Craft Breweries in the US
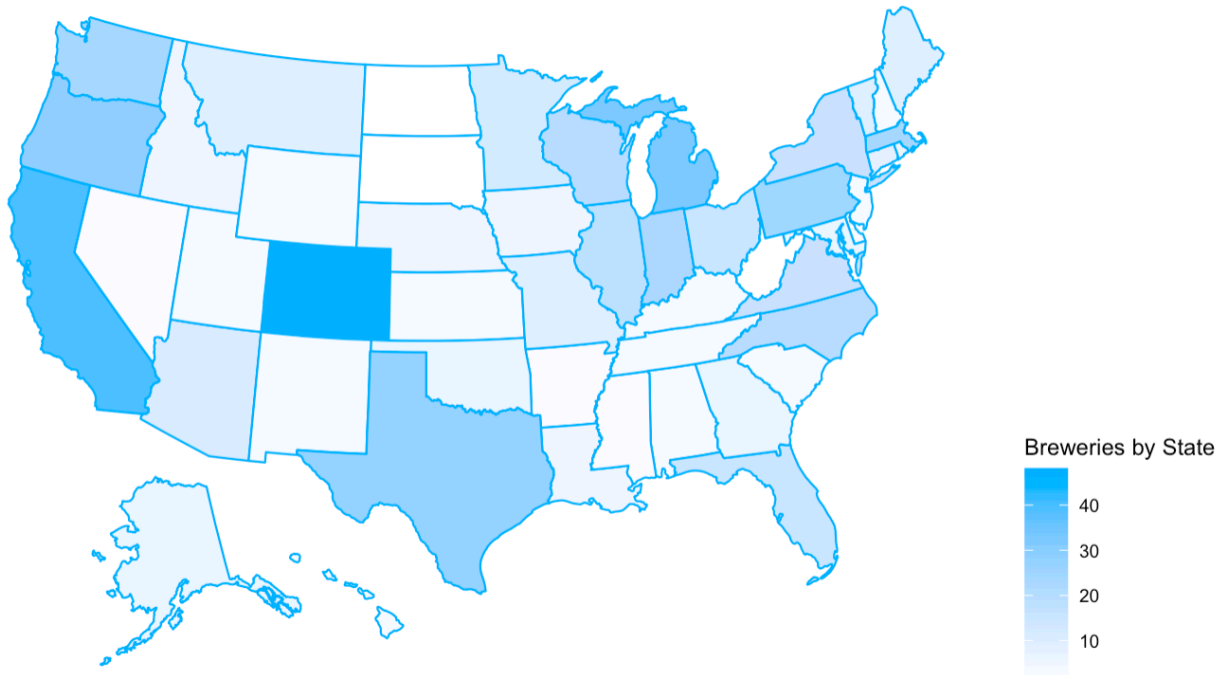
A review of Alcohol by Volume and Bitterness across Breweries in the United States

Analysis by Josh Eysenbach and Julia Layne

Number of Breweries per State

Breweries by State
Count of Breweries per state

Top 5: Colorado, California, Michigan, Oregon, and Texas

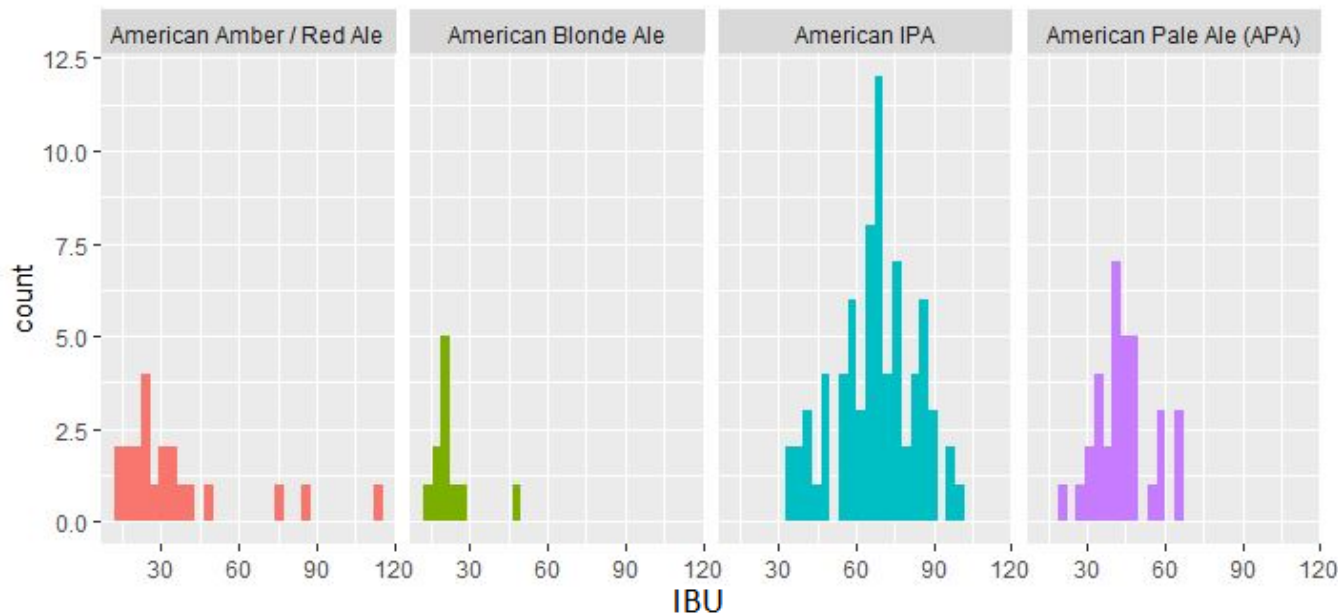| State	Breweries	State	Breweries
CO	47	MD	7
CA	39	OK	6
MI	32	IA	5
OR	29	ID	5
TX	28	LA	5
PA	25	NE	5
MA	23	RI	5
WA	23	HI	4
IN	22	KY	4
WI	20	NM	4
NC	19	SC	4
IL	18	UT	4
NY	16	WY	4
VA	16	AL	3
FL	15	KS	3
OH	15	NH	3
MN	12	NJ	3
AZ	11	TN	3
VT	10	AR	2
ME	9	DE	2
MO	9	MS	2
MT	9	NV	2
CT	8	DC	1
AK	7	ND	1
GA	7	SD	1
		WV	1

Missing Data

- There are 1005 beers with missing values for IBU
- We found values vary greatly by beer type and within types
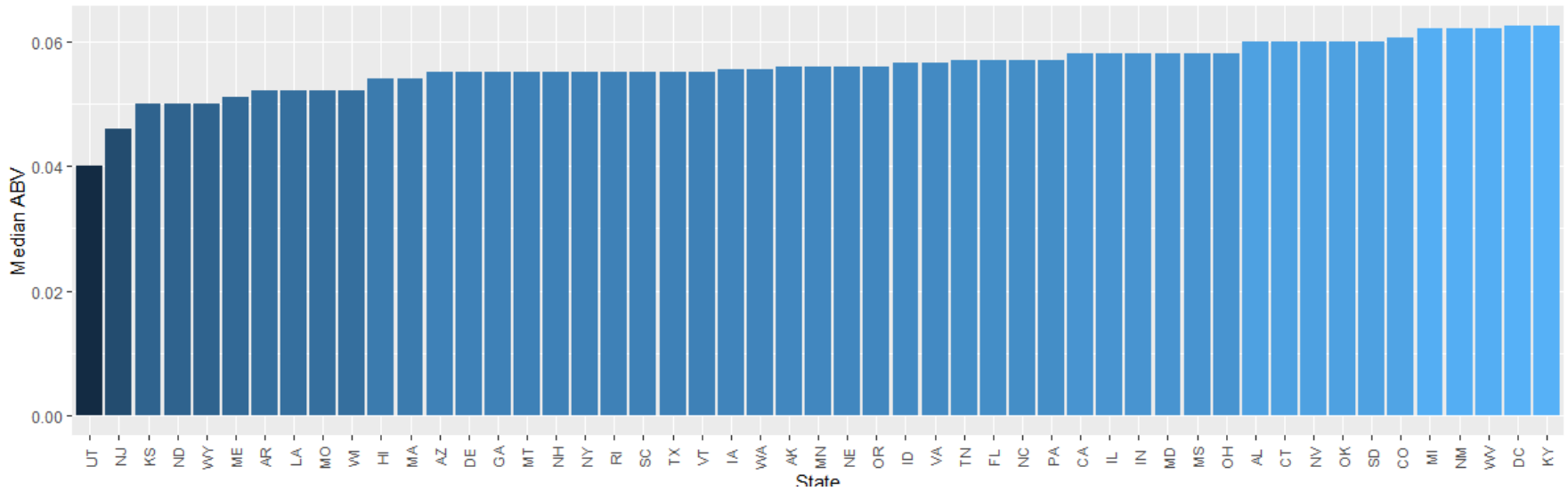- We've decided to remove the missing values to avoid distorting results replacing over 40% of the data

IBU Distributions by Beer Style

Median ABV and IBU by State

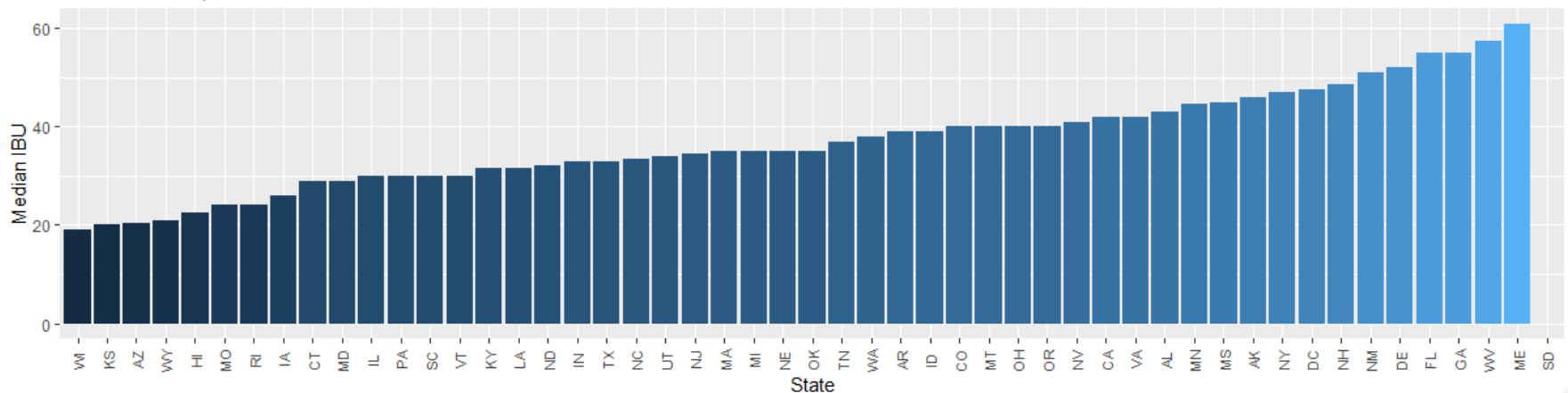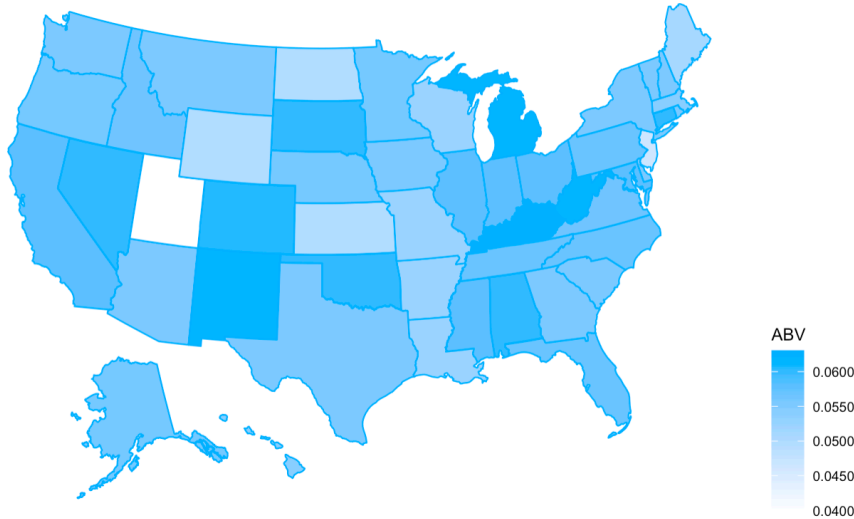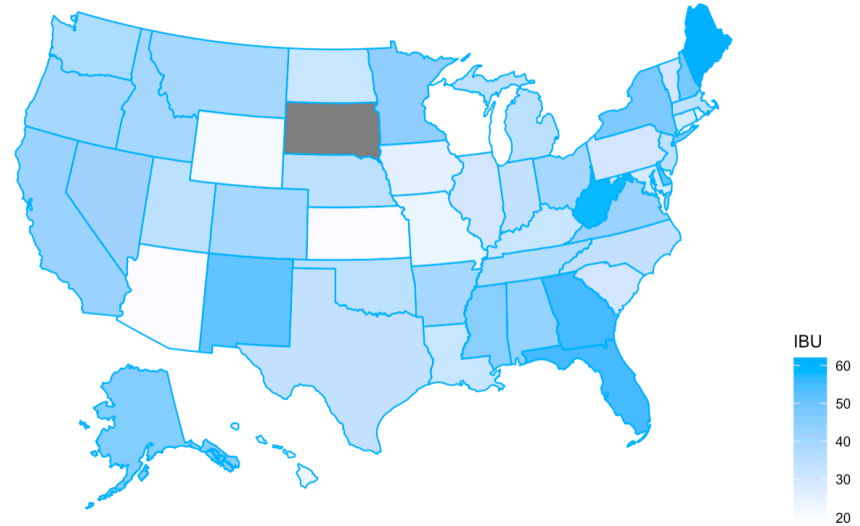# Median ABV and IBU by State

Median ABV by State
Alcohol by Volume

Median IBU by State
International Bitterness Units

State	Median ABV	Median IBU	State	Median ABV	Median IBU	State	Median ABV	Median IBU	State	Median ABV	Median IBU
AK	0.056	46.0	IL	0.058	30.0	MS	0.058	45.0	PA	0.057	30.0
AL	0.060	43.0	IN	0.058	33.0	MT	0.055	40.0	RI	0.055	24.0
AR	0.052	39.0	KS	0.050	20.0	NC	0.057	33.5	SC	0.055	30.0
AZ	0.055	20.5	KY	0.063	31.5	ND	0.050	32.0	SD	0.060	NA
CA	0.058	42.0	LA	0.052	31.5	NE	0.056	35.0	TN	0.057	37.0
CO	0.061	40.0	MA	0.054	35.0	NH	0.055	48.5	TX	0.055	33.0
CT	0.060	29.0	MD	0.058	29.0	NJ	0.046	34.5	UT	0.040	34.0
DC	0.063	47.5	ME	0.051	61.0	NM	0.062	51.0	VA	0.057	42.0
DE	0.055	52.0	MI	0.062	35.0	NV	0.060	41.0	VT	0.055	30.0
FL	0.057	55.0	MN	0.056	44.5	NY	0.055	47.0	WA	0.056	38.0
GA	0.055	55.0	MO	0.052	24.0	OH	0.058	40.0	WI	0.052	19.0
HI	0.054	22.5	MS	0.058	45.0	OK	0.060	35.0	WV	0.062	57.5
ID	0.057	39.0	MO	0.052	24.0	OR	0.056	40.0	WY	0.050	21.0

States with Highest ABV and IBU

States with Highest Median ABV:

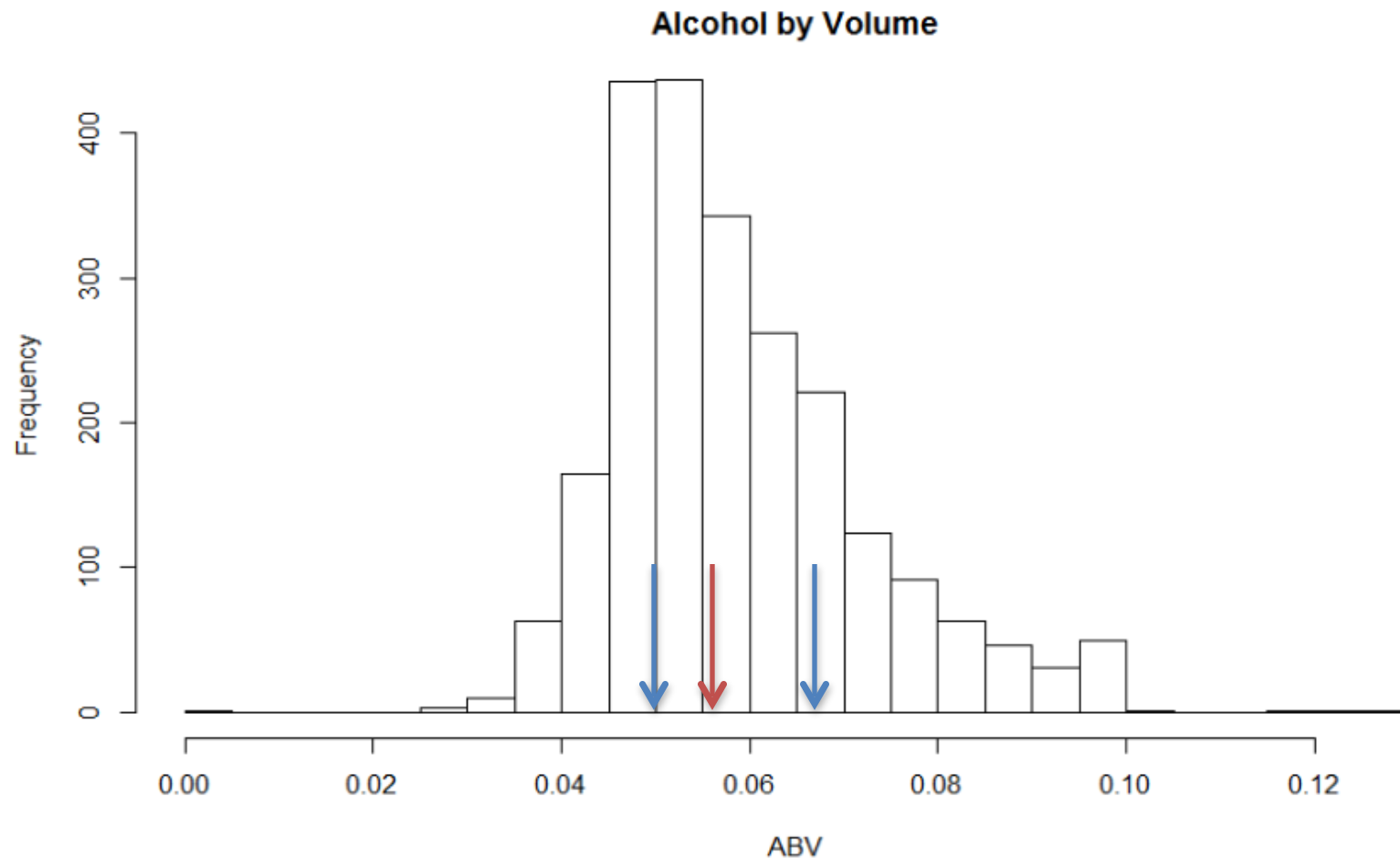**Kentucky and Washington D.C**
(*6.25%*)

State with Highest Median IBU:

Maine
(*61*)

The beer with the highest ABV is
located in **Colorado**
(*Lee Hill Series Vol. 5 Belgian*
Quadrupel Ale -12.8%)

The beer with the highest IBU is
located in **Oregon**
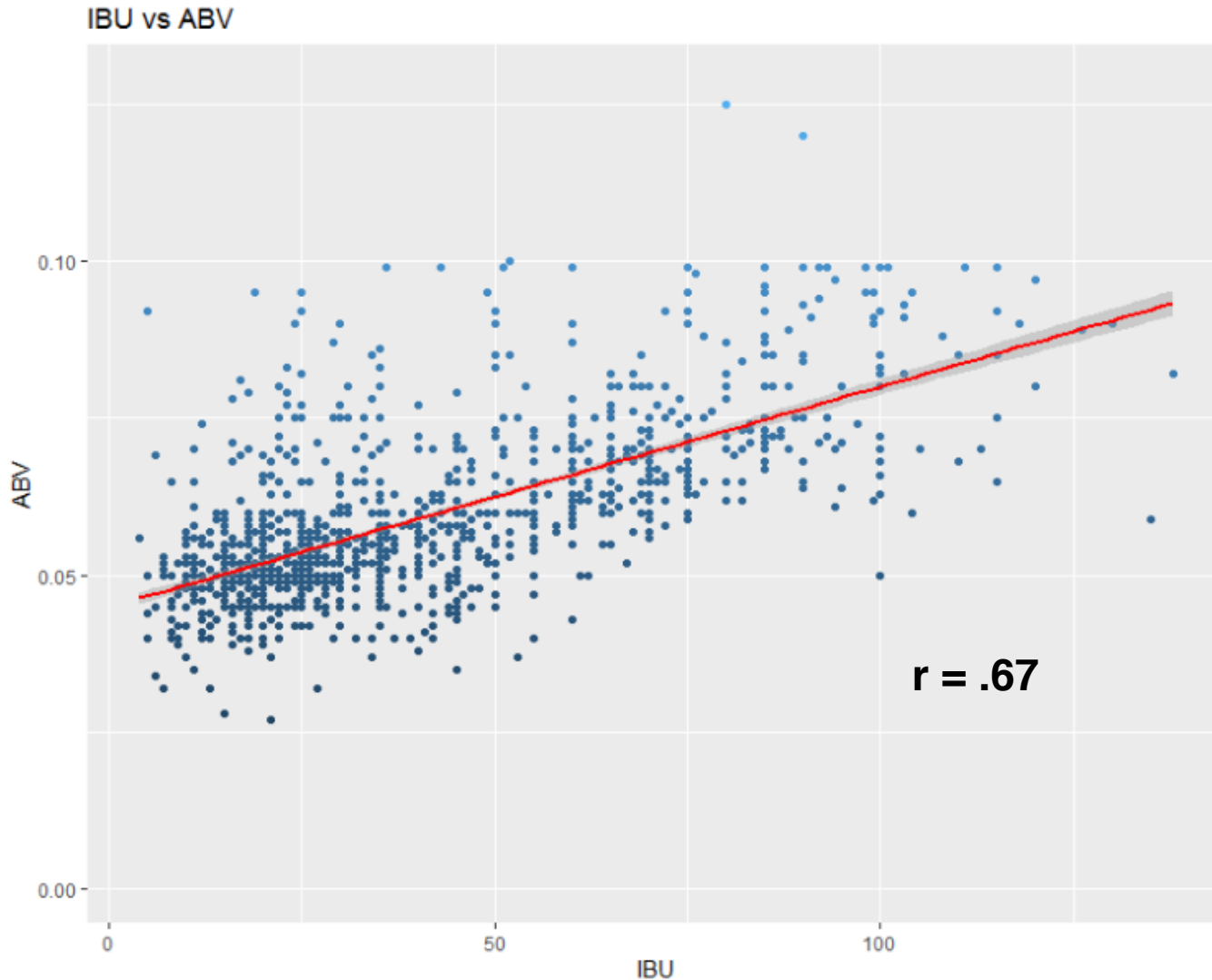(*Bitter Bitch Imperial IPA - 138*)

Stats and Distribution of ABV

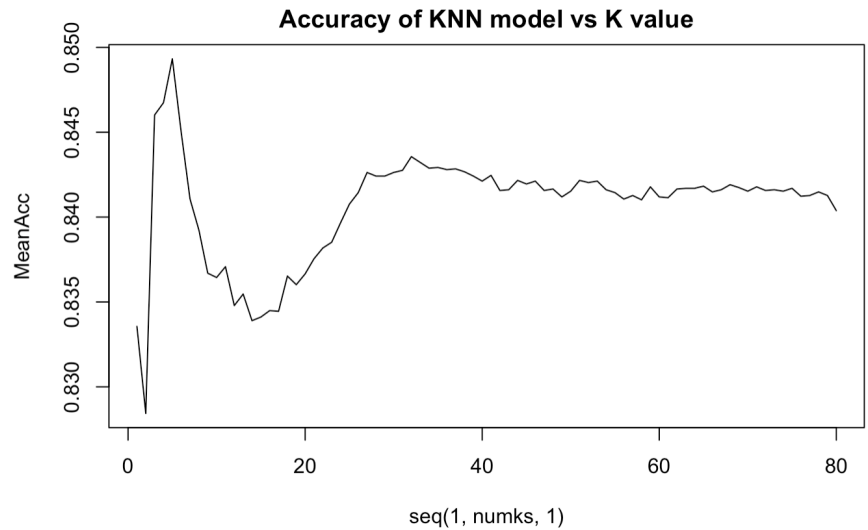| Mean	Std. dev.	Min	1st Q	Median	3rd Q	Max
0.06	0.014	0.001	0.05	0.056	0.067	0.128

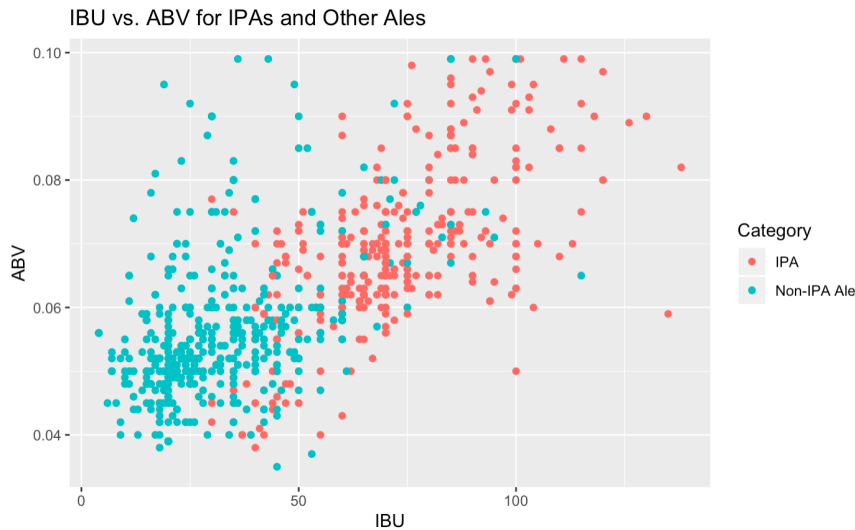# Relationship Between IBU and ABV

IBU vs ABV
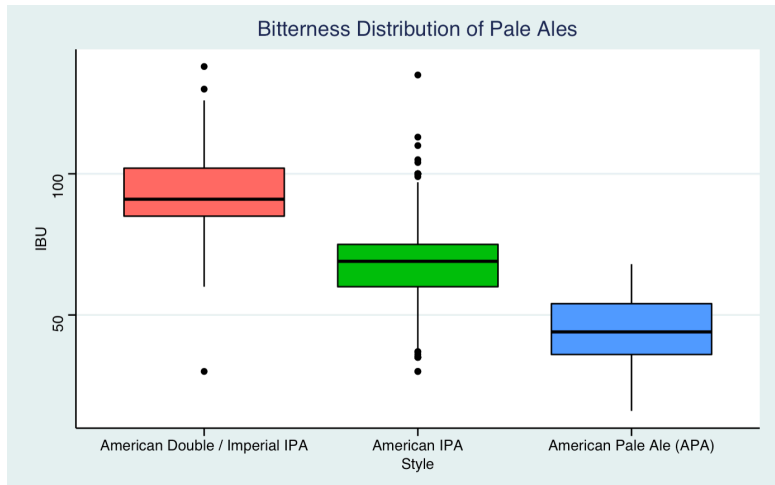
r = .67

$ABV = .00035*IBU + .0449$
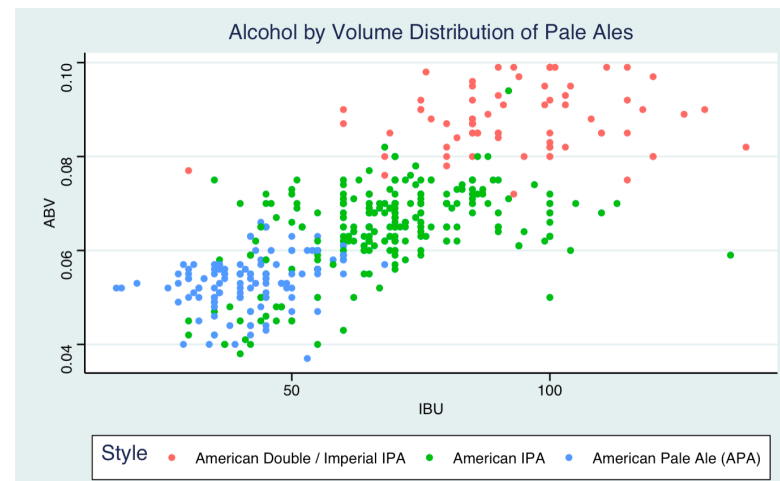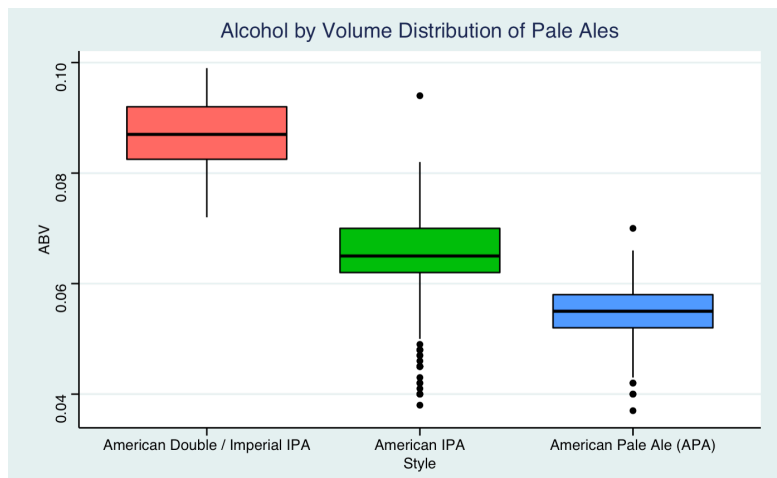
IPAs vs Non-IPA Ales

- Seeing the grouping of IPA and Non-IPA charted, a KNN model seemed appropriate for predicting beer style

- Comparing the accuracy of different K's to estimate showed k= 5 had they greatest accuracy at 86.57%

IBU vs. ABV for IPAs and Other Ales

Accuracy of KNN model vs K value

ABV and IBU Distinct in Pale Ale Styles

Bitterness Distribution of Pale Ales

Alcohol by Volume Distribution of Pale Ales

- Visually on we see what appear to be distinct ranges between Pale Ale Styles
- Two ANOVAs confirmed that both ABV and IBU are distinct between at least two of the pale ale styles ($p < 2e^{16}$)
- Following this with Tukey-Kramer tests, we confirmed all groups are distinct in both ABV and IBU (p value so small it evaluated to 0)

Alcohol by Volume Distribution of Pale Ales

BUDWEISER'S IPA

- Based on our comparisons between styles there are distinct ranges for an American IPA on both IBU and ABV. We suggest the IBU and ABV be within the 50% Middle distribution of the American IPA style
- Bitterness should be between 60 and 75 IBUs to stay in a distinct IPA range, but not too high to stray from Bud's signature drinkability
- Alcohol content should be a blend between the range or the American IPA and Overall ABVs of 6.2% and 6.7% to make it as widely available as possible while staying true to the IPA style

American IPA IBU (Suggested)	60 IBU	75 IBU
American IPA ABV	6.2%	7%
Overall American ABV	5%	6.7%
Suggested ABV Range	6.2%	6.7%

Middle 50% distributions and suggested ranges for IBU ABV

"*It is my aim to win the American people over ... to make them all lovers of beer.*"
- Adolphus Busch (1905)

Recording available:

https://youtu.be/Xiew0VW_CvI