wheat Ale   7
## 12       American Double / Imperial IPA 105
## 13   American Double / Imperial Pilsner   2
## 14     American Double / Imperial Stout   9
## 15            American India Pale Lager   3
## 16                        American IPA 424
## 17                American Malt Liquor   1
## 18              American Pale Ale (APA) 245
## 19                  American Pale Lager  39
## 20              American Pale Wheat Ale  97
## 21                     American Pilsner  25
## 22                      American Porter  68
## 23                      American Stout  39
## 24                  American Strong Ale  14
## 25                   American White IPA  11
## 26                   American Wild Ale   6
## 27                       Baltic Porter   6
## 28                     Belgian Dark Ale  11
## 29                          Belgian IPA  18
## 30                     Belgian Pale Ale  24
```

```
## 31              Belgian Strong Dark Ale   6
## 32              Belgian Strong Pale Ale   7
## 33                   Berliner Weissbier  11
## 34                       Bière de Garde   7
## 35                                 Bock   7
## 36                              Braggot   1
## 37       California Common / Steam Beer   6
## 38                           Chile Beer   3
## 39                                Cider  37
## 40                            Cream Ale  29
## 41                        Czech Pilsener  28
## 42                           Doppelbock   7
## 43            Dortmunder / Export Lager   6
## 44                               Dubbel   5
## 45                          Dunkelweizen   4
## 46                     English Barleywine   3
## 47                         English Bitter   3
## 48                     English Brown Ale  18
## 49                  English Dark Mild Ale   6
## 50          English India Pale Ale (IPA)  13
## 51                       English Pale Ale  12
## 52                  English Pale Mild Ale   3
## 53                           English Stout   2
## 54                     English Strong Ale   4
## 55                        Euro Dark Lager   5
## 56                        Euro Pale Lager   2
## 57  Extra Special / Strong Bitter (ESB)  20
## 58                     Flanders Oud Bruin   1
## 59                       Flanders Red Ale   1
## 60                 Foreign / Export Stout   6
## 61                 Fruit / Vegetable Beer  49
## 62                        German Pilsener  36
## 63                                  Gose  10
## 64                              Grisette   1
## 65                            Hefeweizen  40
## 66                  Herbed / Spiced Beer   9
## 67                       Irish Dry Stout   5
## 68                         Irish Red Ale  12
## 69            Keller Bier / Zwickel Bier   3
## 70                                Kölsch  42
## 71                          Kristalweizen   1
## 72                            Light Lager  12
## 73                     Low Alcohol Beer   1
## 74                  Maibock / Helles Bock   5
## 75                  Märzen / Oktoberfest  30
## 76                                  Mead   5
## 77                    Milk / Sweet Stout  10
## 78                  Munich Dunkel Lager   4
## 79                  Munich Helles Lager  20
## 80                        Oatmeal Stout  18
## 81                              Old Ale   2
## 82                                Other   1
## 83                           Pumpkin Ale  23
## 84                     Quadrupel (Quad)   4
```

```
## 85                              Radler   3
## 86                            Rauchbier   2
## 87                           Roggenbier   2
## 88                 Russian Imperial Stout  11
## 89                             Rye Beer  18
## 90                 Saison / Farmhouse Ale  52
## 91                            Schwarzbier   9
## 92                 Scotch Ale / Wee Heavy  15
## 93                            Scottish Ale  19
## 94                                 Shandy   3
## 95                           Smoked Beer   1
## 96                                Tripel  11
## 97                           Vienna Lager  20
## 98                              Wheat Ale   1
## 99                           Winter Warmer  15
## 100                               Witbier  51
```

```
#filter missing value
beermerged %>%
  filter(beerstyle == '')
```

```
##   beer.brewery.id                        beername beerID beerABV beerIBU beerstyle beerOunce
## 1              30                  Special Release   2210      NA      NA                16
## 2              67                    OktoberFiesta   2527   0.053      27                12
## 3             161 Kilt Lifter Scottish-Style Ale   1635   0.060      21                12
## 4             167                     The CROWLER   1796      NA      NA                32
## 5             167             CAN'D AID Foundation   1790      NA      NA                12
##   brewery.state.abb                brewery.name brewery.city state.name state.region
## 1                TX          Cedar Creek Brewery Seven Points      Texas        South
## 2                TX     Freetail Brewing Company  San Antonio      Texas        South
## 3                AZ Four Peaks Brewing Company        Tempe    Arizona         West
## 4                CO          Oskar Blues Brewery     Longmont   Colorado         West
## 5                CO          Oskar Blues Brewery     Longmont   Colorado         West
##   Population Income beeripaale
## 1      12237   4188
## 2      12237   4188
## 3       2212   4530
## 4       2541   4884
## 5       2541   4884
```

```
beermerged %>%
  filter(beerstyle %in% c("American Double / Imperial IPA", "American IPA", "Belgian IPA", "English Indi
  count(beerstyle)
```

```
##                       beerstyle   n
## 1 American Double / Imperial IPA 105
## 2                  American IPA 424
## 3                   Belgian IPA  18
## 4   English India Pale Ale (IPA)  13
```

```
beeripa <- beermerged %>%
  filter(beerstyle %in% c("American Double / Imperial IPA", "American IPA", "Belgian IPA", "English Indi
```

```
  mutate(beeripaale= 'IPA')
head(beeripa)
```

```
##   beer.brewery.id       beername beerID beerABV beerIBU                     beerstyle
## 1               1   Get Together   2692   0.045      50                   American IPA
## 2               2 Citra Ass Down   2686   0.080      68 American Double / Imperial IPA
## 3               2    Rico Sauvin   2678   0.076      68 American Double / Imperial IPA
## 4               2   Pile of Face   2675   0.060      65                   American IPA
## 5               4 Habitus (2014)   2668   0.080     100 American Double / Imperial IPA
## 6               4          Solis   2667   0.075      85                   American IPA
##   beerOunce brewery.state.abb             brewery.name brewery.city state.name
## 1        16                MN        NorthGate Brewing   Minneapolis  Minnesota
## 2        16                KY Against the Grain Brewery   Louisville   Kentucky
## 3        16                KY Against the Grain Brewery   Louisville   Kentucky
## 4        16                KY Against the Grain Brewery   Louisville   Kentucky
## 5        16                CA Mike Hess Brewing Company    San Diego California
## 6        16                CA Mike Hess Brewing Company    San Diego California
##    state.region Population Income beeripaale
## 1 North Central       3921   4675        IPA
## 2         South       3387   3712        IPA
## 3         South       3387   3712        IPA
## 4         South       3387   3712        IPA
## 5          West      21198   5114        IPA
## 6          West      21198   5114        IPA
```

```
# Kilt Lifter Scottish-Style Ale (1635)
beermerged[946,]
```

```
##     beer.brewery.id                       beername beerID beerABV beerIBU beerstyle
## 946             161 Kilt Lifter Scottish-Style Ale   1635    0.06      21
##     beerOunce brewery.state.abb               brewery.name brewery.city state.name
## 946        12                AZ Four Peaks Brewing Company        Tempe    Arizona
##     state.region Population Income beeripaale
## 946         West       2212   4530
```

```
beermerged %>%
  filter(!beerstyle %in% c("American Double / Imperial IPA", "American IPA", "Belgian IPA", "English In
  filter(str_detect(beerstyle, "Ale") |  beerID==1635) %>%
  count(beerstyle)
```

```
##                   beerstyle   n
## 1                           1
## 2          Abbey Single Ale   2
## 3  American Amber / Red Ale 133
## 4        American Black Ale  36
## 5       American Blonde Ale 108
## 6        American Brown Ale  70
## 7   American Dark Wheat Ale   7
## 8   American Pale Ale (APA) 245
## 9   American Pale Wheat Ale  97
## 10      American Strong Ale  14
## 11        American Wild Ale   6
```

```
## 12         Belgian Dark Ale  11
## 13         Belgian Pale Ale  24
## 14  Belgian Strong Dark Ale   6
## 15  Belgian Strong Pale Ale   7
## 16               Cream Ale  29
## 17       English Brown Ale  18
## 18    English Dark Mild Ale   6
## 19         English Pale Ale  12
## 20    English Pale Mild Ale   3
## 21       English Strong Ale   4
## 22         Flanders Red Ale   1
## 23            Irish Red Ale  12
## 24                 Old Ale   2
## 25             Pumpkin Ale  23
## 26   Saison / Farmhouse Ale  52
## 27   Scotch Ale / Wee Heavy  15
## 28            Scottish Ale  19
## 29               Wheat Ale   1
```

```
beerale <- beermerged %>%
  filter(!beerstyle %in% c("American Double / Imperial IPA", "American IPA", "Belgian IPA", "English In
  filter(str_detect(beerstyle, "Ale") |beerID==1635) %>%
  mutate(beeripaale= 'Ale')

head(beerale)
```

```
##   beer.brewery.id         beername beerID beerABV beerIBU               beerstyle beerOunce
## 1               1       Wall's End   2690   0.048      19       English Brown Ale        16
## 2               1          Pumpion   2689   0.060      38             Pumpkin Ale        16
## 3               2           A Beer   2683   0.042      42 American Pale Ale (APA)        16
## 4               2    Flesh Gourd'n   2681   0.066      21             Pumpkin Ale        16
## 5               2         Sho'nuff   2680   0.040      13        Belgian Pale Ale        16
## 6               2 Coq de la Marche   2677   0.051      38  Saison / Farmhouse Ale        16
##   brewery.state.abb              brewery.name brewery.city state.name  state.region
## 1                MN        NorthGate Brewing   Minneapolis  Minnesota North Central
## 2                MN        NorthGate Brewing   Minneapolis  Minnesota North Central
## 3                KY Against the Grain Brewery   Louisville   Kentucky         South
## 4                KY Against the Grain Brewery   Louisville   Kentucky         South
## 5                KY Against the Grain Brewery   Louisville   Kentucky         South
## 6                KY Against the Grain Brewery   Louisville   Kentucky         South
##   Population Income beeripaale
## 1       3921   4675        Ale
## 2       3921   4675        Ale
## 3       3387   3712        Ale
## 4       3387   3712        Ale
## 5       3387   3712        Ale
## 6       3387   3712        Ale
```

```
head(beermerged) %>%
  mutate(beer.style.words = as.character(str_split(beerstyle, boundary("word")))) %>%
  select(beer.style.words)
```

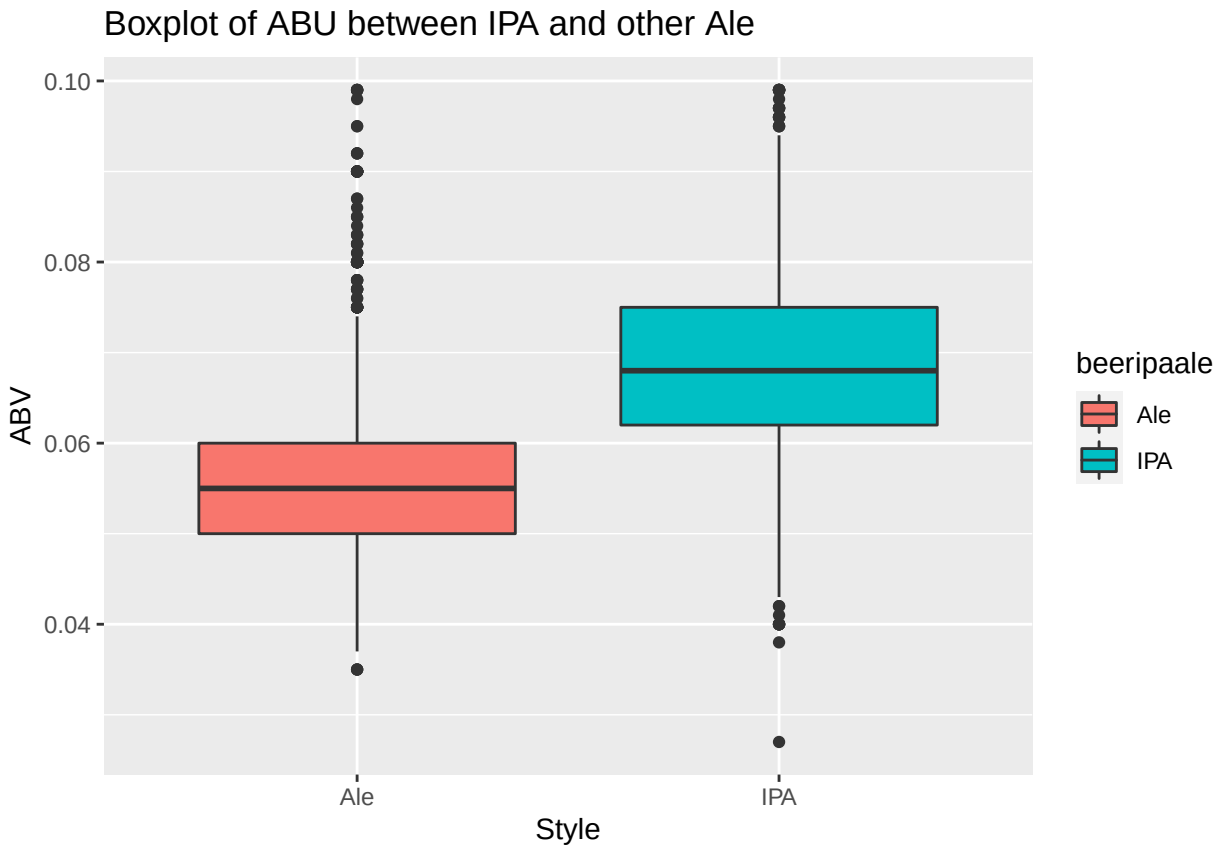
```
##                                beer.style.words
```

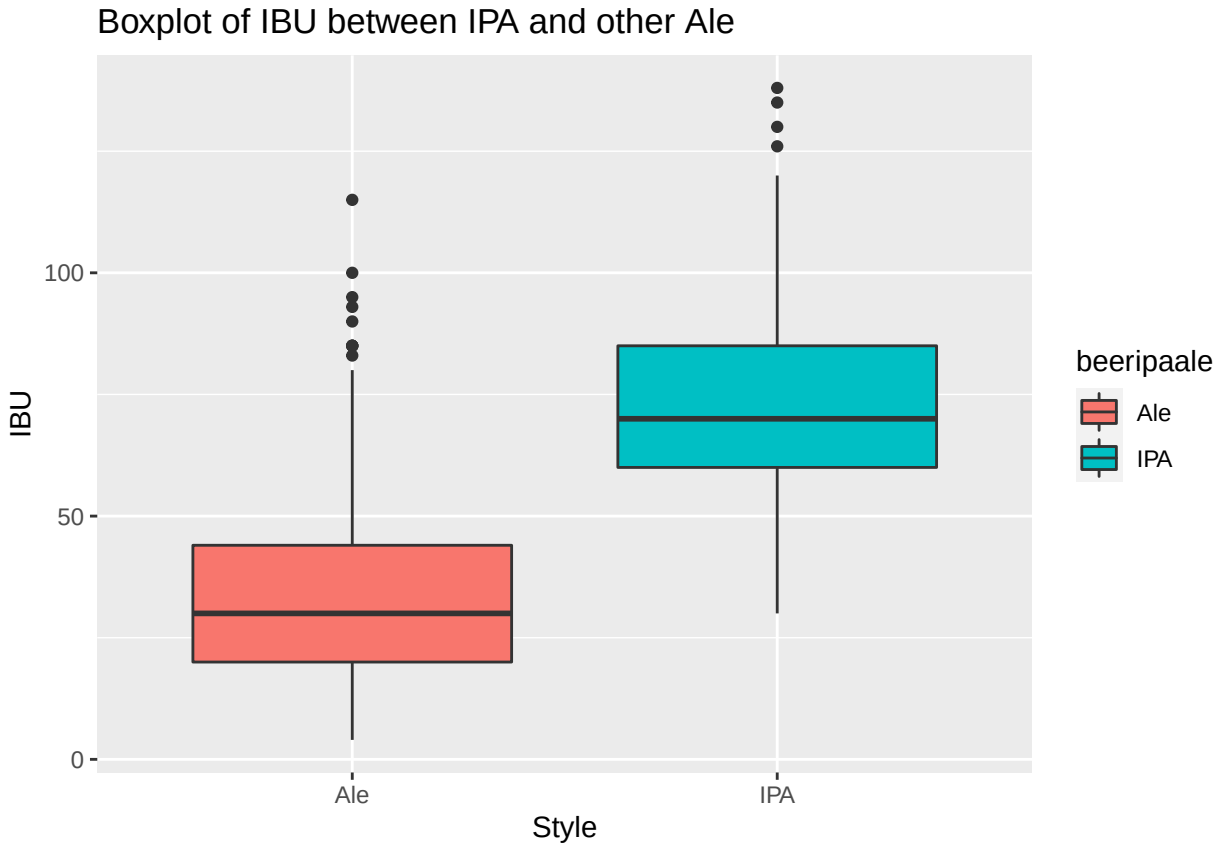
```
## 1                            c("American", "IPA")
## 2                      c("Milk", "Sweet", "Stout")
## 3                     c("English", "Brown", "Ale")
## 4                              c("Pumpkin", "Ale")
## 5                          c("American", "Porter")
## 6 c("Extra", "Special", "Strong", "Bitter", "ESB")
```

```
# India Pale Ale
IPA <- c("American Double / Imperial IPA", "American IPA", "Belgian IPA", "English India Pale Ale (IPA)
```

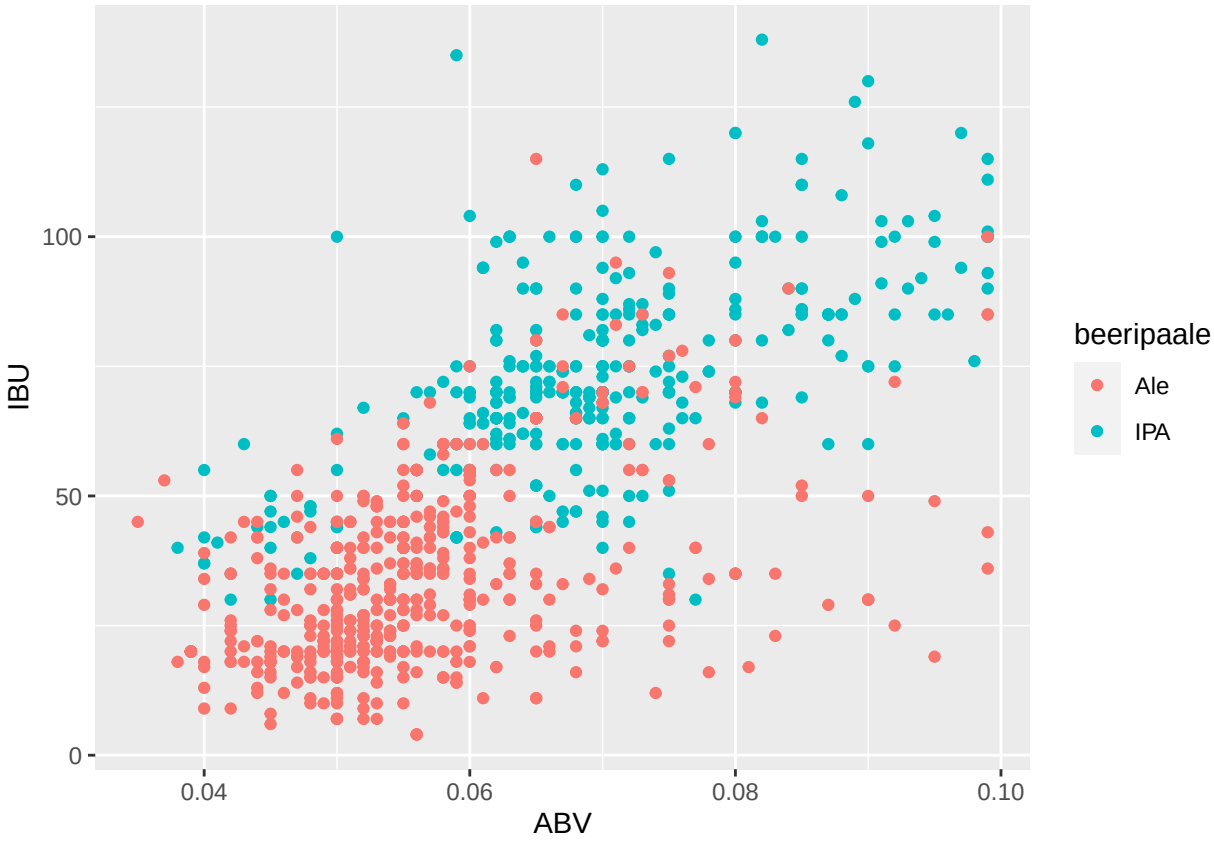
```
total_beers_count <- dim(beermerged)[1]
ipa_count <- dim(beeripa)[1]
ale_count <- dim(beerale)[1]

beercombined_ale <- rbind(beeripa, beerale)

ipa_ale_count <- dim(beercombined_ale)[1]


head(beercombined_ale)
```

```
##   beer.brewery.id       beername beerID beerABV beerIBU                     beerstyle
## 1               1   Get Together   2692   0.045      50                   American IPA
## 2               2 Citra Ass Down   2686   0.080      68 American Double / Imperial IPA
## 3               2    Rico Sauvin   2678   0.076      68 American Double / Imperial IPA
## 4               2   Pile of Face   2675   0.060      65                   American IPA
## 5               4 Habitus (2014)   2668   0.080     100 American Double / Imperial IPA
## 6               4          Solis   2667   0.075      85                   American IPA
##   beerOunce brewery.state.abb             brewery.name brewery.city state.name
## 1        16                MN        NorthGate Brewing   Minneapolis  Minnesota
## 2        16                KY Against the Grain Brewery   Louisville   Kentucky
## 3        16                KY Against the Grain Brewery   Louisville   Kentucky
## 4        16                KY Against the Grain Brewery   Louisville   Kentucky
## 5        16                CA Mike Hess Brewing Company    San Diego California
## 6        16                CA Mike Hess Brewing Company    San Diego California
##    state.region Population Income beeripaale
## 1 North Central       3921   4675        IPA
## 2         South       3387   3712        IPA
## 3         South       3387   3712        IPA
## 4         South       3387   3712        IPA
## 5          West      21198   5114        IPA
## 6          West      21198   5114        IPA
```


Boxplot of ABU between IPA and other Ale
0.10
0.08
0.06
0.04
ABV
Ale
IPA
Style
beeripaale
Ale
IPA


Boxplot of IBU between IPA and other Ale
100
50
0
IBU
Ale
IPA
Style
beeripaale
Ale
IPA

```
## `summarise()` ungrouping output (override with `.groups` argument)

## # A tibble: 2 x 4
##   beeripaale beers.abv.median beers.ibu.median count
##   <chr>                 <dbl>            <dbl> <int>
## 1 Ale                  0.0545               30   552
## 2 IPA                  0.0685               70   384
```

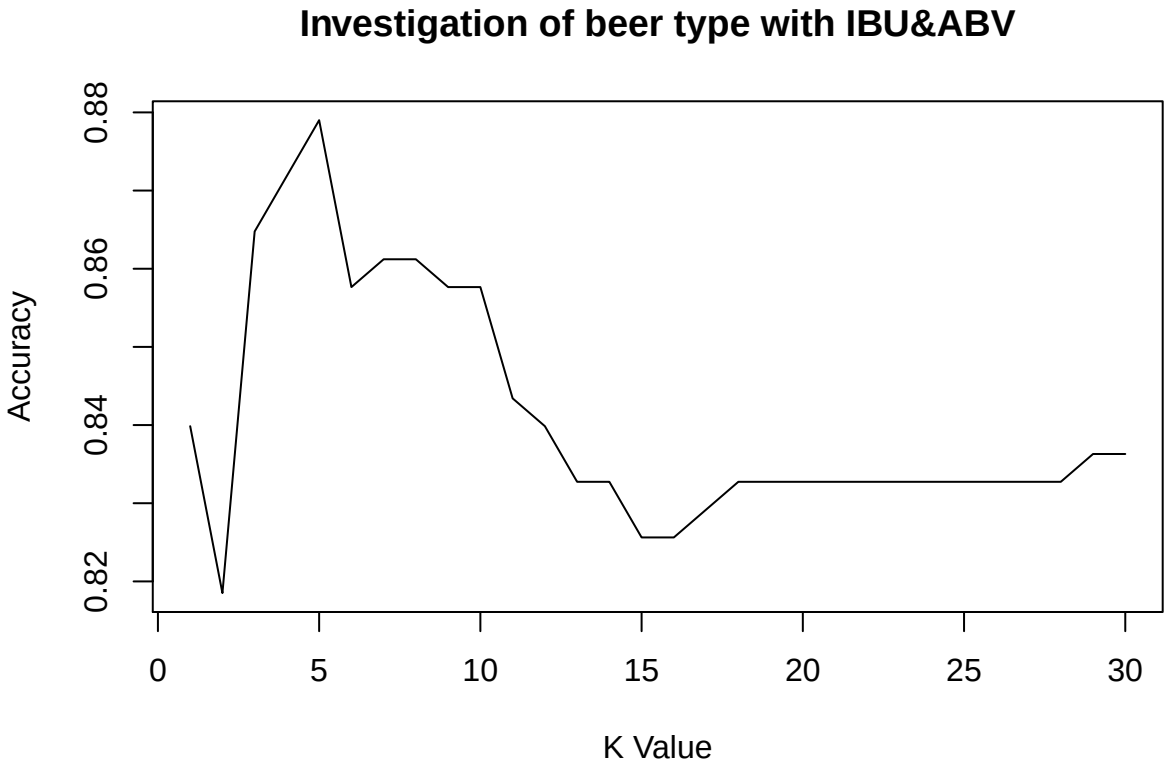



```
## [1] 936  15

## [1] 655  15

## [1] 281  15

## Confusion Matrix and Statistics
##
##      classifications
##       Ale IPA
##   Ale 166  10
##   IPA  31  74
##
##                Accuracy : 0.8541
##                  95% CI : (0.8073, 0.8932)
##     No Information Rate : 0.7011
##     P-Value [Acc > NIR] : 1.723e-09
```

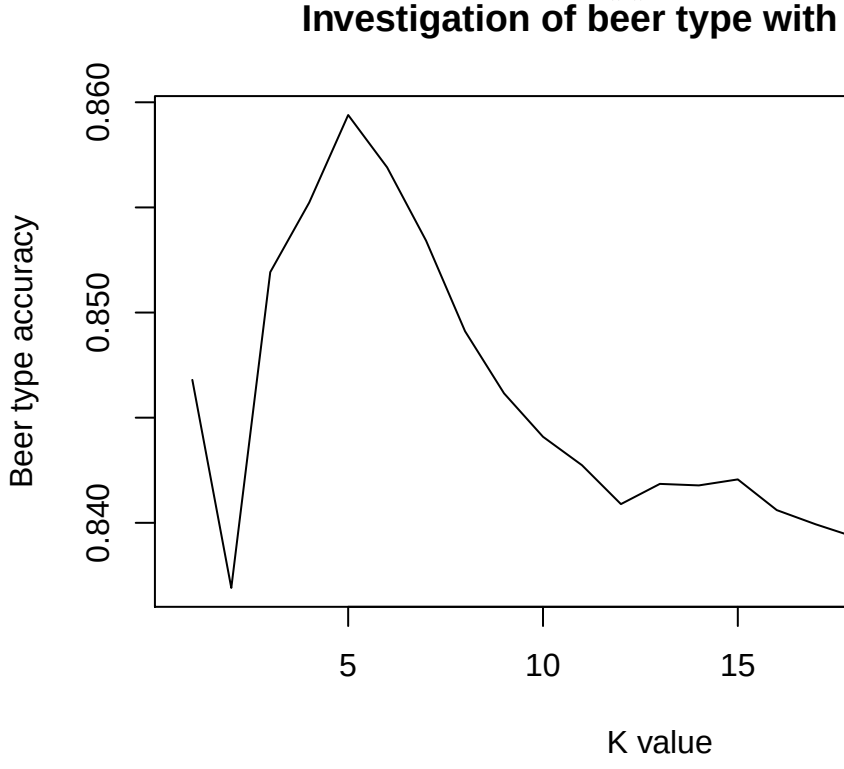
```
##
##                  Kappa : 0.6752
##
##  Mcnemar's Test P-Value : 0.001787
##
##             Sensitivity : 0.8426
##             Specificity : 0.8810
##          Pos Pred Value : 0.9432
##          Neg Pred Value : 0.7048
##              Prevalence : 0.7011
##          Detection Rate : 0.5907
##    Detection Prevalence : 0.6263
##       Balanced Accuracy : 0.8618
##
##        'Positive' Class : Ale
##
```

```
## Confusion Matrix and Statistics
##
##      classifications
##       Ale IPA
##   Ale 159  17
##   IPA  37  68
##
##                Accuracy : 0.8078
##                  95% CI : (0.7568, 0.8522)
##     No Information Rate : 0.6975
##     P-Value [Acc > NIR] : 1.881e-05
##
##                   Kappa : 0.573
##
##  Mcnemar's Test P-Value : 0.009722
##
##             Sensitivity : 0.8112
##             Specificity : 0.8000
##          Pos Pred Value : 0.9034
##          Neg Pred Value : 0.6476
##              Prevalence : 0.6975
##          Detection Rate : 0.5658
##    Detection Prevalence : 0.6263
##       Balanced Accuracy : 0.8056
##
##        'Positive' Class : Ale
##
```

Loop for many k and one training / test partition



##



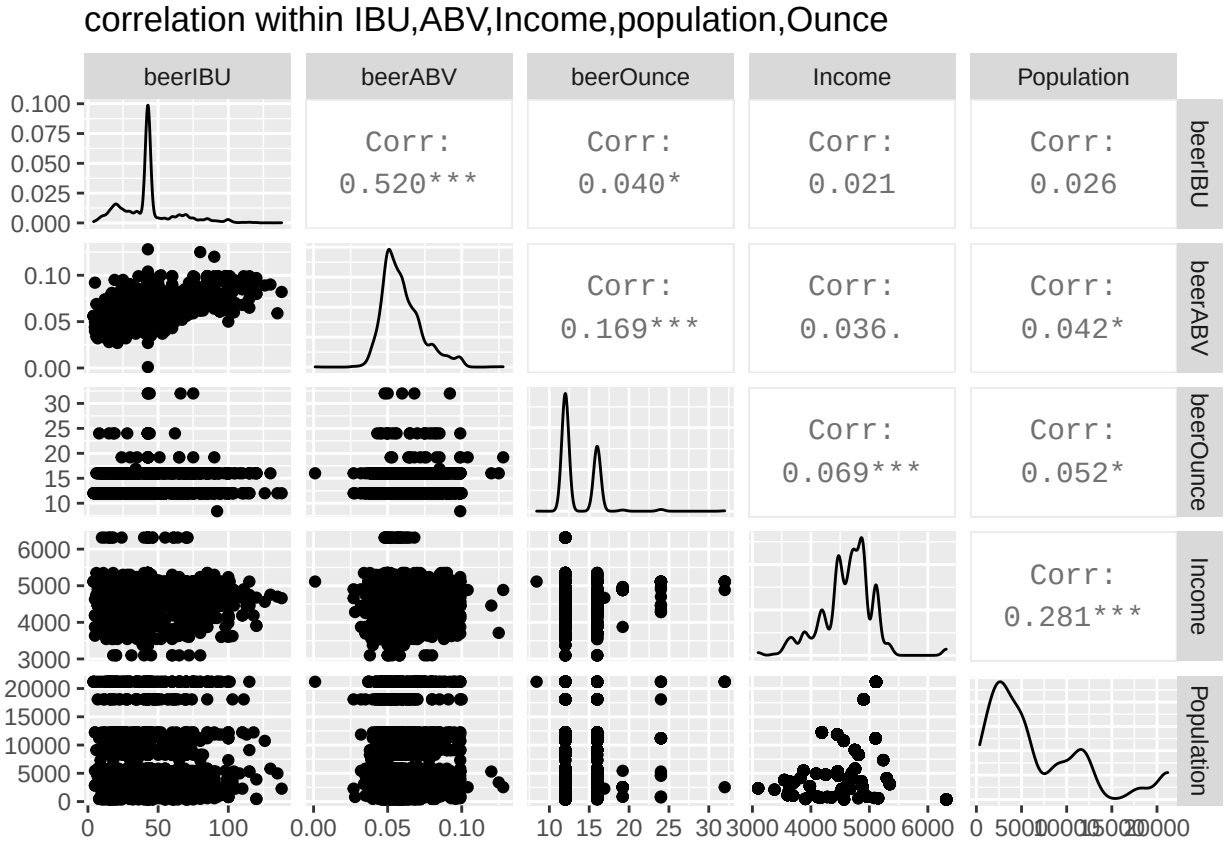
Loop for many k and many training / test partitions

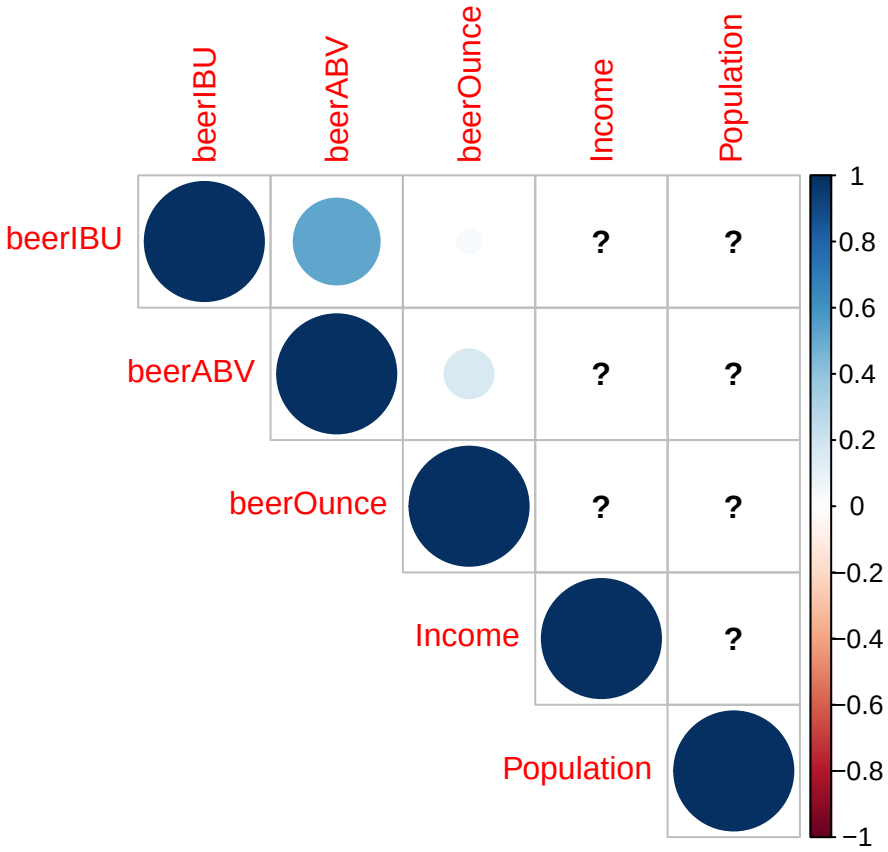
```
## [1] 5
```

```
## [1] 0.859395
```

```
## plot: [1,1] [=>-------------------------------------------------------------] 4% est: 0s
## plot: [1,2] [====>----------------------------------------------------------] 8% est: 0s
## plot: [1,3] [======>--------------------------------------------------------] 12% est: 1s
## plot: [1,4] [=========>-----------------------------------------------------] 16% est: 1s

## Warning in ggally_statistic(data = data, mapping = mapping, na.rm = na.rm, : Removed 8 rows
## containing missing values

## plot: [1,5] [===========>--------------------------------------------------] 20% est: 1s

## Warning in ggally_statistic(data = data, mapping = mapping, na.rm = na.rm, : Removed 8 rows
## containing missing values

## plot: [2,1] [==============>-----------------------------------------------] 24% est: 1s
## plot: [2,2] [================>---------------------------------------------] 28% est: 1s
## plot: [2,3] [===================>------------------------------------------] 32% est: 1s
## plot: [2,4] [=====================>----------------------------------------] 36% est: 1s

## Warning in ggally_statistic(data = data, mapping = mapping, na.rm = na.rm, : Removed 8 rows
## containing missing values

## plot: [2,5] [========================>-------------------------------------] 40% est: 1s

## Warning in ggally_statistic(data = data, mapping = mapping, na.rm = na.rm, : Removed 8 rows
## containing missing values

## plot: [3,1] [==========================>-----------------------------------] 44% est: 0s
## plot: [3,2] [============================>---------------------------------] 48% est: 0s
## plot: [3,3] [==============================>-------------------------------] 52% est: 0s
## plot: [3,4] [================================>-----------------------------] 56% est: 0s

## Warning in ggally_statistic(data = data, mapping = mapping, na.rm = na.rm, : Removed 8 rows
## containing missing values

## plot: [3,5] [==================================>-------------------------] 60% est: 0s

## Warning in ggally_statistic(data = data, mapping = mapping, na.rm = na.rm, : Removed 8 rows
## containing missing values

## plot: [4,1] [====================================>---------------------] 64% est: 0s

## Warning: Removed 8 rows containing missing values (geom_point).

## plot: [4,2] [======================================>-------------------] 68% est: 0s

## Warning: Removed 8 rows containing missing values (geom_point).

## plot: [4,3] [========================================>-----------------] 72% est: 0s

## Warning: Removed 8 rows containing missing values (geom_point).
```

```
## plot: [4,4] [=============================================>---------------] 76% est: 0s

## Warning: Removed 8 rows containing non-finite values (stat_density).

## plot: [4,5] [==============================================>------------] 80% est: 0s

## Warning in ggally_statistic(data = data, mapping = mapping, na.rm = na.rm, : Removed 8 rows
## containing missing values

## plot: [5,1] [===============================================>----------] 84% est: 0s

## Warning: Removed 8 rows containing missing values (geom_point).

## plot: [5,2] [================================================>-------] 88% est: 0s

## Warning: Removed 8 rows containing missing values (geom_point).

## plot: [5,3] [=================================================>-----] 92% est: 0s

## Warning: Removed 8 rows containing missing values (geom_point).

## plot: [5,4] [==================================================>--] 96% est: 0s

## Warning: Removed 8 rows containing missing values (geom_point).

## plot: [5,5] [====================================================]100% est: 0s

## Warning: Removed 8 rows containing non-finite values (stat_density).
```




beerIBU
beerABV
beerOunce
Income
Population
?
1
0.8
0.6
0.4
0.2
0
−0.2
−0.4
−0.6
−0.8
−1