

Beers and Breweries Analysis

Case Study 01 - MSDS 6306 Section 402

Luke Pierce lepierce@smu.edu
Lokesh Maganti lmaganti@smu.edu
Andrew Walch awalch@smu.edu
MJKelleher mikek@smu.edu

February 14, 2018

Contents

Codebook	1
Introduction	5
Answers to Data Analysis Questions	5
Conclusion	8
Appendix	8

Codebook

1. Raw Data
 - Beer Names and Metrics
 - Variable names
 - * Beer
 - The name of the beer
 - String
 - Contains non UTF-8 characters
 - No NA's
 - * Beer_ID
 - Unique Identifier of the beer
 - Integer - Range: (1 - 2692)
 - No NA's
 - * ABV
 - Alcohol by volume of the beer
 - Real Number - Range (0.001 - 0.128)
 - Contains NA's
 - * IBU
 - International Bitterness Units of the beer
 - Integer - Range (4 - 138)
 - Contains NA's
 - * Brew_ID
 - Brewery ID associated with the beer
 - Integer - Range (1 - 558)
 - No NA's
 - * Style
 - Style of the beer
 - String
 - Contains non UTF-8 characters
 - No NA's
 - * Ounces
 - Ounces of the beer

- Real Number - Values: (8.4, 12.0, 16.0, 16.9, 19.2, 24.0, 32.0)
 - Contains NA's
 - Breweries By State
 - Variable names
 - * Brew_ID
 - Unique identifier of the brewery
 - Integer (1 - 558)
 - No NA's
 - * Brewery
 - Name of the brewery
 - String
 - Contains non UTF-8 characters
 - No NA's
 - * City
 - City where the brewery is located
 - String
 - No NA's
 - * State
 - US state where the brewery is located
 - 2 Characters
 - No NA's
 - 51 Unique Values
- 2. Final Merged Data
 - Beer Names and Metrics
 - Info
 - * Dataframe: beer
 - * CSV name: data/tidy/beer.csv
 - Variable names
 - * Beer
 - The name of the beer
 - String
 - UTF-8 characters only
 - No NA's
 - * Beer_ID
 - Unique Identifier of the beer
 - Integer - Range: (1 - 2692)
 - No NA's
 - * ABV
 - Alcohol by volume of the beer
 - Real Number - Range (0.001 - 0.128)
 - Contains NA's
 - * IBU
 - International Bitterness Units of the beer
 - Integer - Range (4 - 138)
 - Contains NA's
 - * Brew_ID
 - Brewery ID associated with the beer
 - Integer - Range (1 - 558)
 - No NA's
 - * Style
 - Style of the beer
 - String
 - UTF-8 characters only
 - No NA's

- * Ounces
 - Ounces of the beer
 - Real Number - Values: (8.4, 12.0, 16.0, 16.9, 19.2, 24.0, 32.0)
 - No NA's
- Breweries By State
 - Info
 - * Dataframe: brewery
 - * CSV name: data/tidy/brewery.csv
 - Variable names
 - * Brew_ID
 - Unique identifier of the brewery
 - Integer (1 - 558)
 - No NA's
 - * Brewery
 - Name of the brewery
 - String
 - UTF-8 characters only
 - No NA's
 - * City
 - City where the brewery is located
 - String
 - No NA's
 - * State
 - US state where the brewery is located
 - 2 Characters
 - No NA's
 - 51 Unique Values
- Combined Beer and Brewery Names and Metrics
 - Info
 - * Dataframe: beerbrew
 - * CSV name: data/tidy/beerbrew.csv
 - Variable names
 - * Beer_ID
 - Integer - Range: (1 - 2692)
 - No NA's
 - * Beer
 - String - Range: (1 - 1372)
 - No NA's
 - * Style
 - String
 - No NA's
 - * Ounces
 - Real Number - Values: (8.4, 12.0, 16.0, 16.9, 19.2, 24.0, 32.0)
 - No NA's
 - * ABV
 - Real Number - Range (0.027 - 0.125)
 - No NA's
 - * IBU
 - Integer - Range (4 - 138)
 - No NA's
 - * Brew_ID
 - Integer - Range (1 - 547)
 - No NA's

- * Brewery
 - String
 - No NA's
 - * City
 - String
 - No NA's
 - * State
 - 2 Characters - 50 Unique Values
 - No NA's
- Breweries by State
 - Info
 - * Dataframe: breweryByState
 - * CSV name: data/tidy/BreweryByState.csv
 - Variable names
 - * State
 - 2 Characters - 50 Unique Values
 - No NA's
 - * Breweries
 - Integer - Range (1 - 47)
 - No NA's

3. Data Modifications

- Load the Beer and Breweries datasets, rename the columns, sort beer dataset
 - Define variables to be used throughout the document
 - Define base/root URL to load the data
 - Define the String URL's for the Beer and Brewery datasets
 - Load the Beer and Brewery Datasets
- Convert UTF-8 format character data in Dataframes for Beer and Brewery
 - Convert UTF-8 format in "beer\$Name"
 - Convert UTF-8 format in "beer\$Style"
 - Convert UTF-8 format in "beer\$Style"
- Modify column/variable names on the Dataframes for Beer and Brewery
 - Rename column "Name" to "Beer" in beer df
 - Rename column "Brewery_id" to "Brew_ID" in beer df
 - Rename column "Name" to "Brewery" in brewery df
 - Arrange beer df by Brew_ID
 - Remove duplicates with all columns other than Brew_ID as criteria for removal
 - Remove row.names column

4. Tidy dataset

- beer
- beerbrew
 - Merge data frames
 - Sort columns
 - NA removal (all)
- brewery
- BreweryByState
 - Count breweries per state
 - Remove Washington DC
 - Rename column "Brewery_id" to "Brew_ID" in beer df
 - Sort by most to least

5. Recipe for Tidy Dataset

- Commented R script file

Introduction

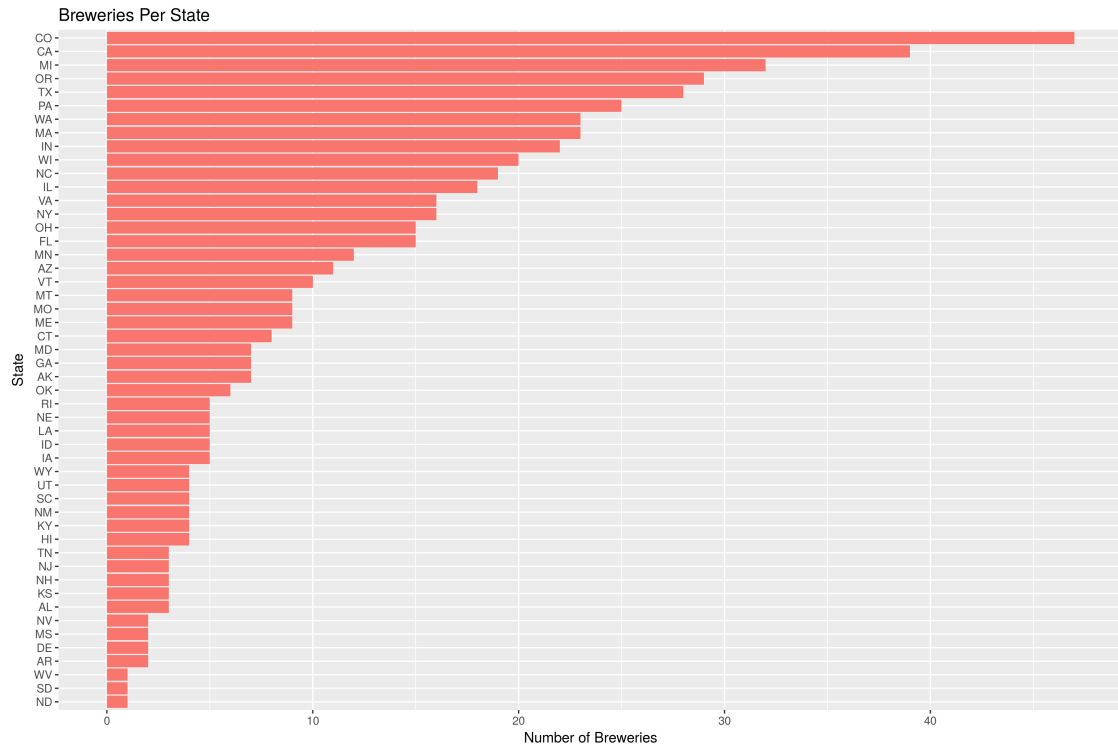
This project analyzes several aspects of Beer and Brewery data from several breweries in the United States. The bulk of the analyses center around bitterness and alcohol content, with the ultimate goal of trying to identify a causal relationship between the two.

Before we can do this our data must be merged and cleaned. This process results in a “tidy” dataset, the steps of which are outline above. In short, this involves renaming some of the data fields, as well as fixing many data deficiencies that would otherwise cause problems with the analysis. Additionally, we ensure that the analysis is limited to breweries in the United States only. The District of Columbia is not included.

In all, the analysis answers 7 main questions, which are addressed below in this report.

Answers to Data Analysis Questions

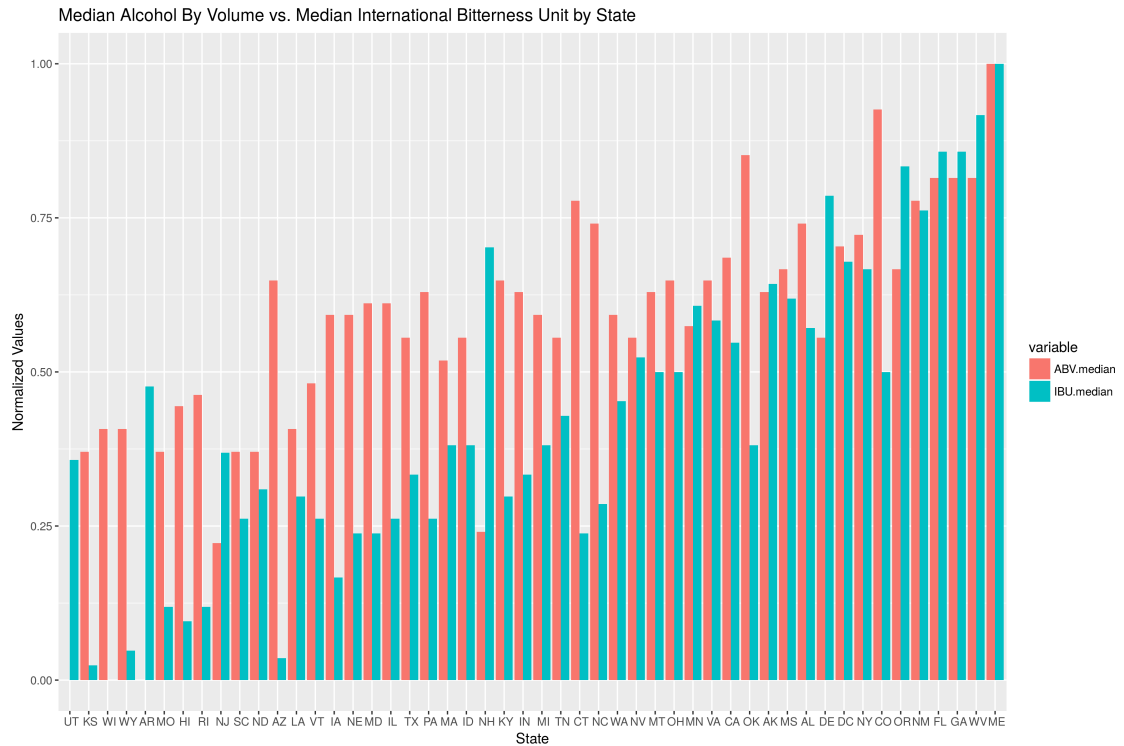
1. *How many breweries are present in each state?*



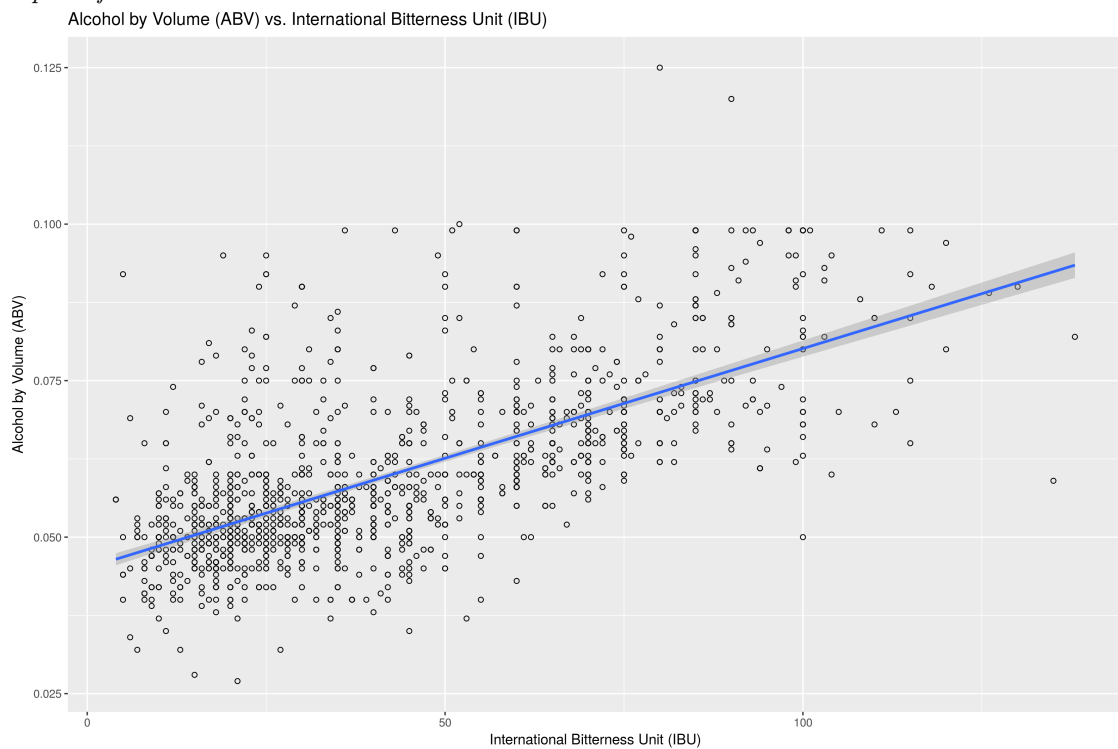
2. *After merging the Beer and Breweries datasets, what are the first and last 6 observations in the datasets?*

Beer_ID	Beer	Style	Category	ABV	Beer_ID	Beer	Style	Category		
1	2692 Get Together	American IPA	16	0.0432365	38	Pilsener Unish	German Pilsener	12		
2	2691 Maggie's Leap	Milk / Shock Stout	16	0.0432366	52	Heinzenmaier Reinschmier	Helveticum	12		
3	2690 Nail's Knot	English Brown Ale	16	0.0432367	51	Bruggenland IPA	American IPA	12		
4	2689 Pampin	Pampin Ale	16	0.0632368	50	Mac Thander Stout	Milk / Shock Stout	12		
5	2688 Stronghold	American Porter	16	0.0632369	49	Forchings Pale Ale	American Pale Ale (APA)	12		
6	2687 Farquah 508 Extra Special / Strong Bitter (508)		16	0.0632370	30	Urban Wilderness Pale Ale	English Pale Ale	12		
181 Beer_ID	Brewery	City	State	ABV	181 Beer_ID	Brewery	City	State		
1	50	1 NorthGate Brewing	Minnesota	502365	0.055	NA	556	Unish Brewing Company	Unish	CA
2	36	1 NorthGate Brewing	Minnesota	502366	0.049	NA	557	Bukkenmaier Beer and Ale	Garrettville	NY
3	19	1 NorthGate Brewing	Minnesota	502367	0.068	NA	557	Bukkenmaier Beer and Ale	Garrettville	NY
4	38	1 NorthGate Brewing	Minnesota	502368	0.049	NA	557	Bukkenmaier Beer and Ale	Garrettville	NY
5	35	1 NorthGate Brewing	Minnesota	502369	0.043	NA	557	Bukkenmaier Beer and Ale	Garrettville	NY
6	47	1 NorthGate Brewing	Minnesota	502370	0.049	NA	558	Slamming Lady Brewing Company	Anchorage	AK

- How many **NA** values are contained in each column?
- What is the median alcohol content and international bitterness unit for each state? This also includes a bar chart of this data.



- Which state has the maximum alcoholic **ABV** beer? Which state has the most bitter **IBU** beer?
- What are the summary statistics for the **ABV** variable?
- Is there an apparent relationship between bitterness of the beer and its alcoholic content? What does a scatter plot of this data look like?



Conclusion

TODO: Add conclusion here

Appendix

Source Code

Required Libraries

1. dplyr - To Install: `install.packages("dplyr")`
2. ggplot2 - To Install: `install.packages("ggplot2")`
3. doBy - To Install: `install.packages("doBy")`
4. stringr - To Install: `install.packages("stringr")`
5. reshape2 - To Install: `install.packages("reshape2")`
6. gridExtra - To Install: `install.packages("gridExtra")`

Case Study Solution

```
#
# NOTE:
# If you add any libraries to this file, make sure you add the library to the
# 'ENVIRONMENT' section of the file: code/00_LoadAndPrepare.R
#
library(dplyr)
library(ggplot2)
library(doBy)
library(stringr)
library(reshape2)
library(gridExtra)
library(gplots)

#
#
#=====

## Load the Beer and Breweries datasets, rename the columns, sort beer dataset

# Define variables to be used throughout the document
# The base/root URL to load the data from
data_root_url <- "https://raw.githubusercontent.com/allthebits/msds6306-case-study-01/master/data/"

# Define the String URL's for the Beer and Brewery datasets
beer_url <- paste(data_root_url, "Beers.csv", sep="");
brewery_url <- paste(data_root_url, "Breweries.csv", sep="");

# Load the Beer and Brewery Datasets
beer <- read.csv(url(beer_url), header = TRUE, sep=",", row.names = NULL)
brewery <- read.csv(url(brewery_url), header = TRUE, sep=",", row.names = NULL)

#=====

# Convert UTF-8 format character data in Dataframes for Beer and Brewery
```



```

# Beer file

# Convert UTF-8 format in "beer$Name"
beer$Name <- str_conv(beer$Name, "UTF-8")

# Convert UTF-8 format in "beer$Style"
beer$Style <- str_conv(beer$Style, "UTF-8")

# Brewery file

# Convert UTF-8 format in "beer$Style"
brewery$Name <- str_conv(brewery$Name, "UTF-8")

# =====

# Modify column/variable names on the Dataframes for Beer and Brewery

# in beer df rename column "Name" to "Beer"
beer <- rename(beer, Beer = Name)

# in beer df rename column "Brewery_id" to "Brew_ID"
beer <- rename(beer, Brew_ID = Brewery_id)

# in brewery df rename column "Name" to "Brewery"
brewery <- rename(brewery, Brewery = Name)

# Arrange beer df by Brew_ID
beer <- arrange(beer, (Brew_ID))

# Remove duplicates with all columns other than Brew_ID as criteria for removal
beer <- beer[!duplicated(beer[c('Beer', 'ABV', 'IBU', 'Style', 'Ounces')]),]

# Remove row.names column
row.names(beer) <- NULL
#
#
# Case Study 01 : Question 01) Breweries per state?
# Requires the library: 'ggplot2'

# The source path MUST include the "code" directory because the context
# when the source statement executes is within the RMarkdown file and that
# is one directory 'up' from here
source('code/01_Question_01.tidy.R')

summary(BreweryByState)

```

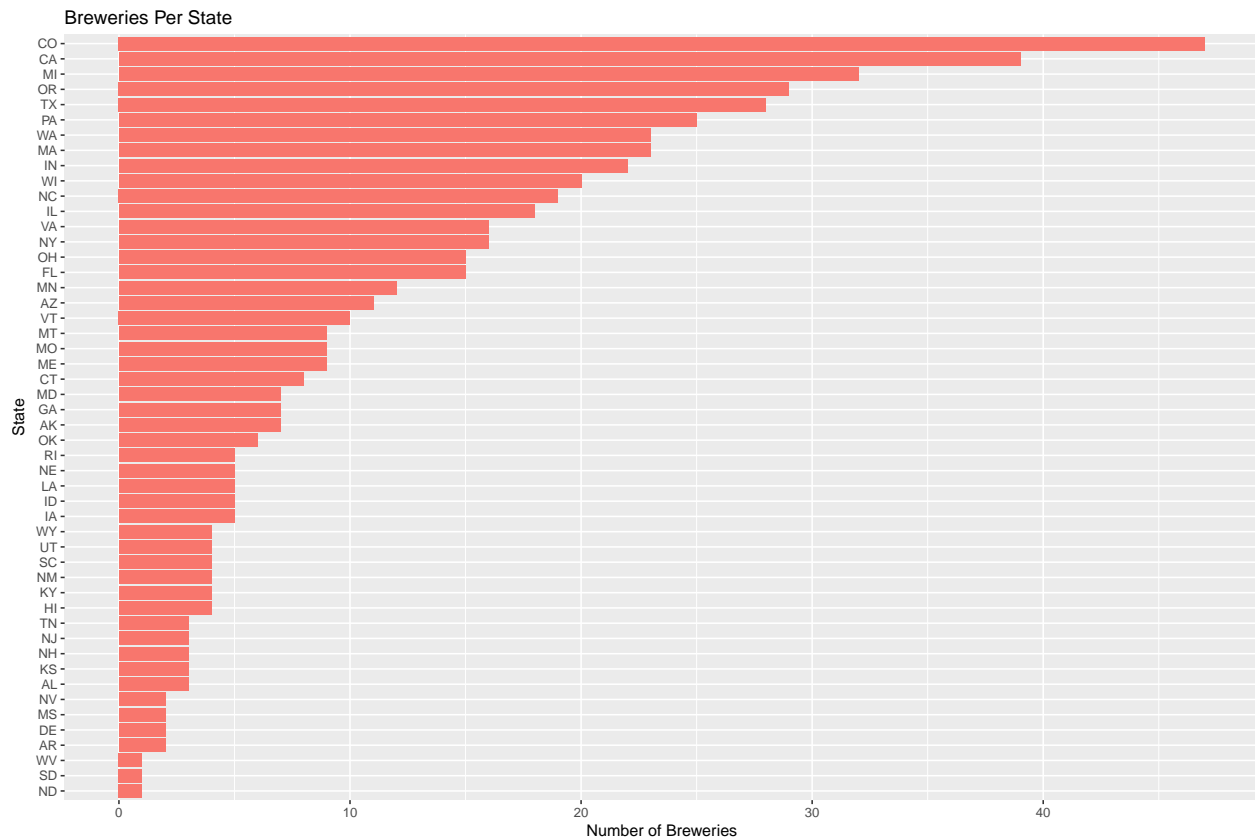
```

##      State      Breweries
## AK       : 1    Min.    : 1.00
## AL       : 1    1st Qu.: 4.00
## AR       : 1    Median : 7.00
## AZ       : 1    Mean     :11.14
## CA       : 1    3rd Qu.:16.00
## CO       : 1    Max.     :47.00

```

```
## (Other):44
```

```
q1_plot <- ggplot(BreweryByState, aes(x=reorder(State, Breweries), y=(Breweries), fill = "red")) + geom_bar()
grid::grid.draw(q1_plot)
```



```
ggsave(q1_plot, filename="tmp/q1_plot.png")
```

```
## Saving 12 x 8 in image
```

```
#
#
# Case Study 01 : Question 02) Merge beer and brewery data. Print first and last
#                      6 observations
# QC
source('code/02_Question_02.tidy.R')
summary(beerbrew)
```

```
##      Beer_ID      Beer      Style      Ounces
## Min.   : 4.0   Length:2370   Length:2370   Min.   : 8.40
## 1st Qu.:813.2   Class :character   Class :character   1st Qu.:12.00
## Median :1457.5   Mode  :character   Mode  :character   Median :12.00
## Mean   :1432.6
## 3rd Qu.:2073.8
## Max.   :2692.0
##
##      ABV      IBU      Brew_ID      Brewery
```

```
## Min. :0.00100 Min. : 4.00 Min. : 1.0 Length:2370
## 1st Qu.:0.05000 1st Qu.: 21.00 1st Qu.: 94.0 Class :character
## Median :0.05600 Median : 35.00 Median :206.0 Mode :character
## Mean :0.05987 Mean : 42.78 Mean :232.8
## 3rd Qu.:0.06800 3rd Qu.: 64.00 3rd Qu.:367.8
## Max. :0.12800 Max. :138.00 Max. :558.0
## NA's :62 NA's :998
## City State
## Grand Rapids: 66 CO : 259
## Chicago : 55 CA : 180
## Portland : 53 MI : 162
## Indianapolis: 43 IN : 139
## Boulder : 41 TX : 130
## San Diego : 41 OR : 114
## (Other) :2071 (Other):1386
```

```
str(beerbrew)
```

```
## 'data.frame': 2370 obs. of 10 variables:
## $ Beer_ID: int 2692 2691 2690 2689 2688 2687 2686 2685 2684 2683 ...
## $ Beer : chr "Get Together" "Maggie's Leap" "Wall's End" "Pumpkin" ...
## $ Style : chr "American IPA" "Milk / Sweet Stout" "English Brown Ale" "Pumpkin Ale" ...
## $ Ounces : num 16 16 16 16 16 16 16 16 16 16 ...
## $ ABV : num 0.045 0.049 0.048 0.06 0.06 0.056 0.08 0.125 0.077 0.042 ...
## $ IBU : int 50 26 19 38 25 47 68 80 25 42 ...
## $ Brew_ID: int 1 1 1 1 1 1 2 2 2 2 ...
## $ Brewery: chr "NorthGate Brewing " "NorthGate Brewing " "NorthGate Brewing " "NorthGate Brewing "
## $ City : Factor w/ 384 levels "Abingdon","Abita Springs",...: 228 228 228 228 228 228 200 200 200 ...
## $ State : Factor w/ 51 levels "AK","AL","AR",...: 24 24 24 24 24 24 18 18 18 18 ...
```

```
# Check beerbrew
```

```
q2_out1 <- capture.output(head(beerbrew,6))
q2_out2 <- capture.output(tail(beerbrew,6))
```

```
text <- paste0(q2_out1, q2_out2)
textplot(text, valign="top")
```

Beer_ID	Beer	Style	Ounces	ABV	Beer_ID	Beer	Style
1 2692	Get Together	American IPA	16	0.0452365	98	Pilsner Ukiah	German Pilsener
2 2691	Maggie's Leap	Milk / Sweet Stout	16	0.0492366	52	Heinnieweisse Weissbier	Hefeweizen
3 2690	Wall's End	English Brown Ale	16	0.0482367	51	Snapperhead IPA	American IPA
4 2689	Pumpkin	Pumpkin Ale	16	0.0602368	50	Moo Thunder Stout	Milk / Sweet Stout
5 2688	Stronghold	American Porter	16	0.0602369	49	Porkslap Pale Ale	American Pale Ale (APA)
6 2687	Parapet ESB Extra Special / Strong Bitter (ESB)		16	0.0562370	30	Urban Wilderness Pale Ale	English Pale Ale

IBU	Brew_ID	Brewery	City	State	ABV	IBU	Brew_ID	Brewery	City	State	
1 50	1	NorthGate Brewing	Minneapolis	MN	2365	0.055	NA	556	Ukiah Brewing Company	Ukiah	CA
2 26	1	NorthGate Brewing	Minneapolis	MN	2366	0.049	NA	557	Butternuts Beer and Ale	Garrattsville	NY
3 19	1	NorthGate Brewing	Minneapolis	MN	2367	0.068	NA	557	Butternuts Beer and Ale	Garrattsville	NY
4 38	1	NorthGate Brewing	Minneapolis	MN	2368	0.049	NA	557	Butternuts Beer and Ale	Garrattsville	NY
5 25	1	NorthGate Brewing	Minneapolis	MN	2369	0.043	NA	557	Butternuts Beer and Ale	Garrattsville	NY
6 47	1	NorthGate Brewing	Minneapolis	MN	2370	0.049	NA	558	Sleeping Lady Brewing Company	Anchorage	AK

```
png(file="tmp/q2_plot.png")
textplot(text, valign="top")
dev.off();
```

```
## pdf
## 2
```

```
#
#
# Case Study 01 : Question 03) Report NA in each column
```

```
q3_out <- capture.output(sapply(beerbrew, function(x) sum(is.na(x))))
q3_out
```

```
## [1] "Beer_ID    Beer    Style  Ounces    ABV    IBU Brew_ID Brewery    City "
```

```
## [2] "          0          0          0          62    998          0          0          0 "
```

```
## [3] "    State  "
```

```
## [4] "          0 "
```

```
#
source('code/03_Question_03.tidy.R')
#
#
# Case Study 01 : Question 04) Median ABV and IBU by state. Plot barchart.
# Requires the library: 'dplyr'
```

```
# Calculate median values for each obs of ABV and IBU by state using DoBy
```

```
MedianABV <- summaryBy(ABV ~ State, data = beerbrew, FUN = median)
MedianIBU <- summaryBy(IBU ~ State, data = beerbrew, FUN = median)
```

```
# Merge into one df
```

```
ABV_IBU_median <- dplyr::inner_join(MedianABV, MedianIBU, by = "State")
```

```
summary(ABV_IBU_median)
```

```
##      State      ABV.median      IBU.median
```

```
## AK      : 1      Min.      :0.04000      Min.      :19.00
```

```
## AL      : 1      1st Qu.:0.05262      1st Qu.:30.00
```

```
## AR      : 1      Median :0.05625      Median :35.00
```

```
## AZ      : 1      Mean    :0.05557      Mean    :37.05
```

```
## CA      : 1      3rd Qu.:0.05838      3rd Qu.:44.25
```

```
## CO      : 1      Max.     :0.06700      Max.     :61.00
```

```
## (Other):44
```

```
str(ABV_IBU_median)
```

```
## 'data.frame': 50 obs. of 3 variables:
```

```
## $ State      : Factor w/ 51 levels " AK"," AL"," AR",...: 1 2 3 4 5 6 7 8 9 10 ...
```

```
## $ ABV.median: num 0.057 0.06 0.04 0.0575 0.0585 0.065 0.061 0.059 0.055 0.062 ...
```

```
## $ IBU.median: num 46 43 39 20.5 42 40 29 47.5 52 55 ...
```

```
# Normalize ABV and IBU values for direct comparison
```

```
ABV_IBU_median_norm <- as.data.frame(apply(ABV_IBU_median[, 2:3], 2, function(x) (x - min(x))/(max(x)-min(x))))
```

```
# Add back State column
```

```
ABV_IBU_median_norm <- cbind(State = ABV_IBU_median$State, ABV_IBU_median_norm)
```

```
# Melt data frame (ABV and IBU in one column) for ggplot
```

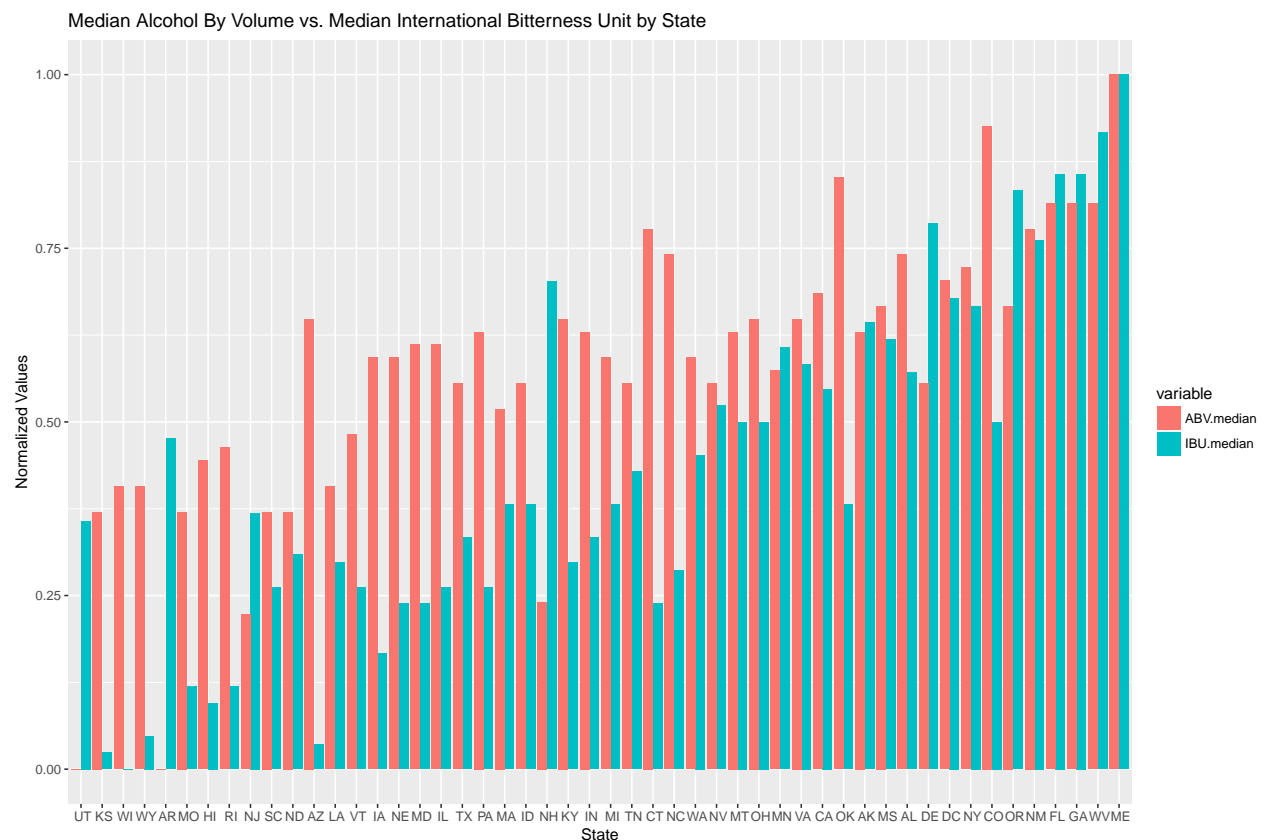
```
ABV_IBU_median_long <- melt(ABV_IBU_median_norm)
```

```
## Using State as id variables
```

```
# Plot dual barplots with ggplot2
```

```
q4_plot <- ggplot(ABV_IBU_median_long, aes(x = reorder(State, value), y = value, fill=variable)) + geom_bar()
```

```
grid::grid.draw(q4_plot)
```



```
ggsave(q4_plot, filename="tmp/q4_plot.png")
```

```
## Saving 12 x 8 in image
```

```
#
#
# Case Study 01 : Question 05) State with highest ABV? Highest IBU?
# Most alcoholic beer (Kentucky)
dplyr::top_n(beerbrew, 1, ABV)
```

```
##   Beer_ID      Beer      Style Ounces  ABV IBU Brew_ID
## 1    2685 London Balling English Barleywine    16 0.125 80      2
##           Brewery      City State
## 1 Against the Grain Brewery Louisville    KY
```

```
# Most bitter beer (Oregon)
dplyr::top_n(beerbrew, 1, IBU)
```

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

```
#
#
# Case Study 01 : Question 06) Summary Statistics for the ABV variable
summary(beerbrew$ABV)
```

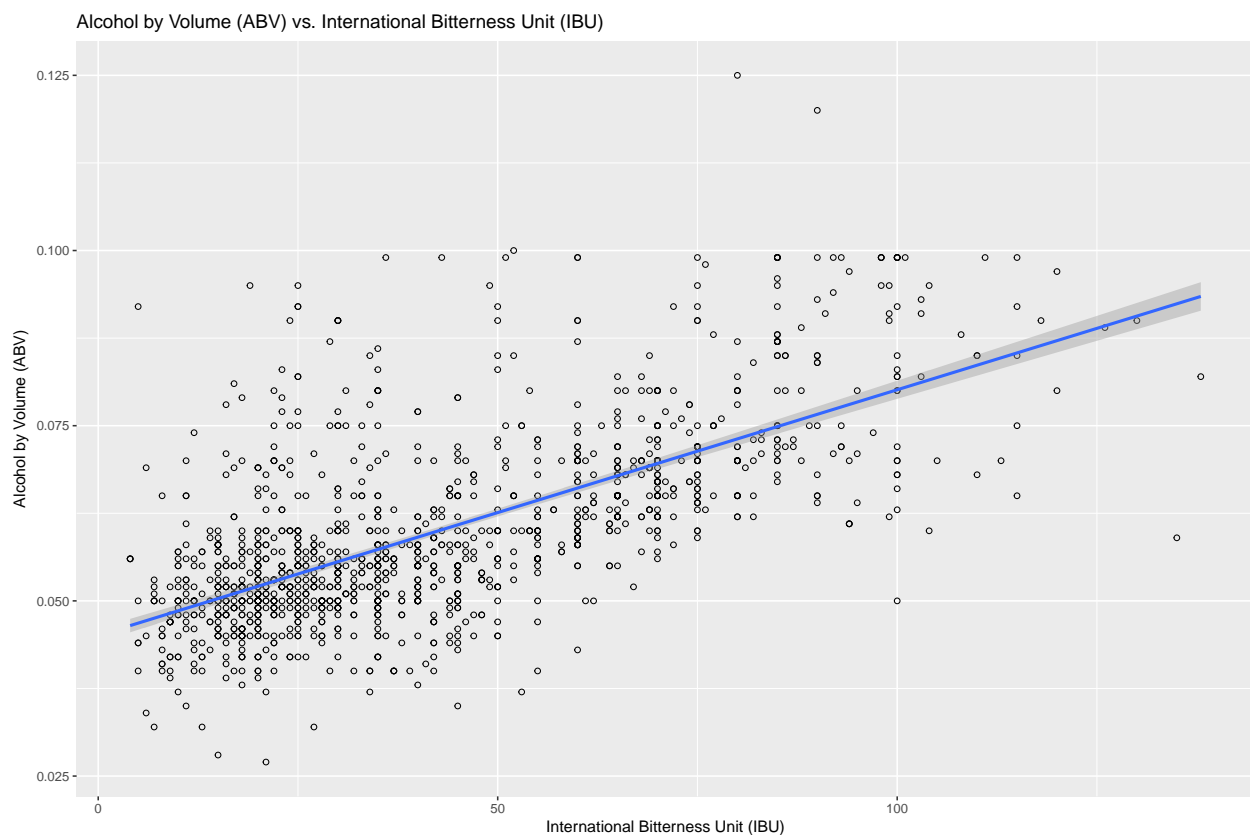
```
##      Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
## 0.02700 0.05000 0.05700 0.06007 0.06800 0.12500
```

```
#
#
```

```
# Case Study 01 : Question 07) Is there an apparent relationship between the
#                               bitterness of the beer and its alcoholic content?
#                               Draw a scatter plot.
```

```
q7_plot <- ggplot(beerbrew, aes(x=IBU, y=ABV)) +
  geom_point(shape=1) +      # Use hollow circles
  geom_smooth(method=lm) +   # Add linear regression line (by default includes 95% confidence region)
  labs(title = "Alcohol by Volume (ABV) vs. International Bitterness Unit (IBU)") + labs(x = "International Bitterness Unit (IBU)")

grid::grid.draw(q7_plot)
```



```
ggsave(q7_plot, filename="tmp/q7_plot.png")
```

```
## Saving 12 x 8 in image
```