hw4worksheet1.R

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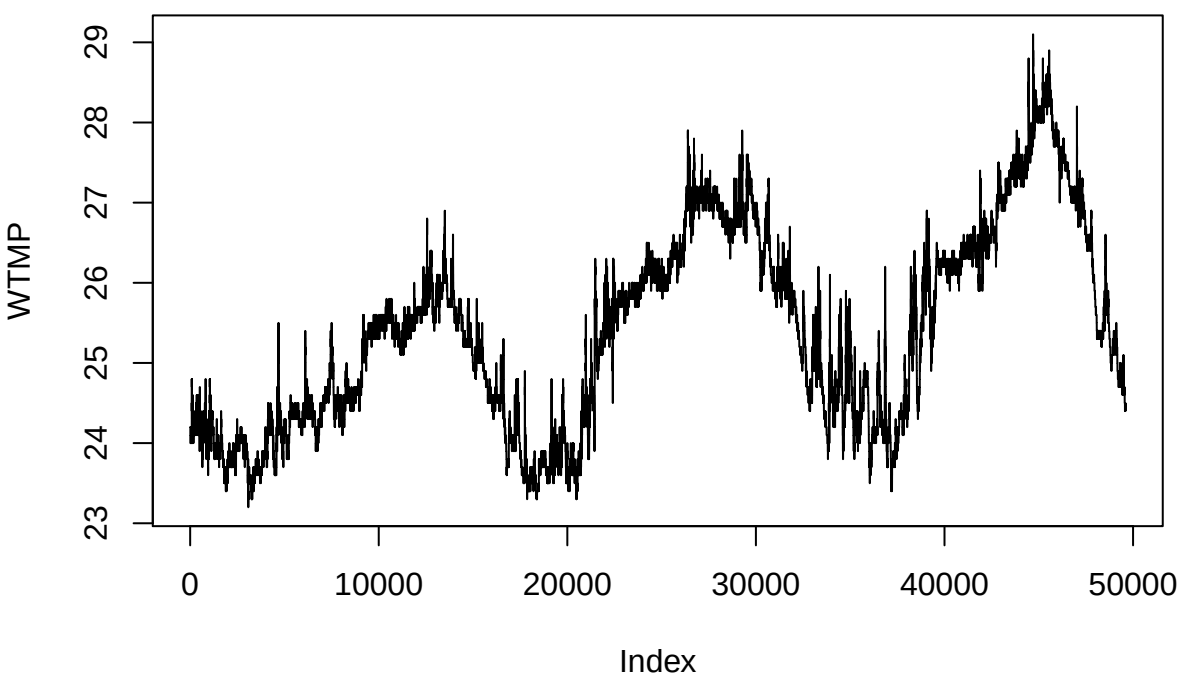
Fri Sep 25 09:05:47 2015

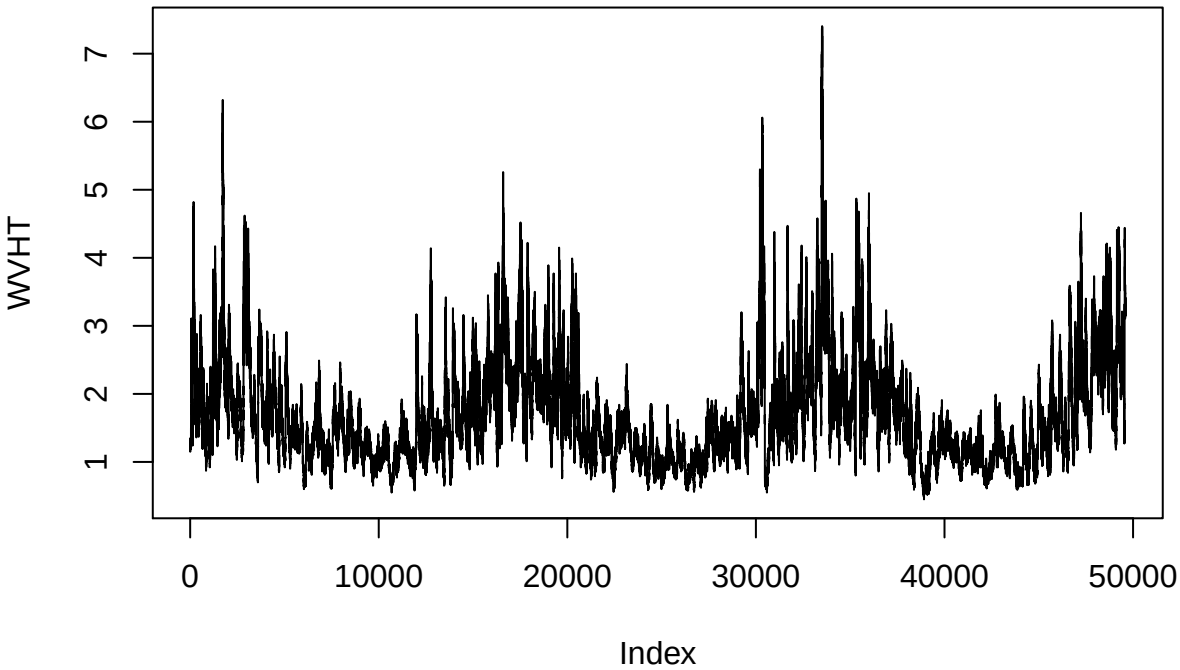
```
#1
library(ggplot2)
str1="http://www.ndbc.noaa.gov/view_text_file.php?filename="
str2=".txt.gz&dir=data/historical/stdmet/"
buoynum<-"51201"
y1<-2012
y2<-2014
WTMP<-NULL
WVHT<-NULL
DPD<-NULL
while(y1<=y2){
  fyl<-paste0(str1,buoynum,"h",y1,str2)
  header<-scan(fyl,nlines=1,what=character())
  buoy<-read.table(fyl,skip=2,header=FALSE)
  colnames(buoy)<-header
  WTMP<-c(WTMP,buoy$WTMP)
  WVHT<-c(WVHT,buoy$WVHT)
  DPD<-c(DPD,buoy$DPD)
  cat(paste(y1))
  y1<-y1+1
}
```

```
## 201220132014
```

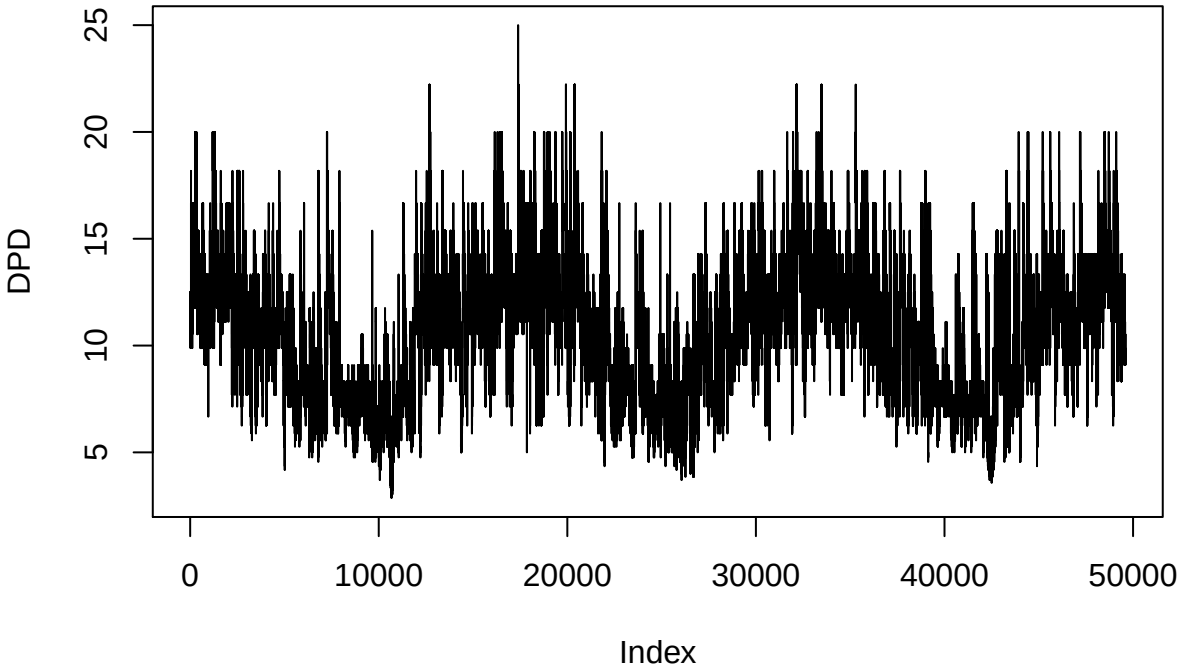
```
plot(WTMP,type="l")
```



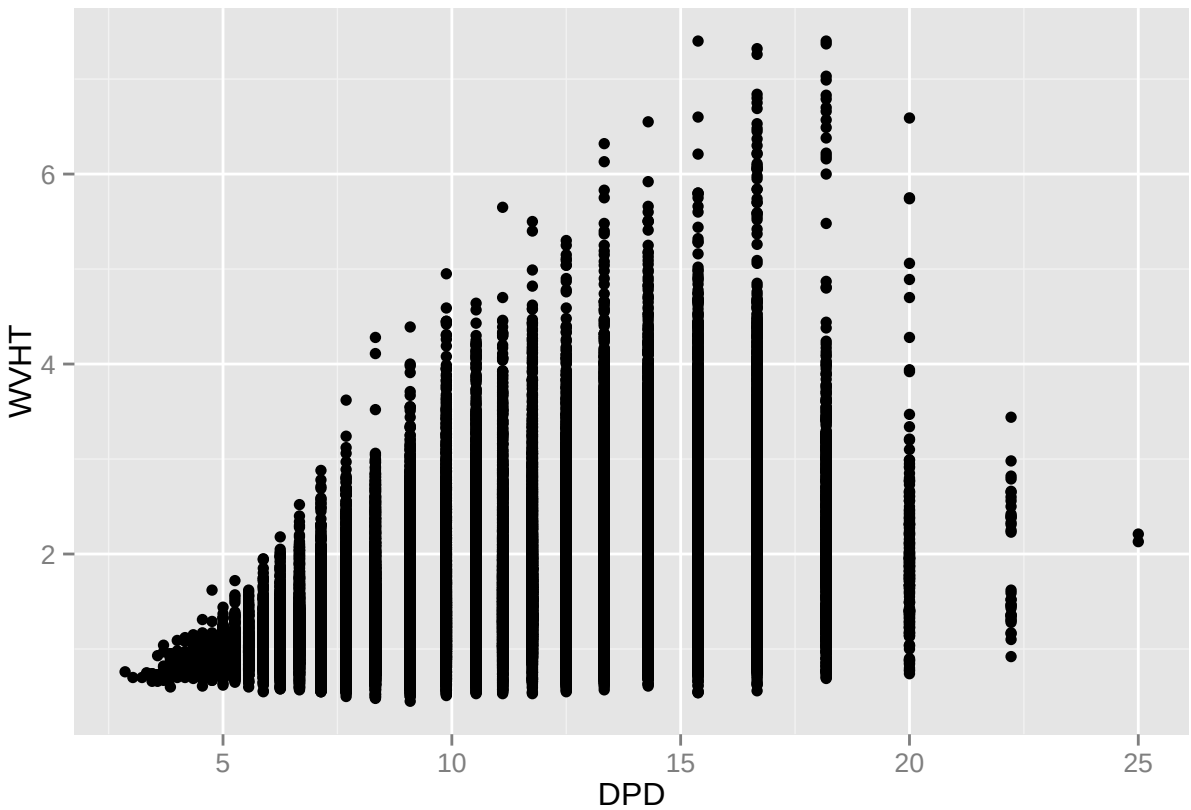
```r
plot(WVHT,type="l")
```




```r
plot(DPD,type="l")
```




```r
qplot(DPD,WVHT)
```




```r
#2
library(ggplot2)
setwd("/Users/jiayuan/Documents/MA881")
data <- read.csv("markets.csv", header=TRUE)
delete<-which(data$Value==" (D)")
data<-data[-c(delete),]
attach(data)
head(data$Value)
```

```
## [1] 1218931 1218931 1218931 1218931 550052  550052
## 3028 Levels:  (D)  (Z) 1000 10000 1000000 1002000 1003000 ... 999000
```

```r
value2 <- gsub(pattern=",", replacement="", data$Value)
head(value2)
```

```
## [1] "1218931" "1218931" "1218931" "1218931" "550052"  "550052"
```

```r
value3 <- as.numeric(value2)
```

```
## Warning: NAs introduced by coercion
```

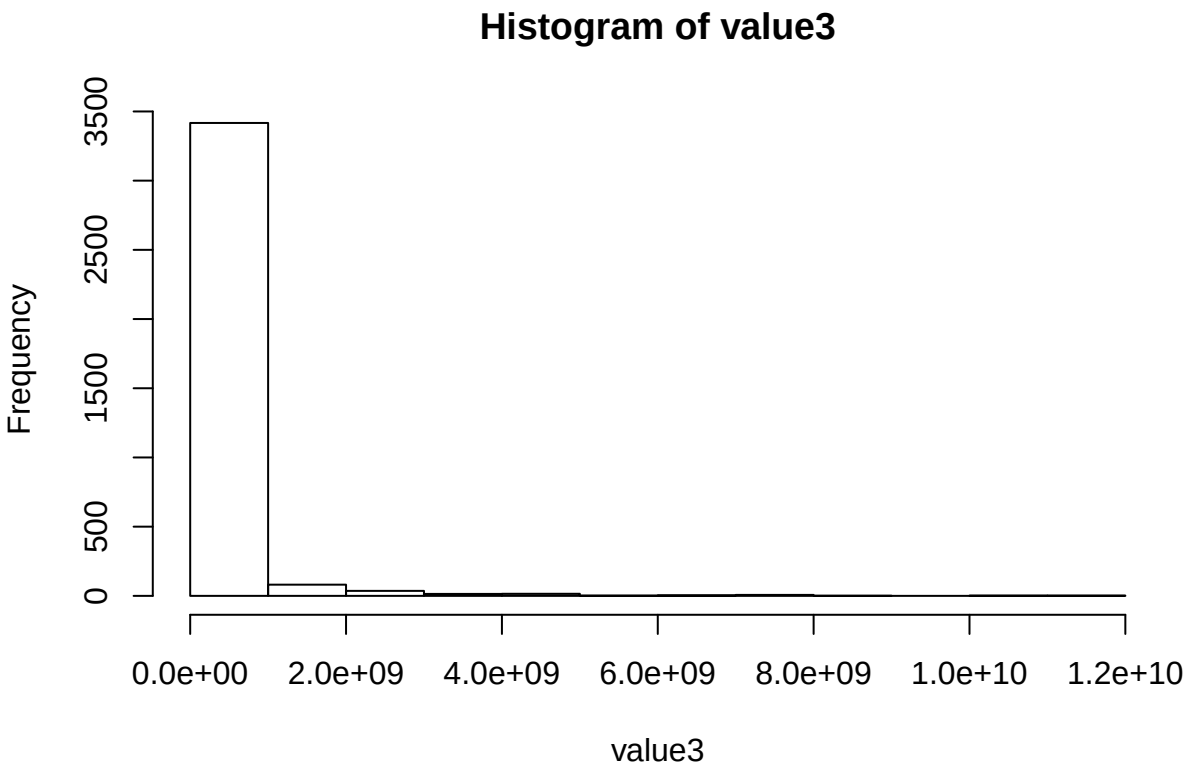
```r
head(value3)
```

```
## [1] 1218931 1218931 1218931 1218931  550052  550052
```

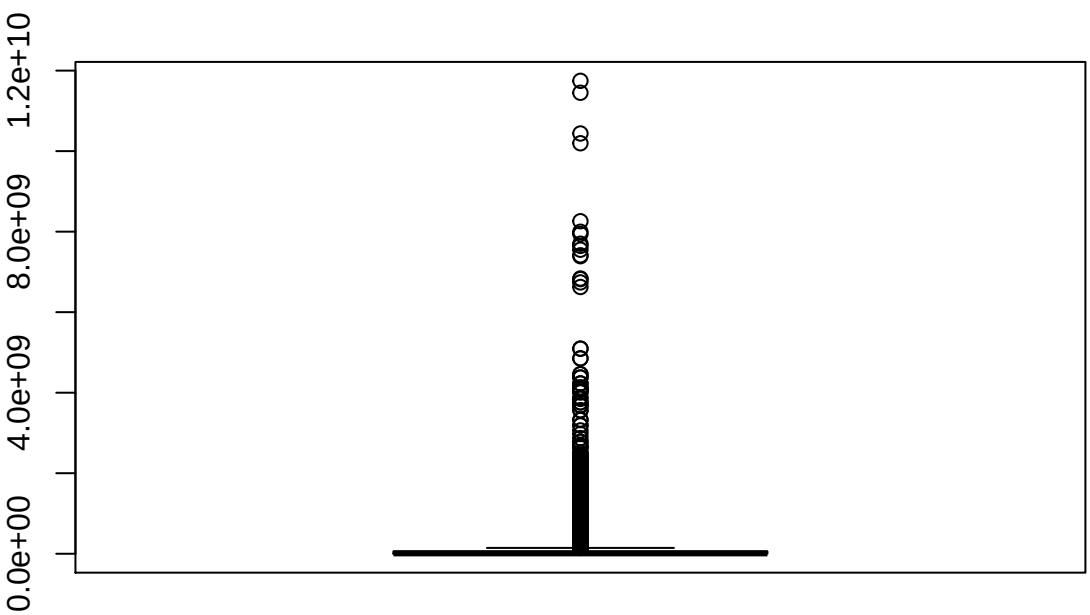
```r
class(value3)
```

```
## [1] "numeric"
```

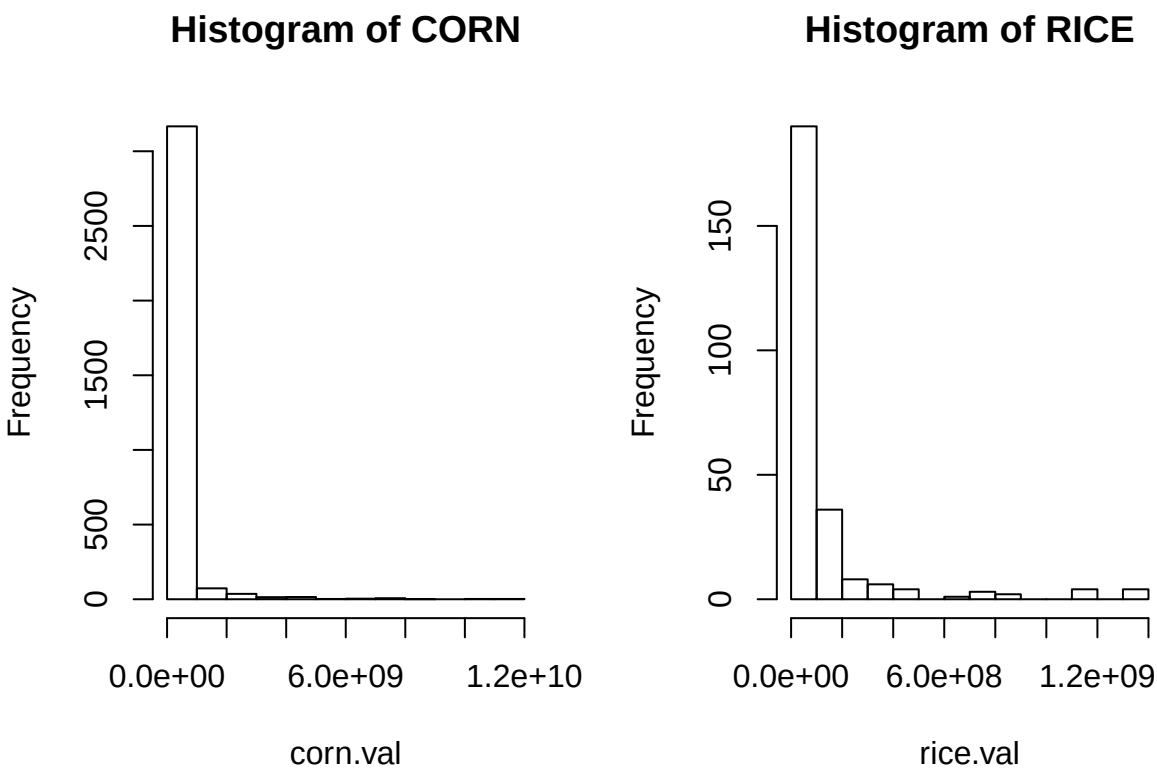
```r
hist(value3)
```




```r
boxplot(value3)
```

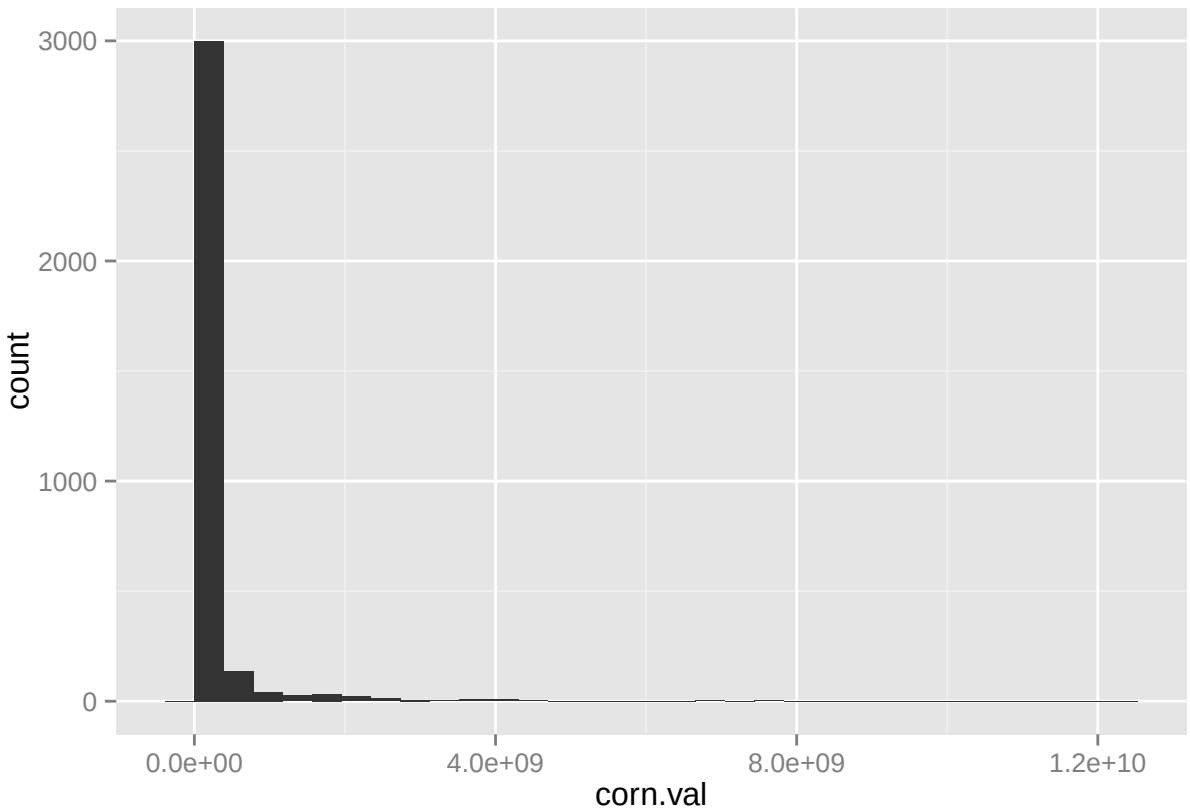


```r
State.ANSI<-data$State.ANSI
corn.val<-value3[Commodity=="CORN"]
rice.val<-value3[Commodity=="RICE"]
corn.state<-State.ANSI[Commodity=="CORN"]
rice.state<-State.ANSI[Commodity=="RICE"]
corn.year<-Year[Commodity=="CORN"]
corn.year<-as.factor(corn.year)
rice.year<-Year[Commodity=="RICE"]
rice.year<-as.factor(rice.year)
corn.com<-Commodity[Commodity=="CORN"]
rice.com<-Commodity[Commodity=="RICE"]

# the counts of different values for corn and rice
par(mfrow=c(1,2))
hist(corn.val, main = "Histogram of CORN")
hist(rice.val, main = "Histogram of RICE")
```



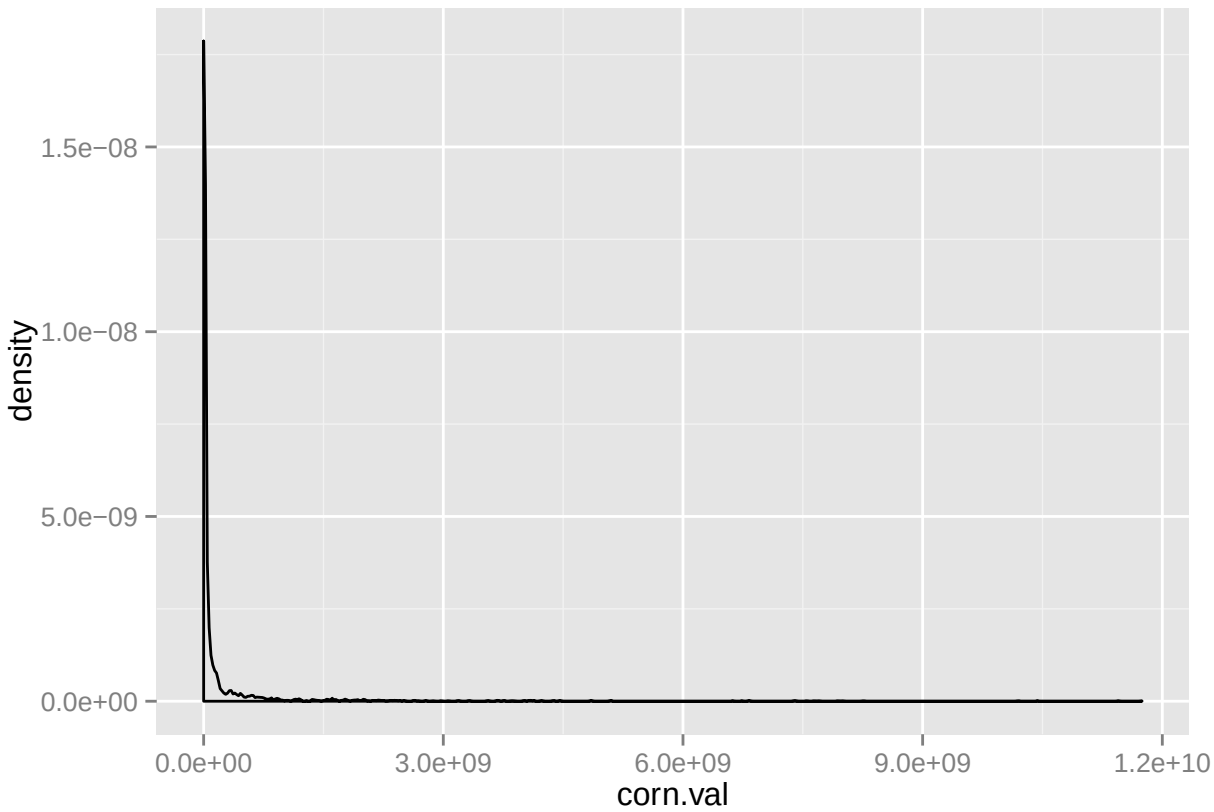

```r
corn1 <- data.frame(corn.state, corn.val, corn.year)
rice1 <- data.frame(rice.state, rice.val, rice.year)

# different forms of visual description for the values of corn and rice
qplot(corn.val,data = corn1, geom = "histogram")
```

```
## stat_bin: binwidth defaulted to range/30. Use 'binwidth = x' to adjust this.
```



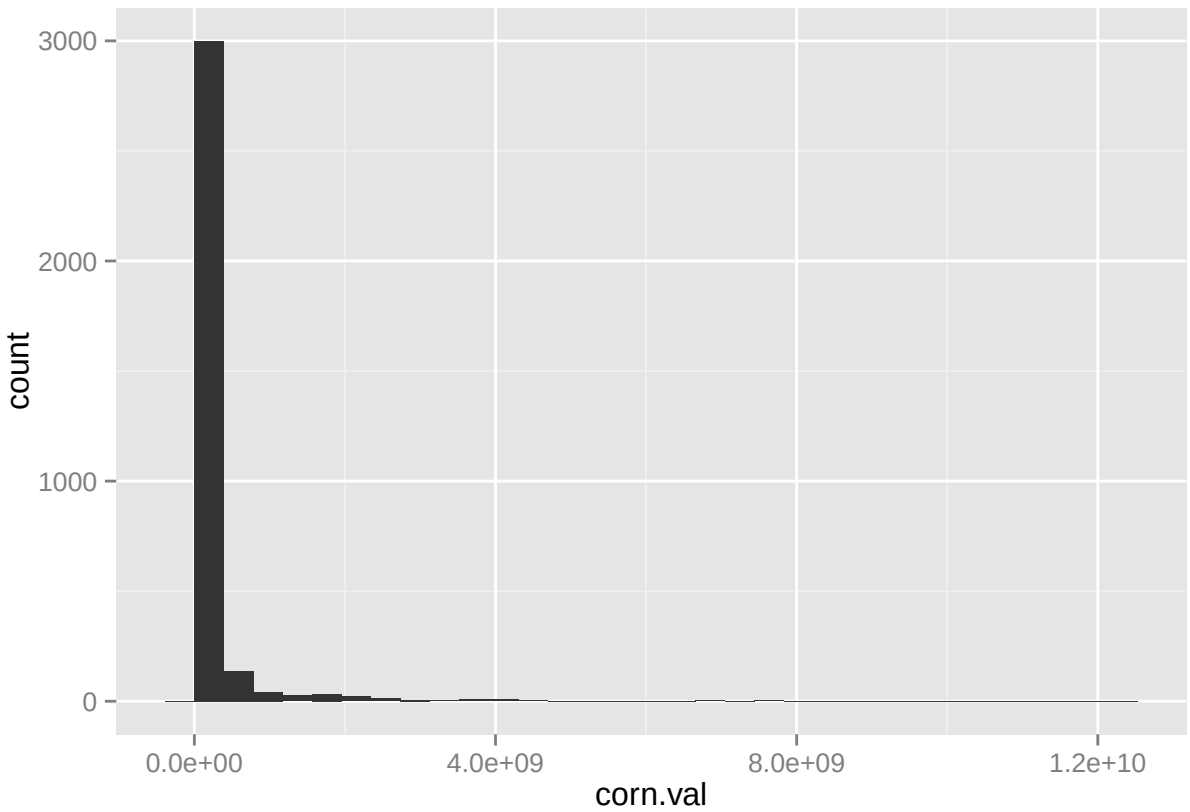

```r
qplot(corn.val, data = corn1, geom = "density")
```

```
## Warning: Removed 3 rows containing non-finite values (stat_density).
```



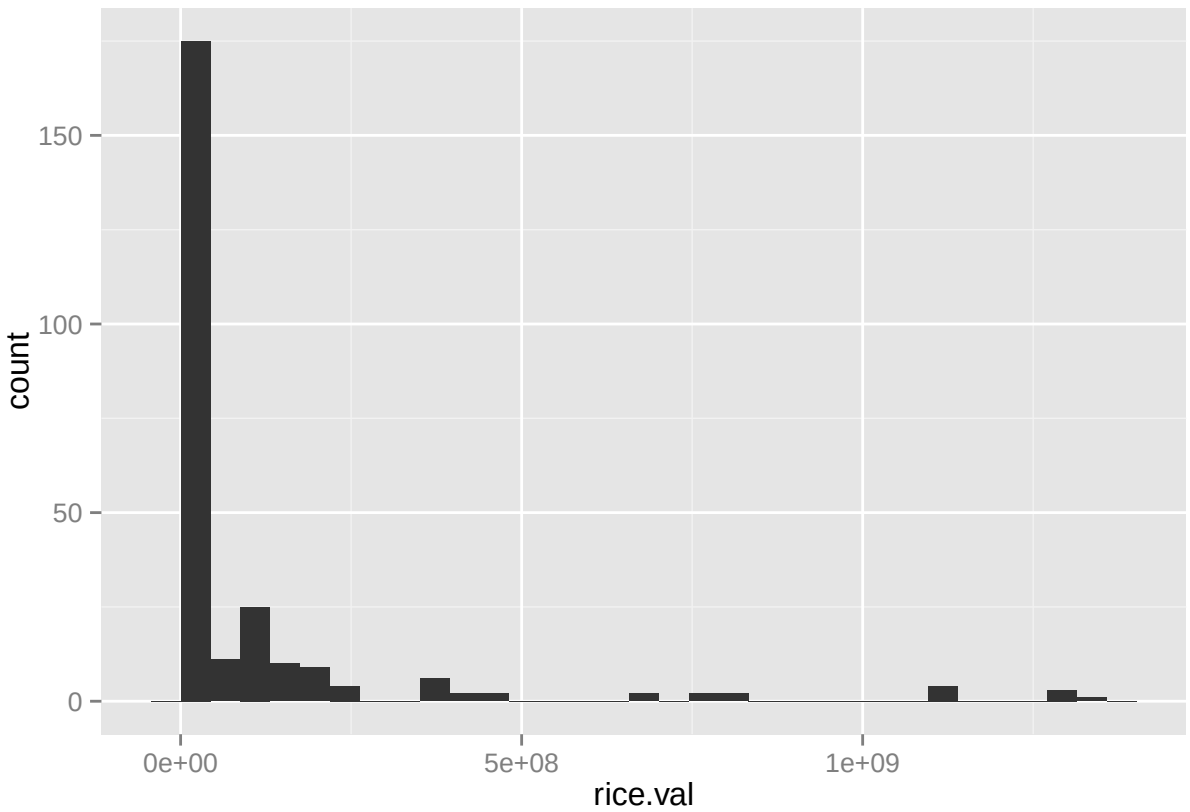

```r
qplot(corn.val, data = corn1, geom = "bar")
```

```
## stat_bin: binwidth defaulted to range/30. Use 'binwidth = x' to adjust this.
```

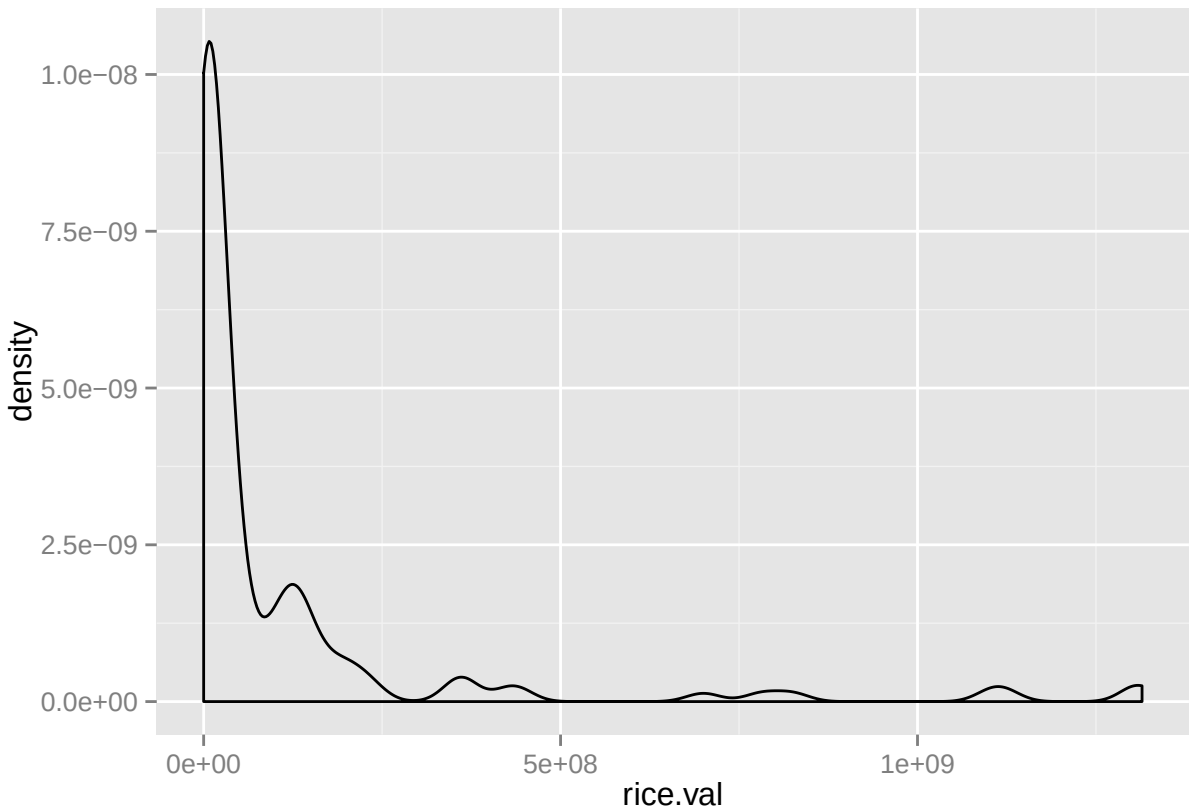



```
qplot(rice.val, data = rice1, geom = "histogram")
```

```
## stat_bin: binwidth defaulted to range/30. Use 'binwidth = x' to adjust this.
```

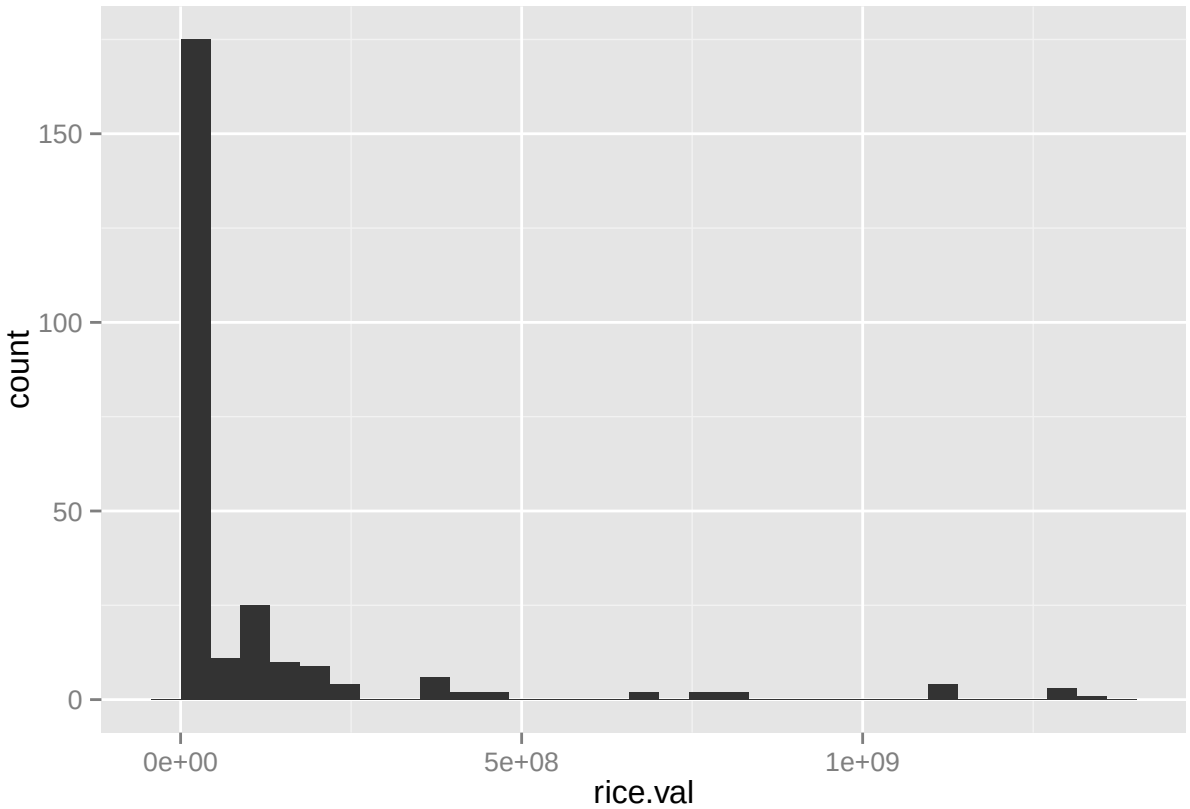



```r
qplot(rice.val, data = rice1, geom = "density")
```



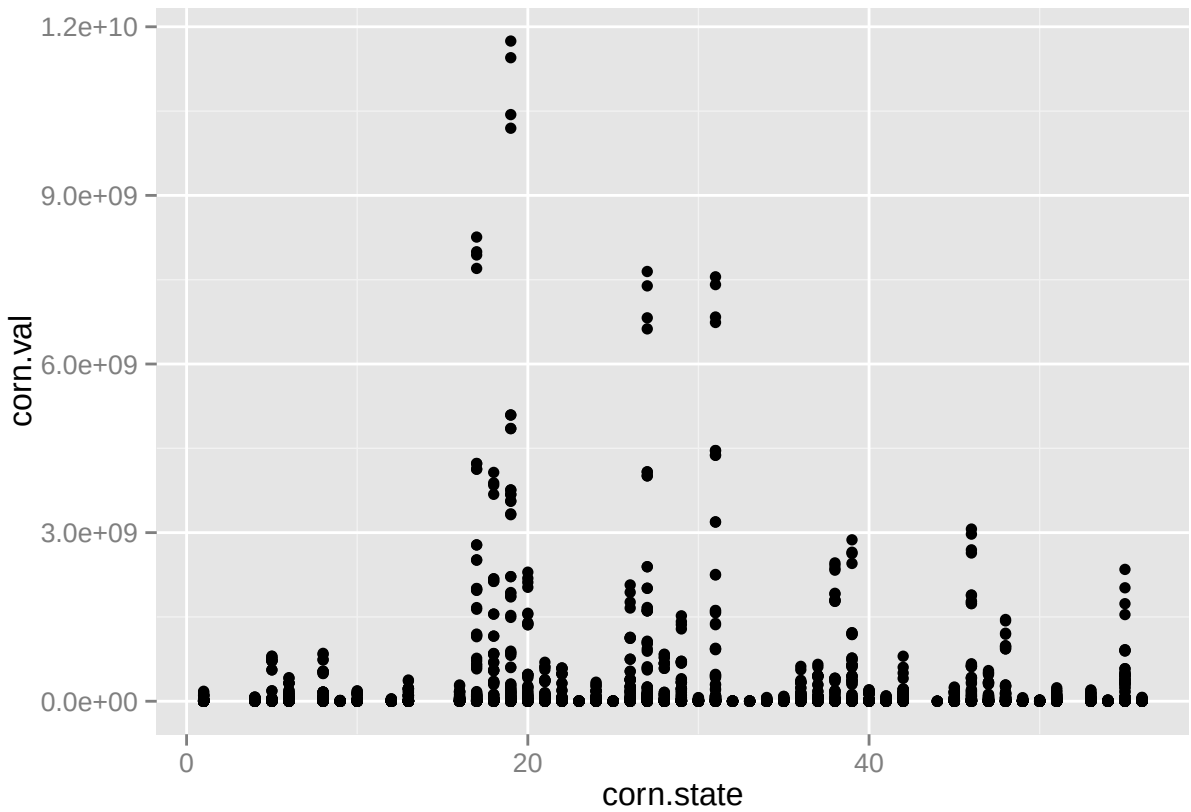
```r
qplot(rice.val, data = rice1, geom = "bar")
```

```
## stat_bin: binwidth defaulted to range/30. Use 'binwidth = x' to adjust this.
```

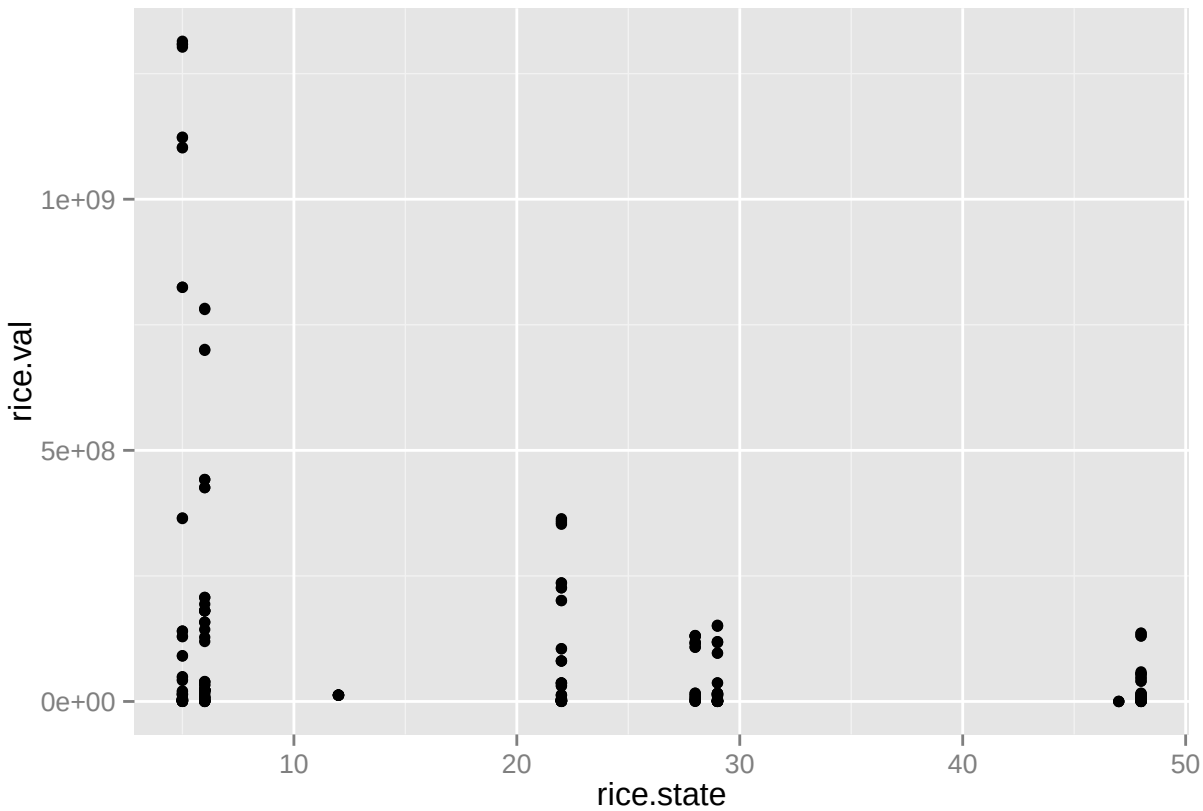



```r
# the distribution of values of corn and rice in different states
qplot(corn.state, corn.val, data = corn1)
```

```
## Warning: Removed 3 rows containing missing values (geom_point).
```




```
qplot(rice.state, rice.val, data = rice1)
```

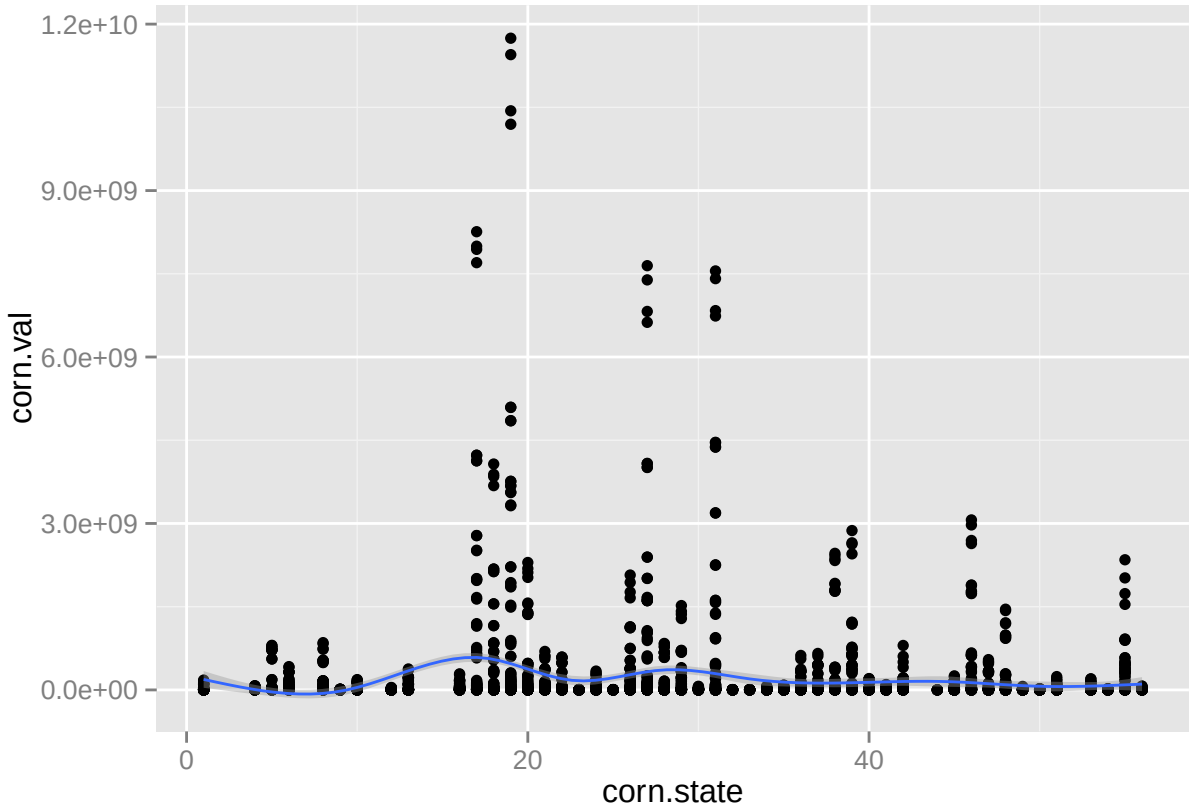


```r
qplot(corn.state, corn.val, data = corn1, geom = c("point", "smooth"),span = 0.2)
```

```
## geom_smooth: method="auto" and size of largest group is >=1000, so using gam with formula: y ~ s(x, b
```

```
## Warning: Removed 3 rows containing missing values (stat_smooth).
```

```
## Warning: Removed 3 rows containing missing values (geom_point).
```




```r
qplot(rice.state, rice.val, data = rice1, geom = c("point", "smooth"),span = 0.2)
```

```
## geom_smooth: method="auto" and size of largest group is <1000, so using loess. Use 'method = x' to ch
```

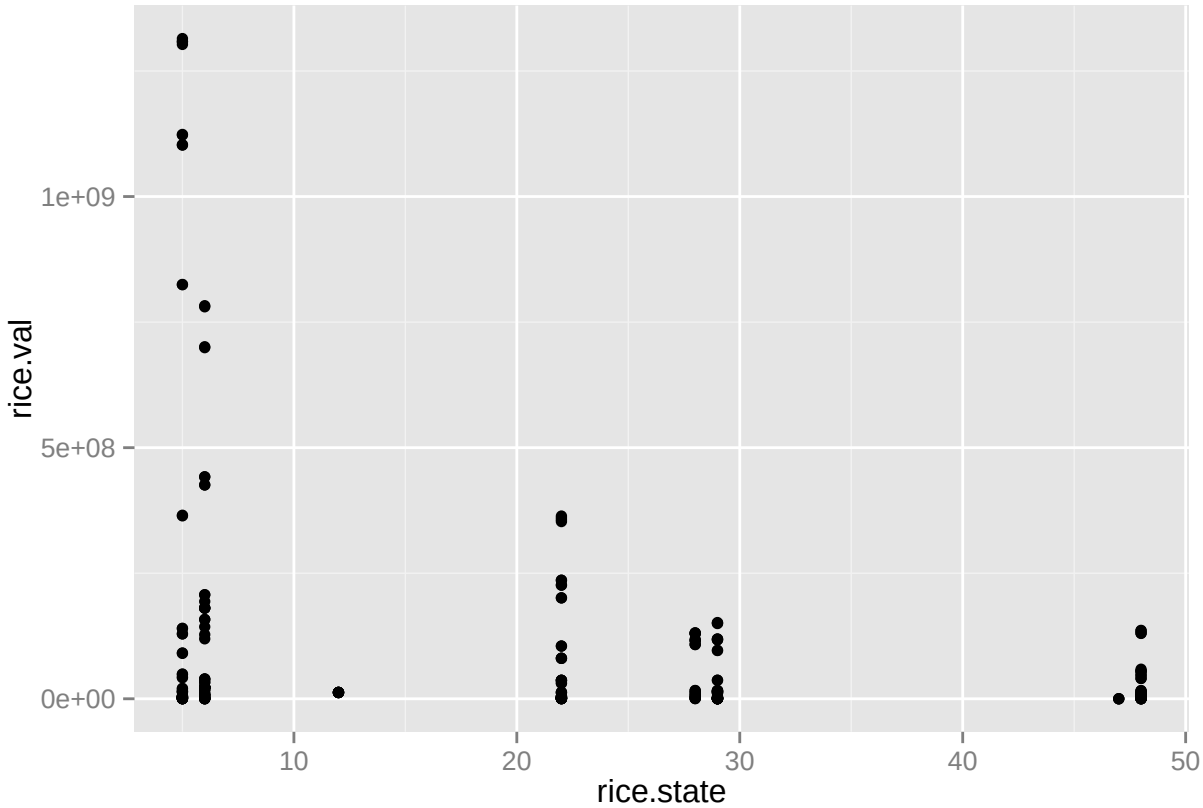
```
## Warning in simpleLoess(y, x, w, span, degree, parametric, drop.square,
## normalize, : pseudoinverse used at 4.785
```

```
## Warning in simpleLoess(y, x, w, span, degree, parametric, drop.square,
## normalize, : neighborhood radius 1.215
```

```
## Warning in simpleLoess(y, x, w, span, degree, parametric, drop.square,
## normalize, : reciprocal condition number 0
```

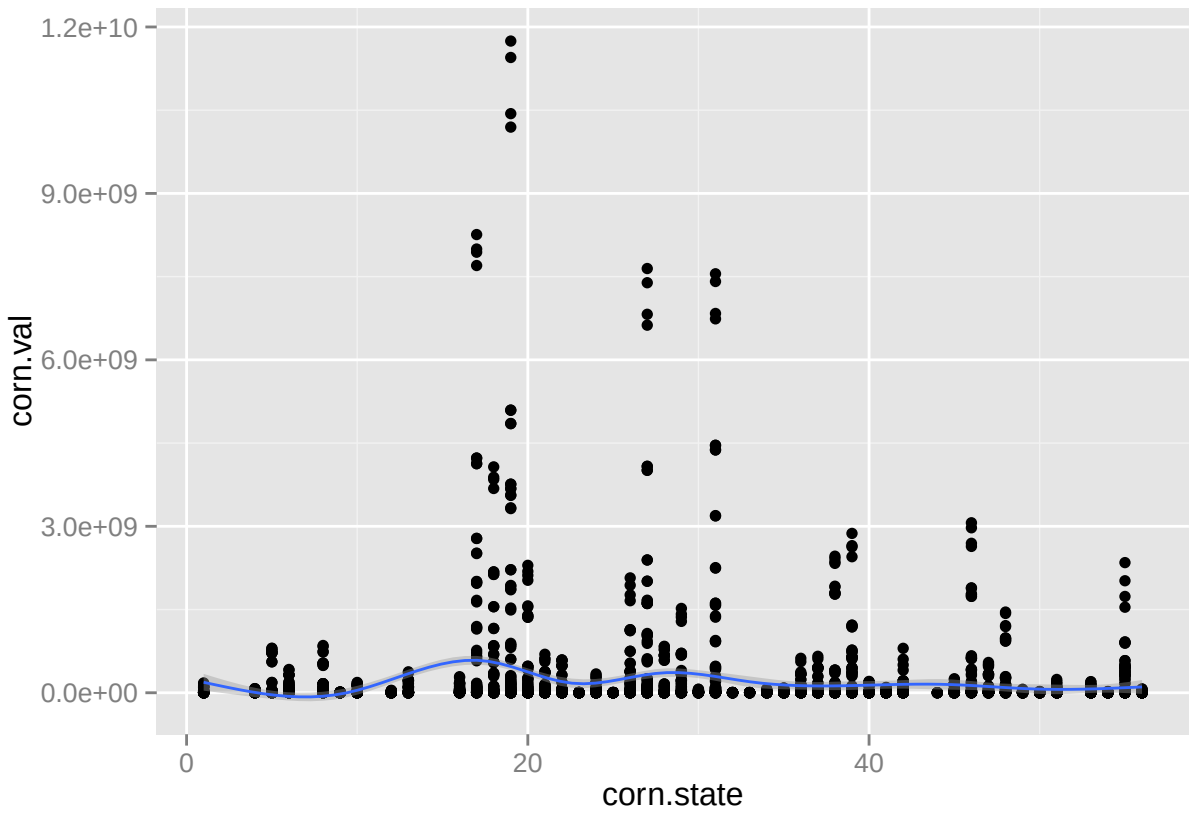
```
## Warning in simpleLoess(y, x, w, span, degree, parametric, drop.square,
## normalize, : There are other near singularities as well. 369.22
```

```
## Warning in simpleLoess(y, x, w, span, degree, parametric, drop.square,
## normalize, : zero-width neighborhood. make span bigger
```



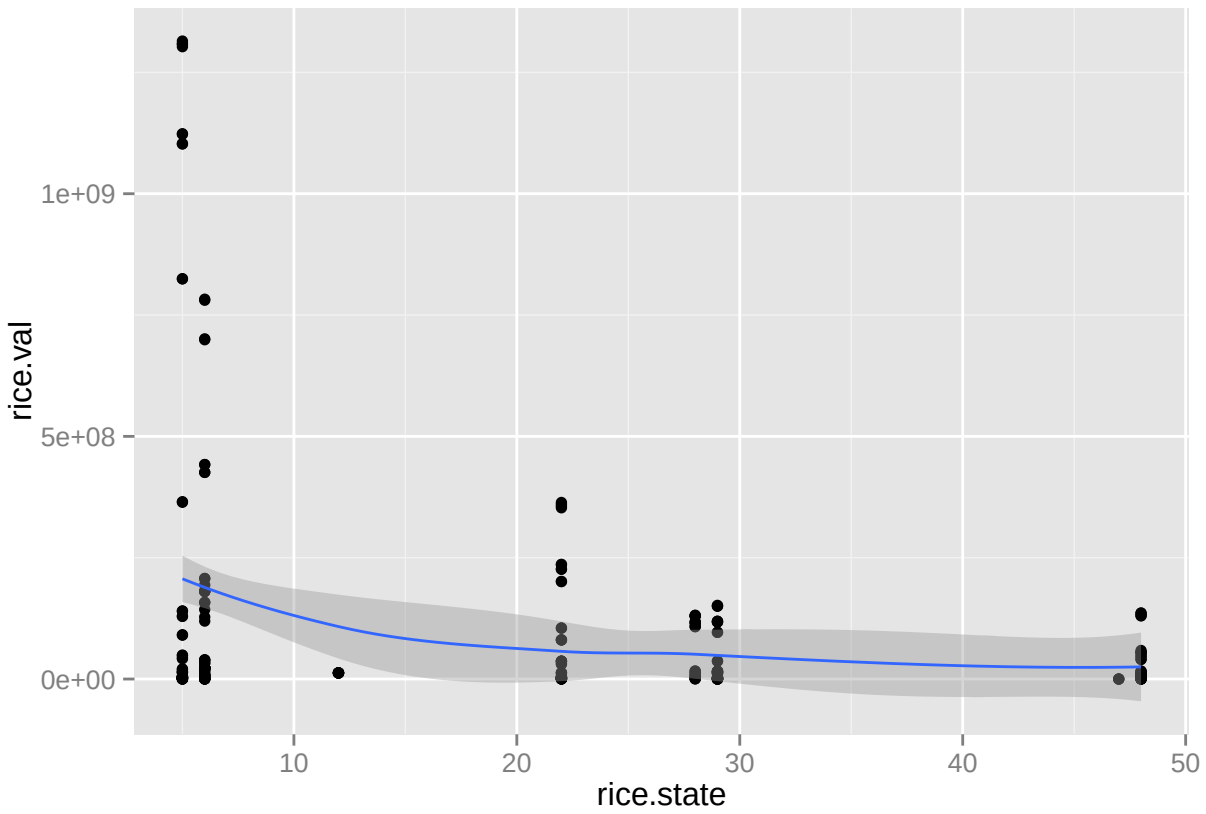

```
qplot(corn.state, corn.val, data = corn1, geom = c("point", "smooth"),span = 1)
```

```
## geom_smooth: method="auto" and size of largest group is >=1000, so using gam with formula: y ~ s(x, b

## Warning: Removed 3 rows containing missing values (stat_smooth).

## Warning: Removed 3 rows containing missing values (geom_point).
```



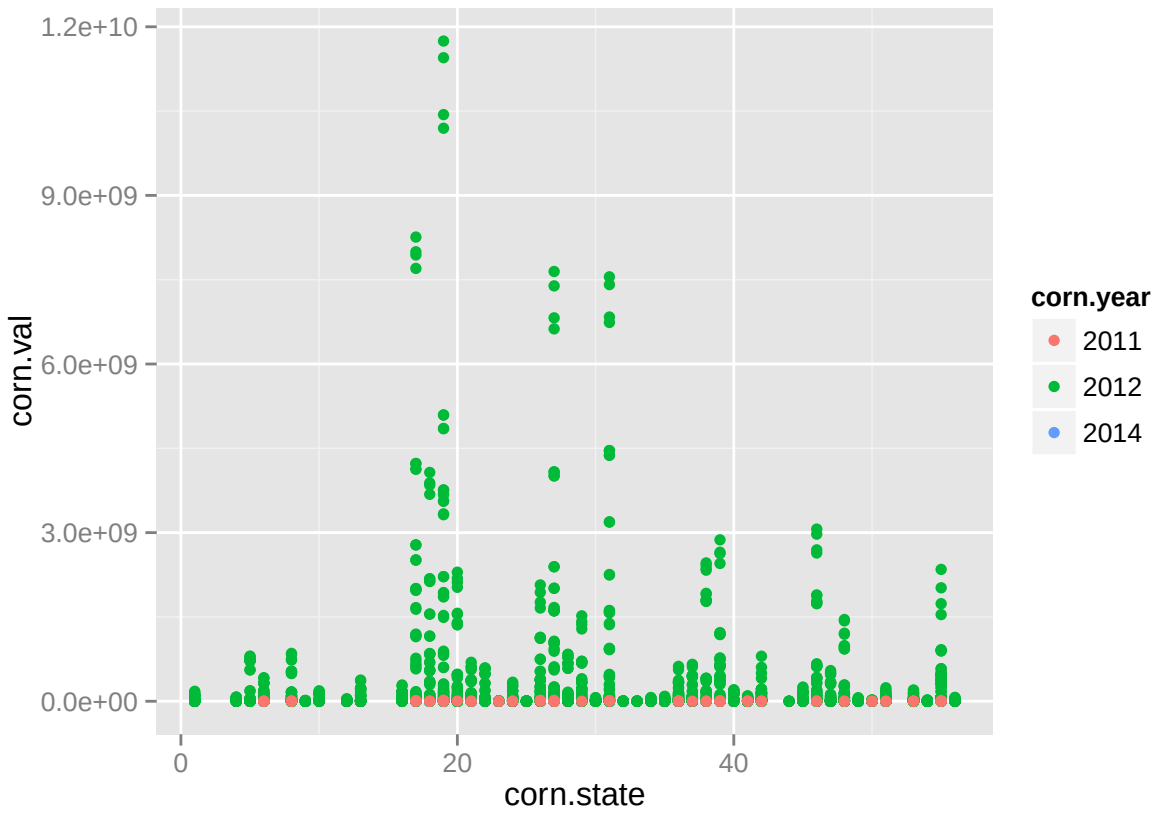

```
qplot(rice.state, rice.val, data = rice1, geom = c("point", "smooth"),span = 1)
```

```
## geom_smooth: method="auto" and size of largest group is <1000, so using loess. Use 'method = x' to cl
```

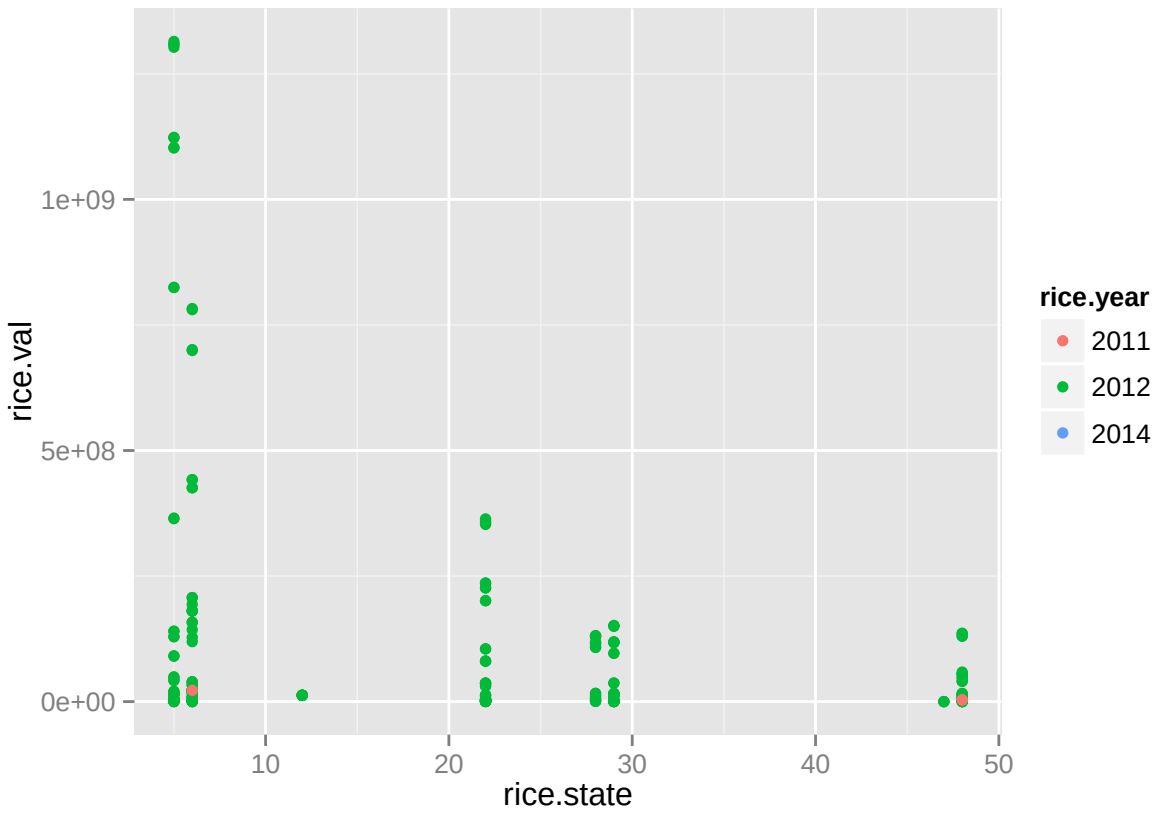



```
qplot(corn.state, corn.val, data = corn1, color=corn.year)
```

```
## Warning: Removed 3 rows containing missing values (geom_point).
```

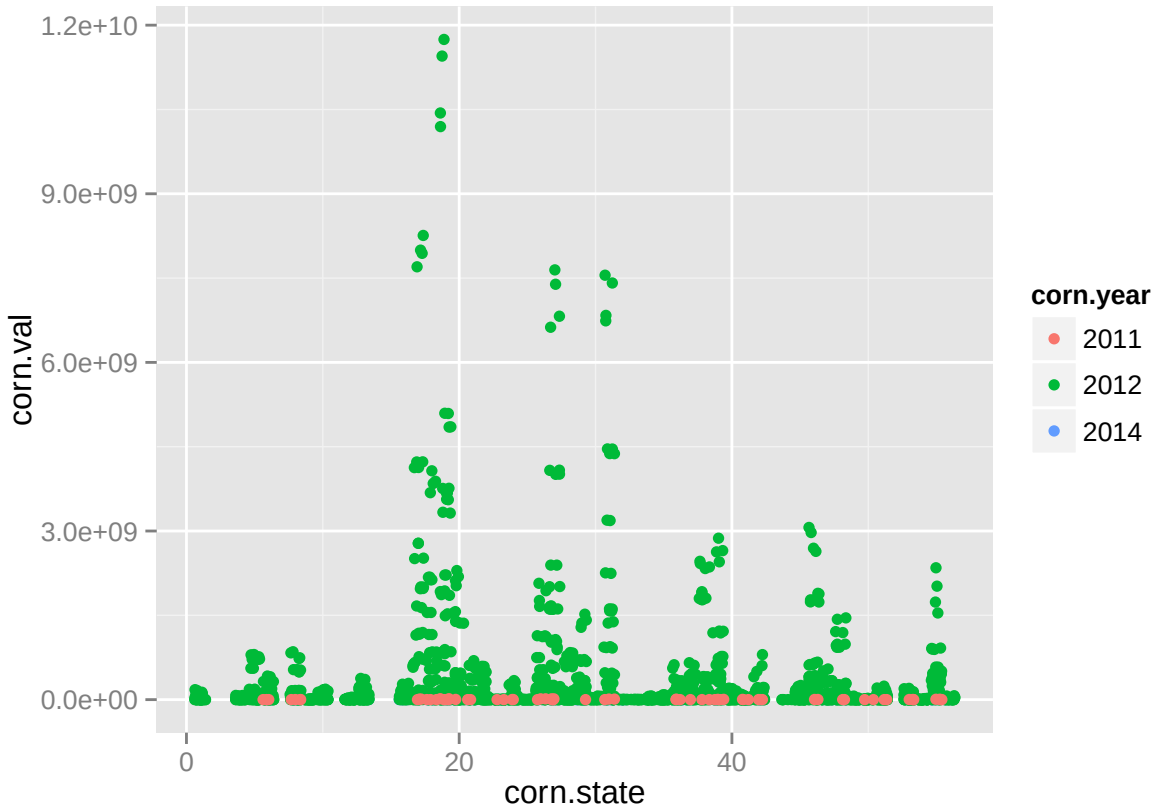



```
qplot(rice.state, rice.val, data = rice1, color=rice.year)
```

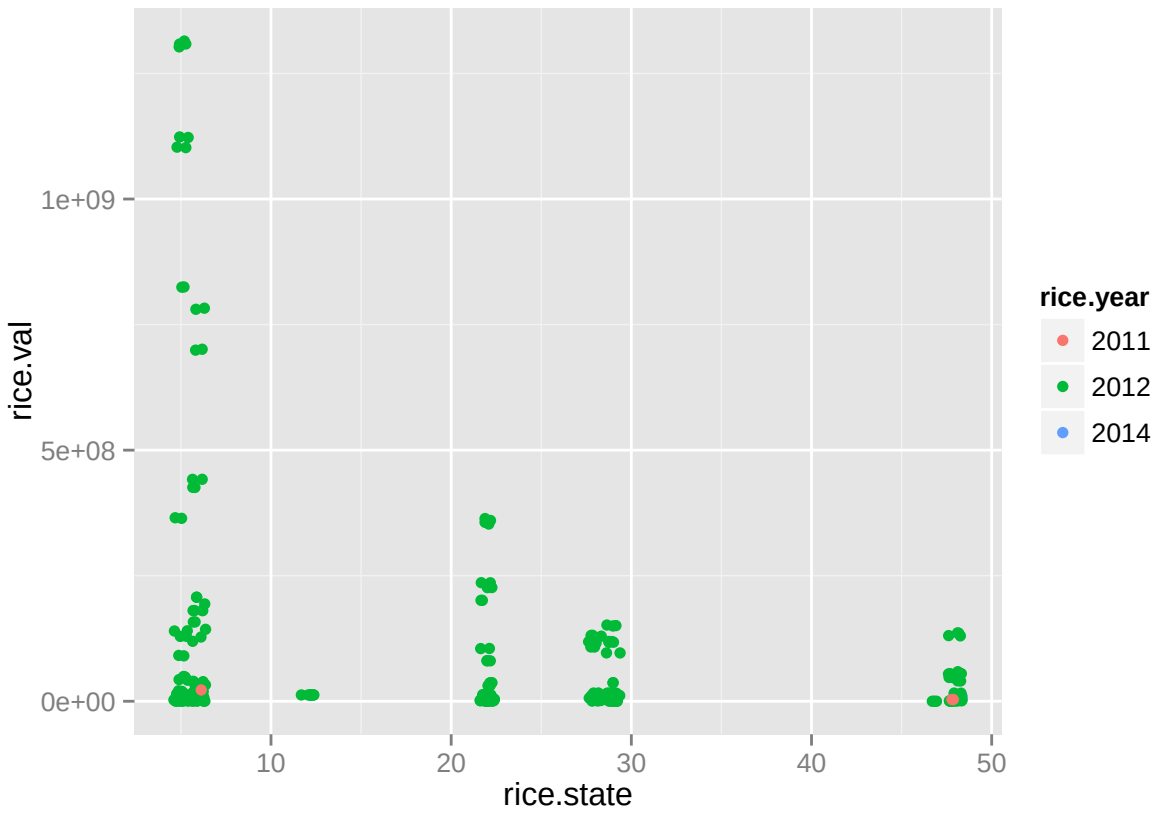


```r
qplot(corn.state, corn.val, data = corn1, color=corn.year, geom = "jitter")
```

```
## Warning: Removed 3 rows containing missing values (geom_point).
```

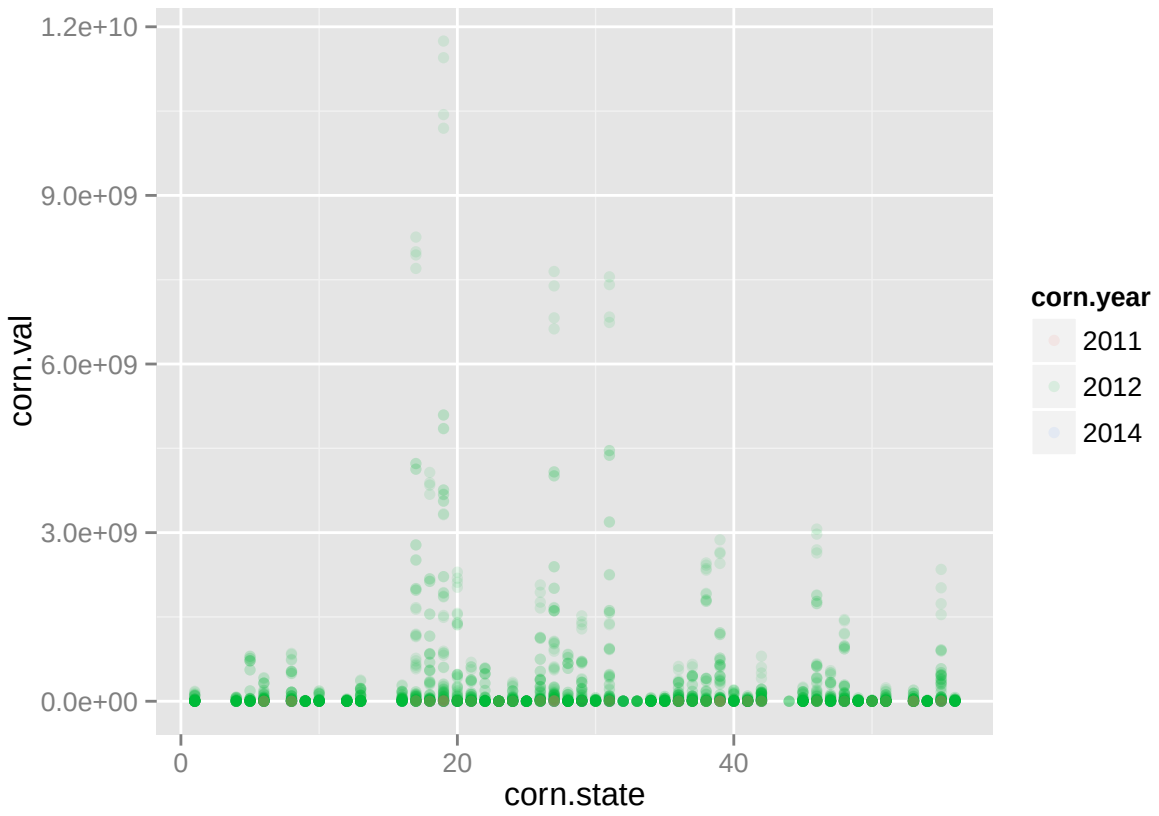



```r
qplot(rice.state, rice.val, data = rice1, color=rice.year,geom = "jitter")
```

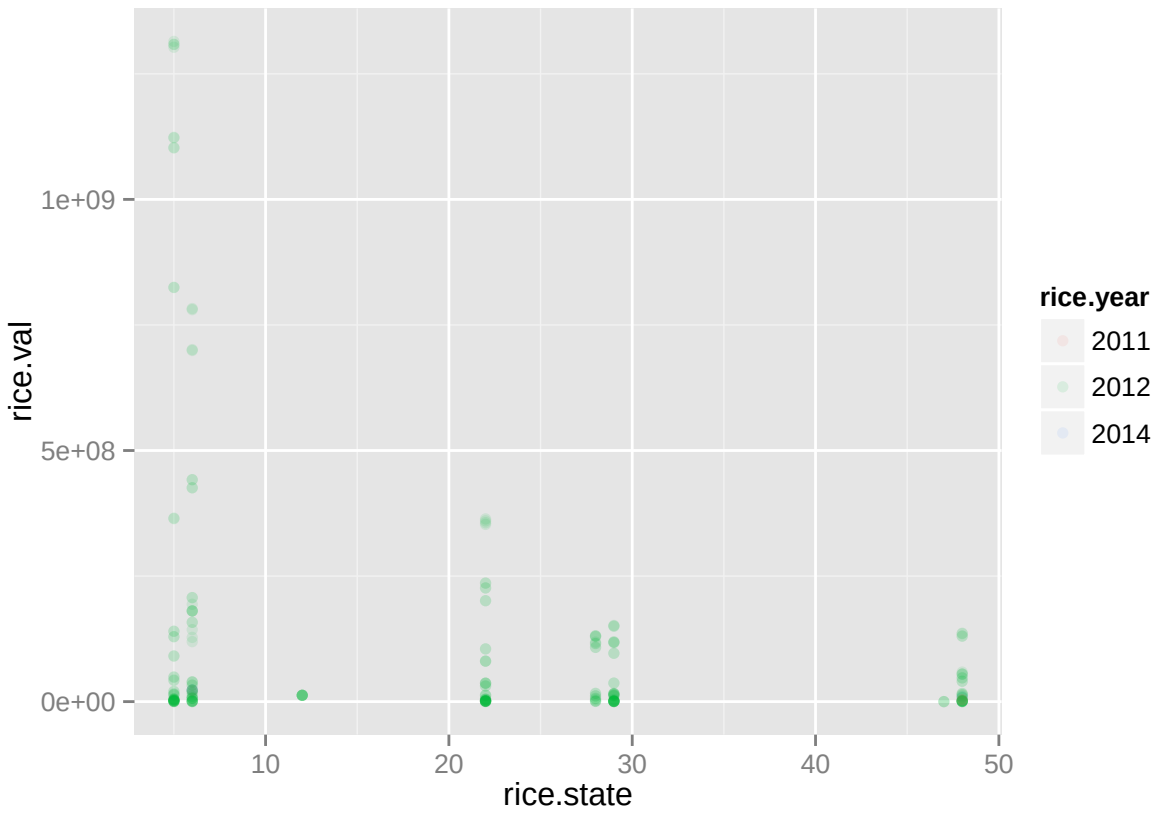



```
qplot(corn.state, corn.val, data = corn1, color=corn.year, alpha = I(1/10))
```

```
## Warning: Removed 3 rows containing missing values (geom_point).
```

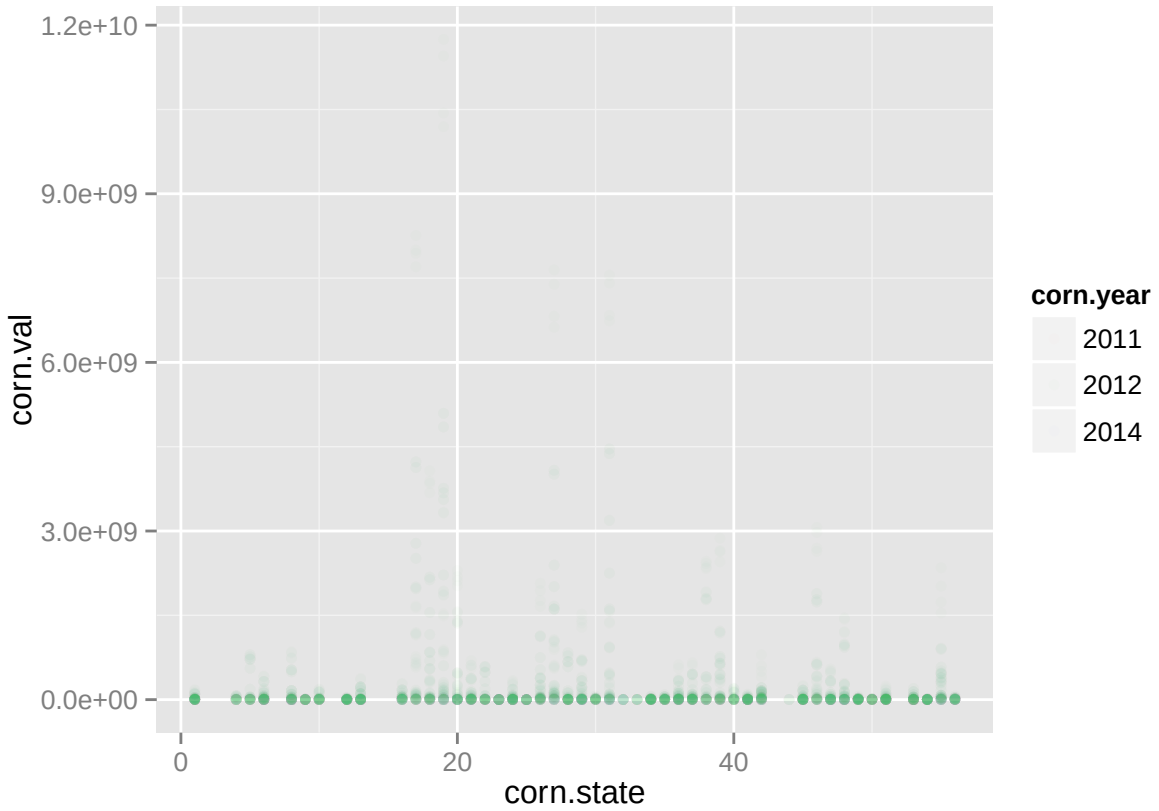



```
qplot(rice.state, rice.val, data = rice1, color=rice.year, alpha = I(1/10))
```

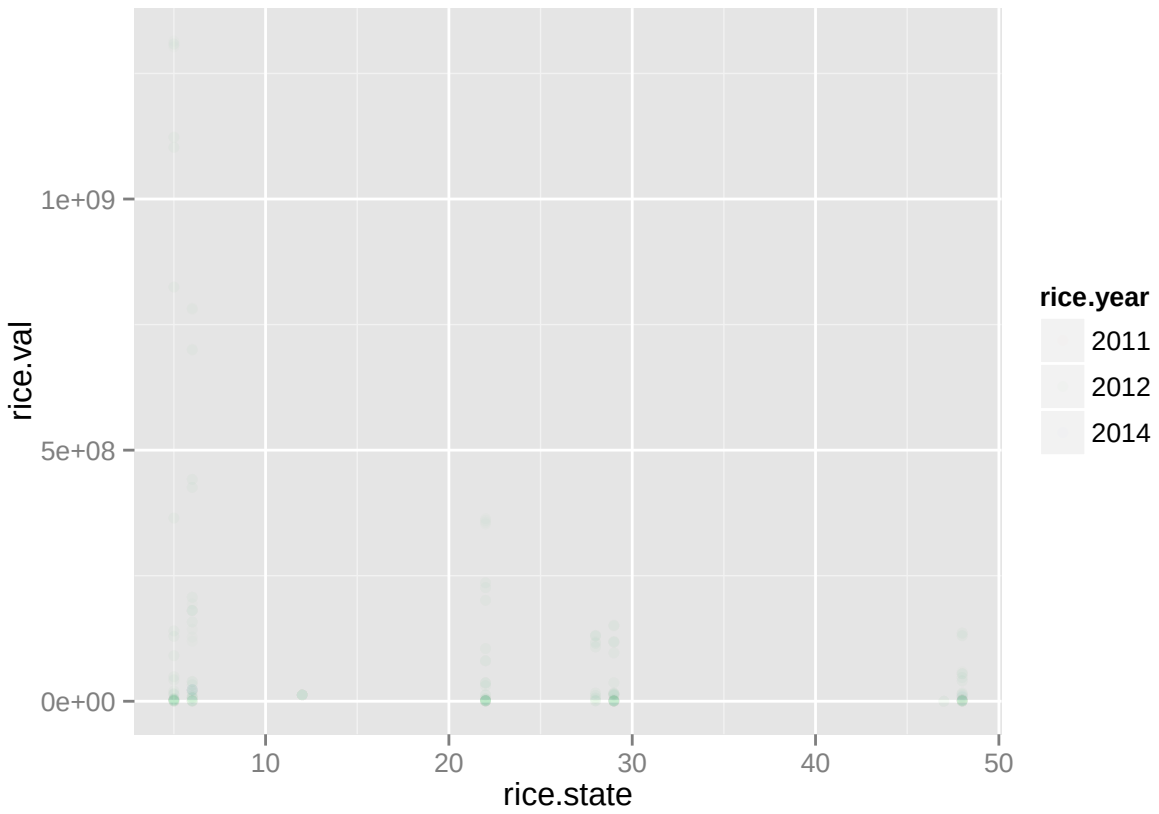


```r
qplot(corn.state, corn.val, data = corn1, color=corn.year, alpha = I(1/100))
```

```
## Warning: Removed 3 rows containing missing values (geom_point).
```

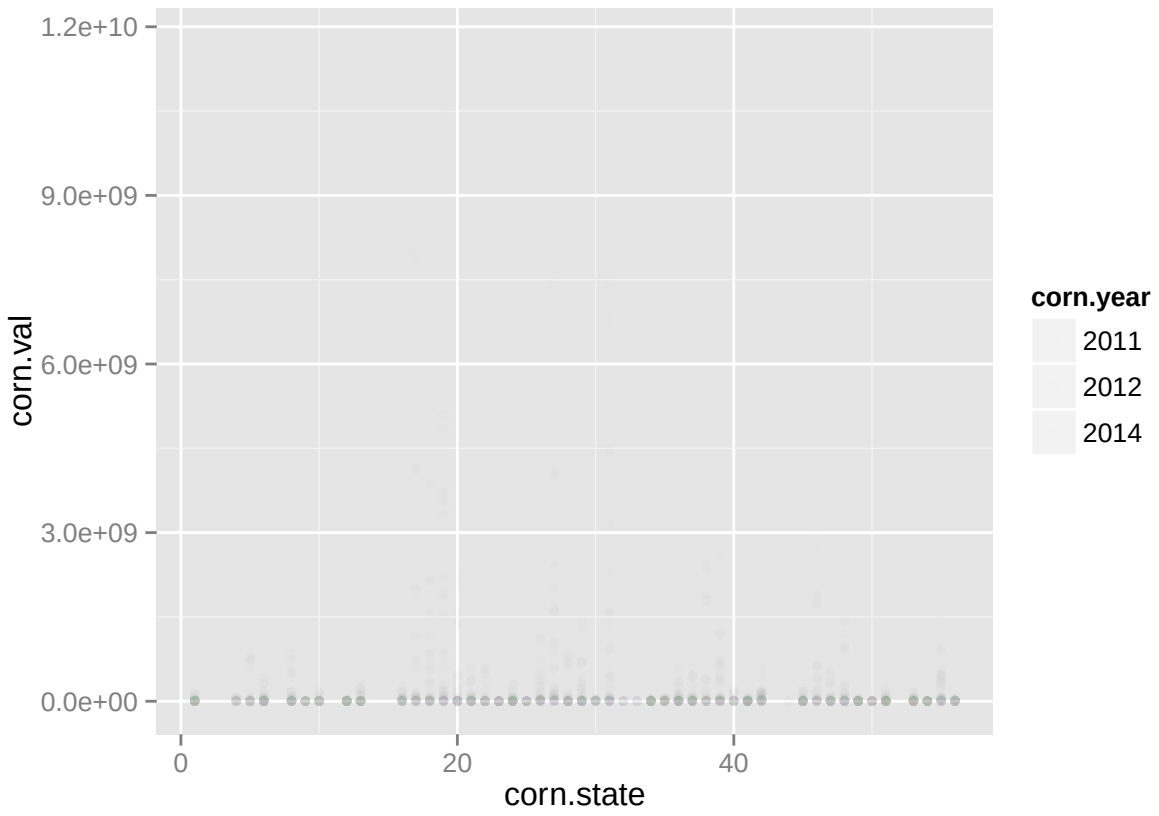



```r
qplot(rice.state, rice.val, data = rice1, color=rice.year, alpha = I(1/100))
```

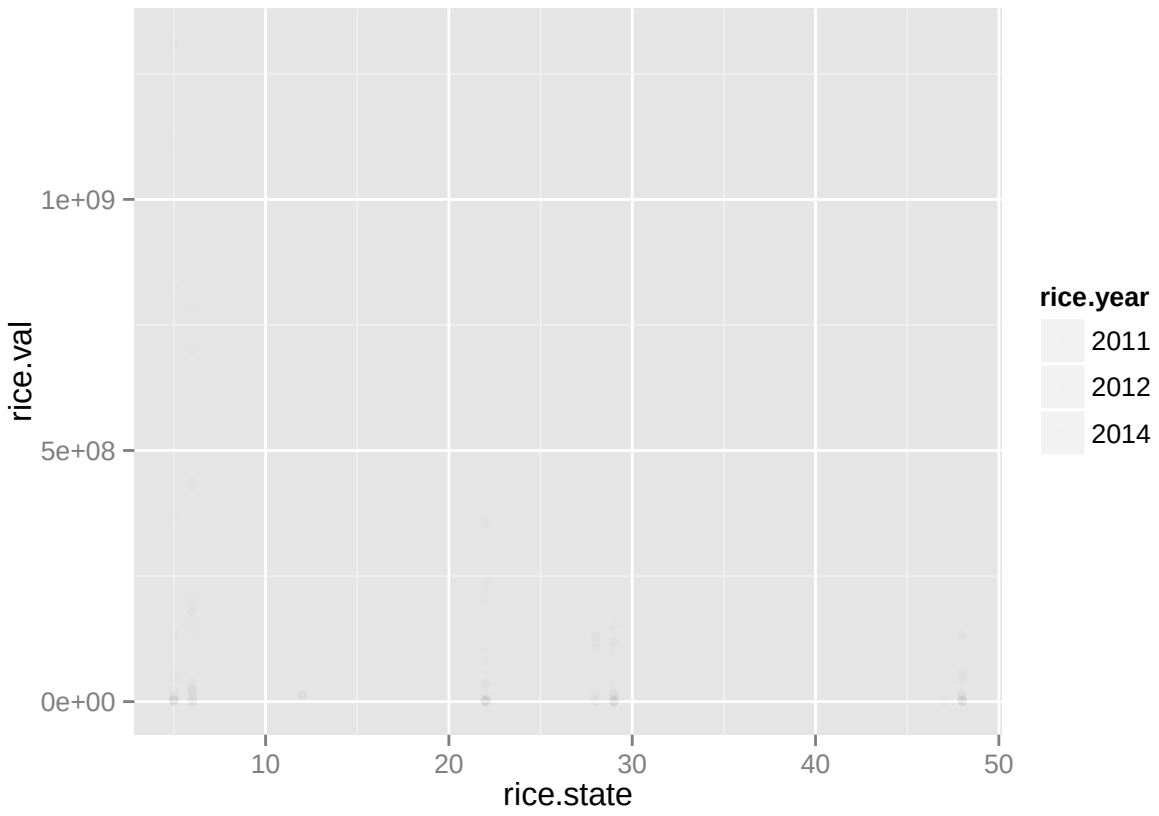



```
qplot(corn.state, corn.val, data = corn1, color=corn.year, alpha = I(1/200))
```

```
## Warning: Removed 3 rows containing missing values (geom_point).
```

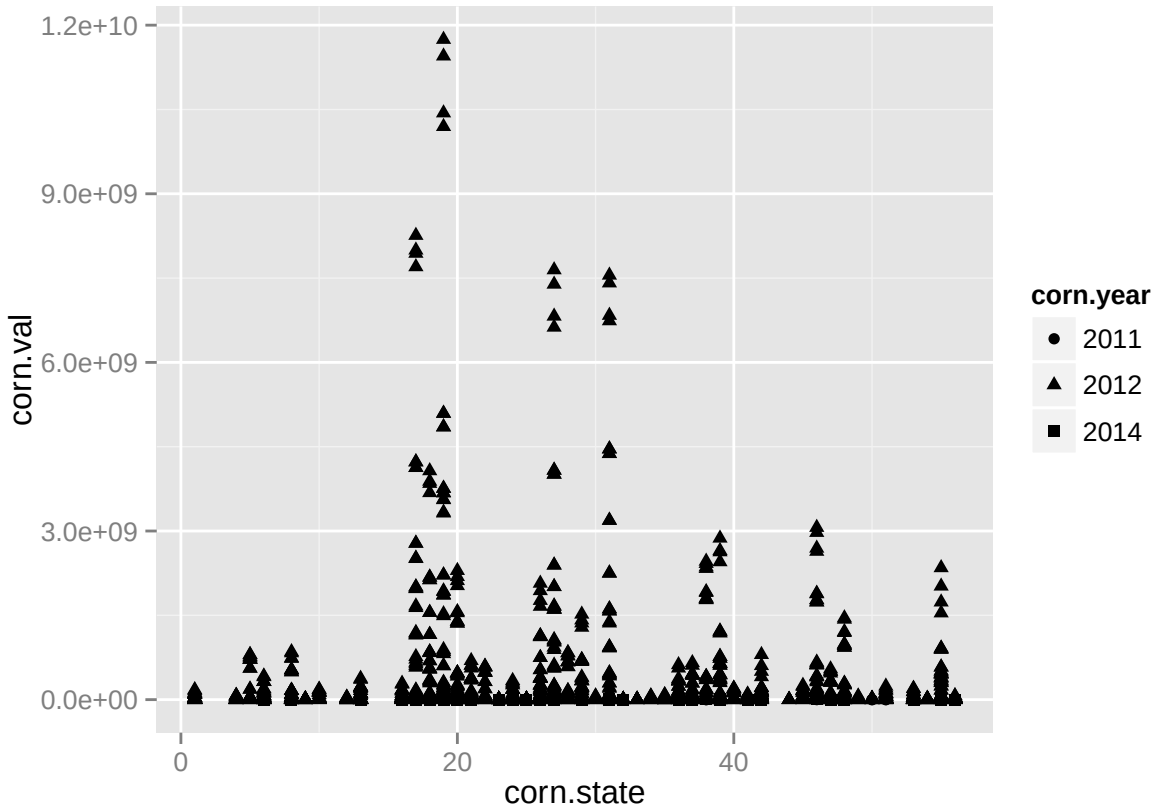



```
qplot(rice.state, rice.val, data = rice1, color=rice.year, alpha = I(1/200))
```

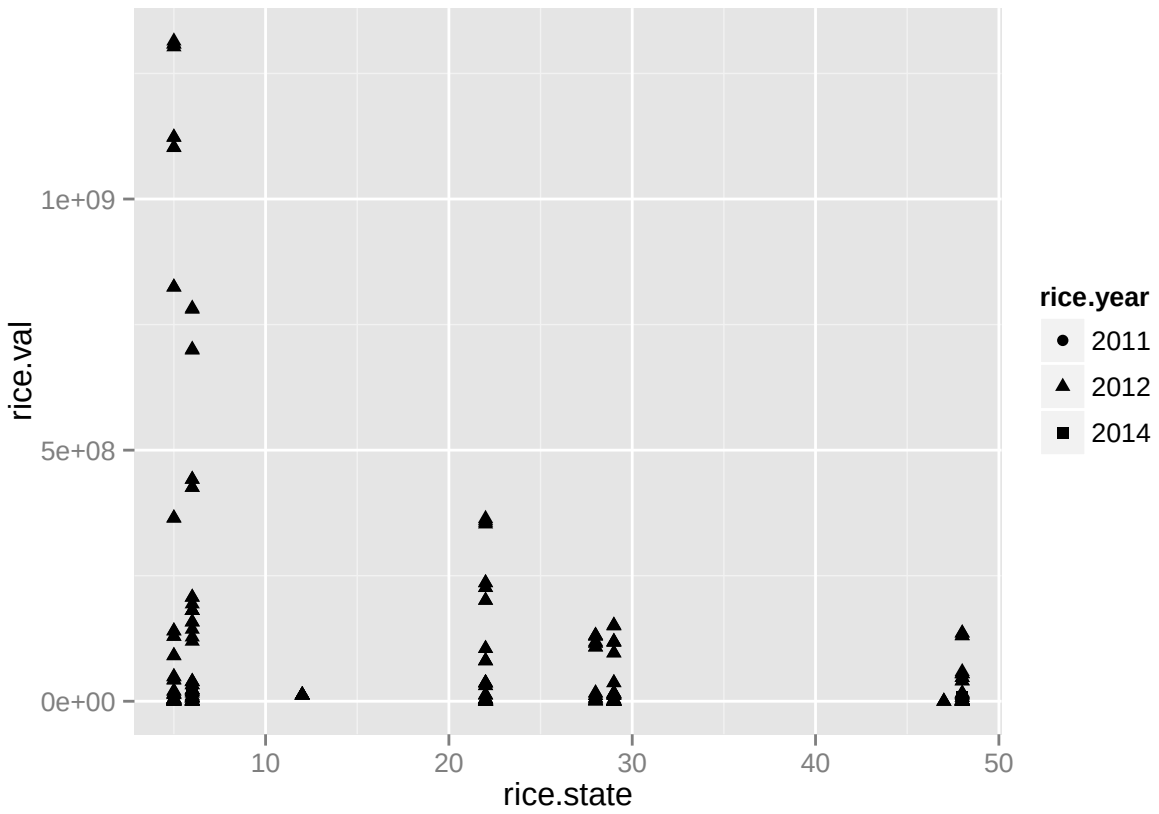


```r
qplot(x=corn.state, y = corn.val, data = corn1, shape=corn.year)
```

```
## Warning: Removed 3 rows containing missing values (geom_point).
```




```r
qplot(x=rice.state, y = rice.val, data = rice1, shape=rice.year)
```




```r
# the counts of values in separate years
qplot(corn.val, data=corn1, facets=corn.year~.,geom="histogram")
```

```
## stat_bin: binwidth defaulted to range/30. Use 'binwidth = x' to adjust this.
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## stat_bin: binwidth defaulted to range/30. Use 'binwidth = x' to adjust this.
```

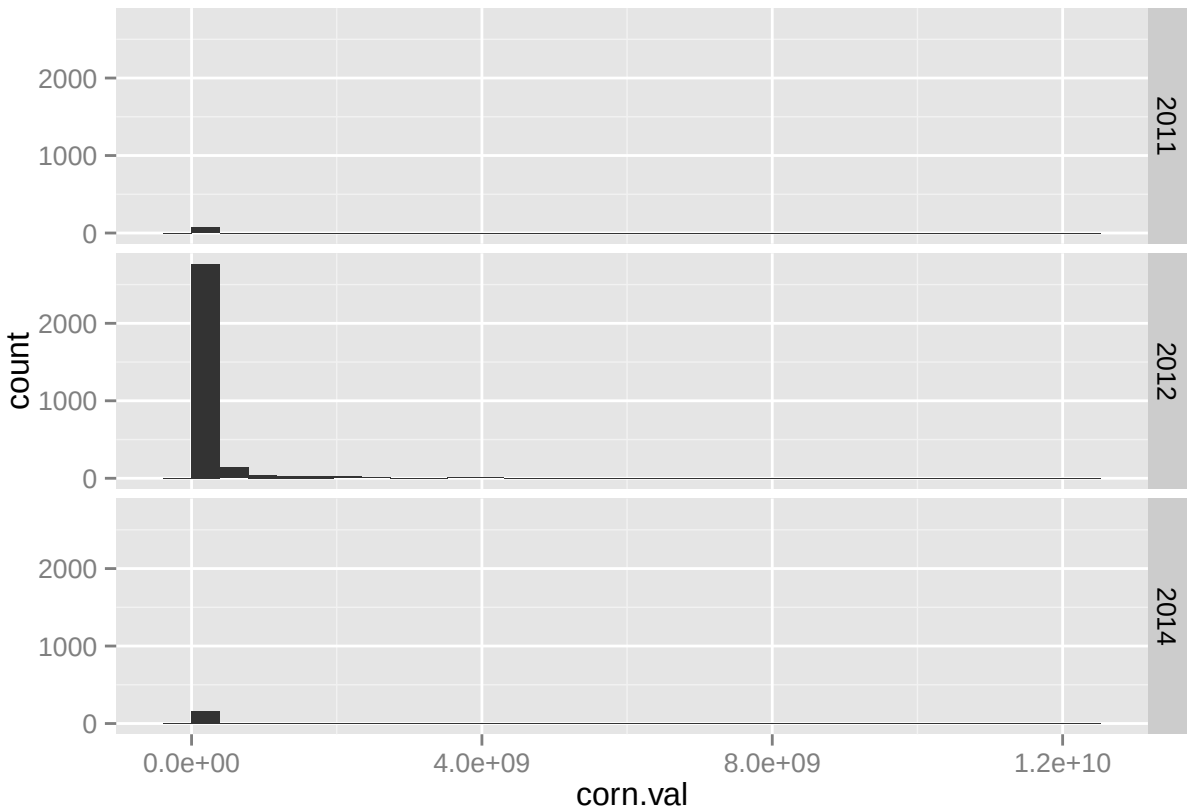


```r
qplot(rice.val, data=rice1, facets=rice.year~., geom="histogram")
```

```
## stat_bin: binwidth defaulted to range/30. Use 'binwidth = x' to adjust this.
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```

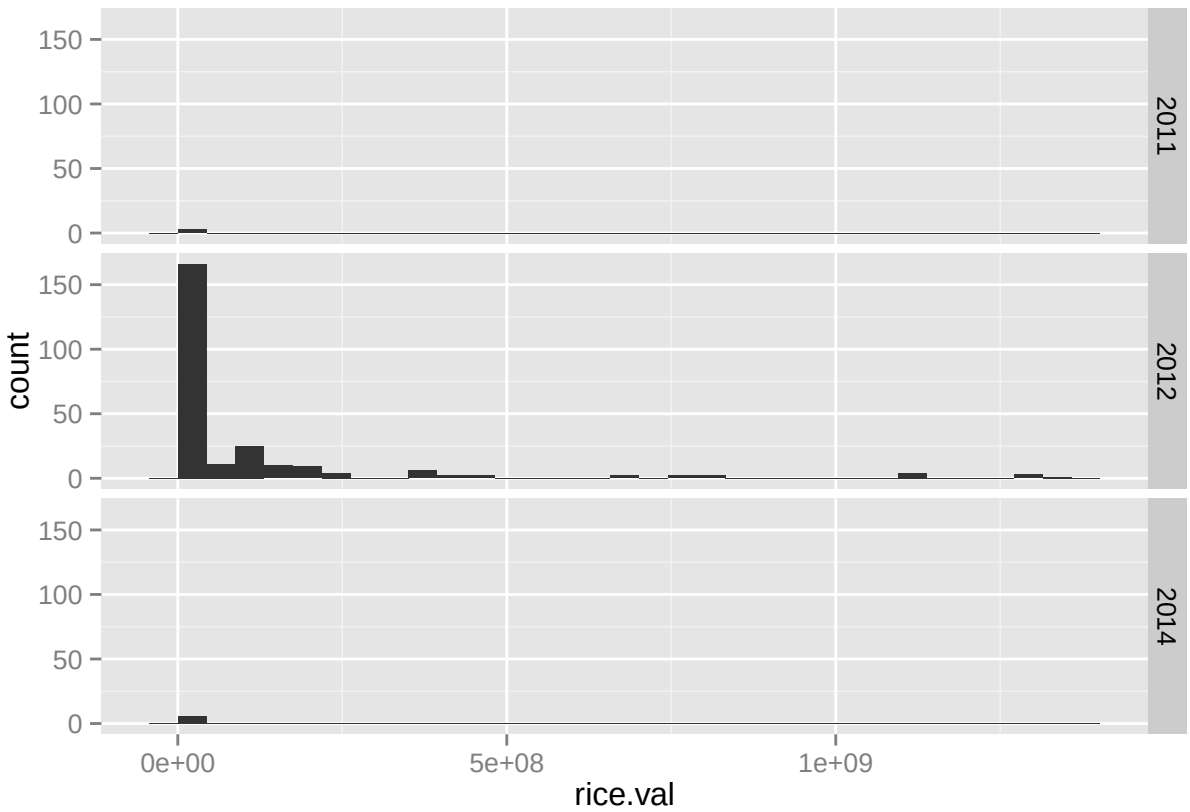


```
p1 <- qplot(corn.val, data=corn1, geom="histogram")
# counts of corn values of different years
p1+facet_wrap(~corn.year)
```

```
## stat_bin: binwidth defaulted to range/30. Use 'binwidth = x' to adjust this.
## stat_bin: binwidth defaulted to range/30. Use 'binwidth = x' to adjust this.
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```

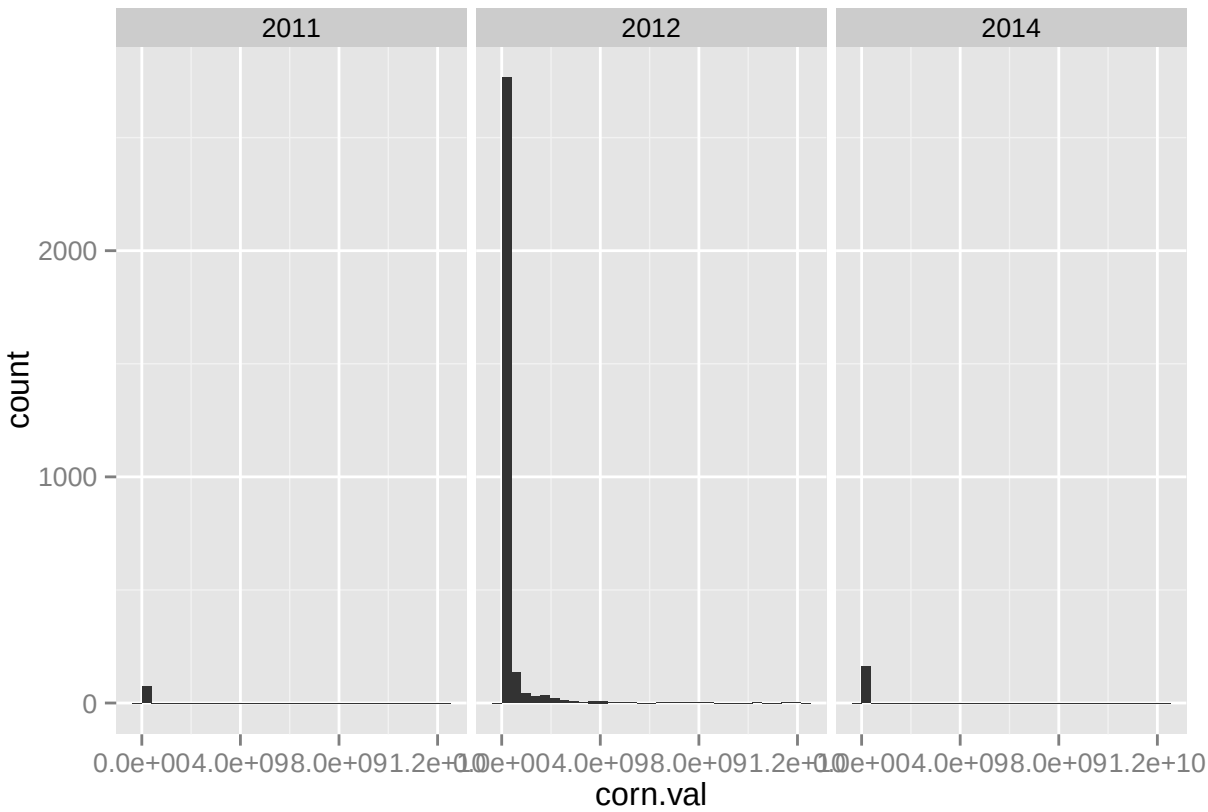


```
# counts of corn values of different states
p1+facet_grid(~corn.state)
```

```
## stat_bin: binwidth defaulted to range/30. Use 'binwidth = x' to adjust this.
## stat_bin: binwidth defaulted to range/30. Use 'binwidth = x' to adjust this.
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```
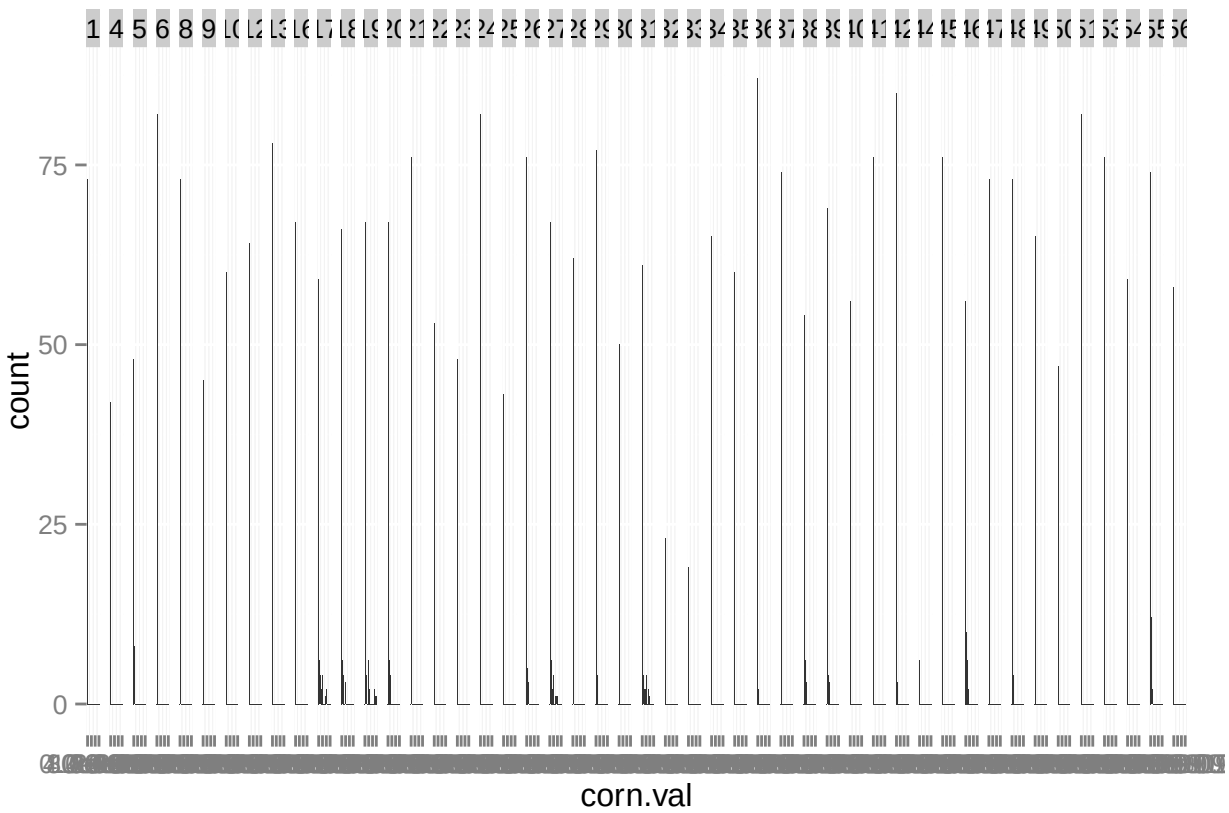
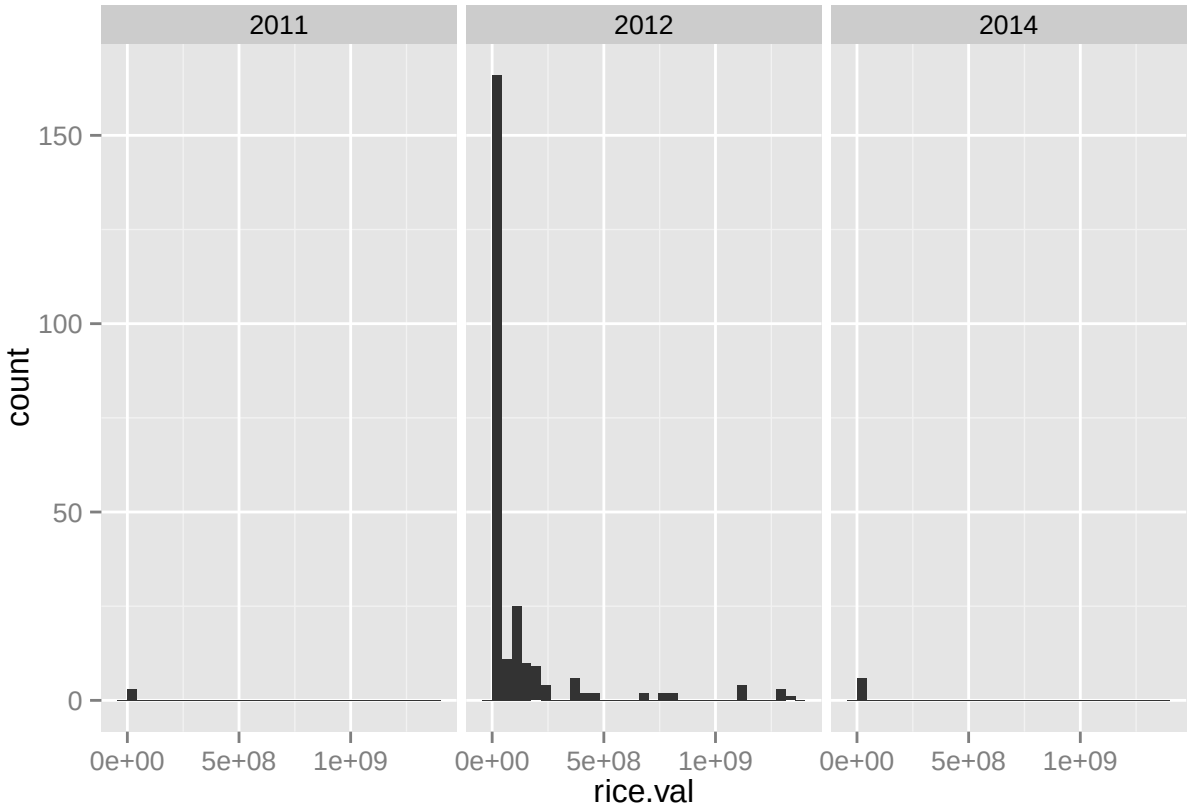




```r
p2 <- qplot(rice.val, data=rice1, geom="histogram")
# counts of rice values of different years
p2+facet_wrap(~rice.year)
```

```
## stat_bin: binwidth defaulted to range/30. Use 'binwidth = x' to adjust this.
## stat_bin: binwidth defaulted to range/30. Use 'binwidth = x' to adjust this.
## stat_bin: binwidth defaulted to range/30. Use 'binwidth = x' to adjust this.
```




```
# counts of rice values of different states
p2+facet_grid(~rice.state)
```

```
## stat_bin: binwidth defaulted to range/30. Use 'binwidth = x' to adjust this.
## stat_bin: binwidth defaulted to range/30. Use 'binwidth = x' to adjust this.
## stat_bin: binwidth defaulted to range/30. Use 'binwidth = x' to adjust this.
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```
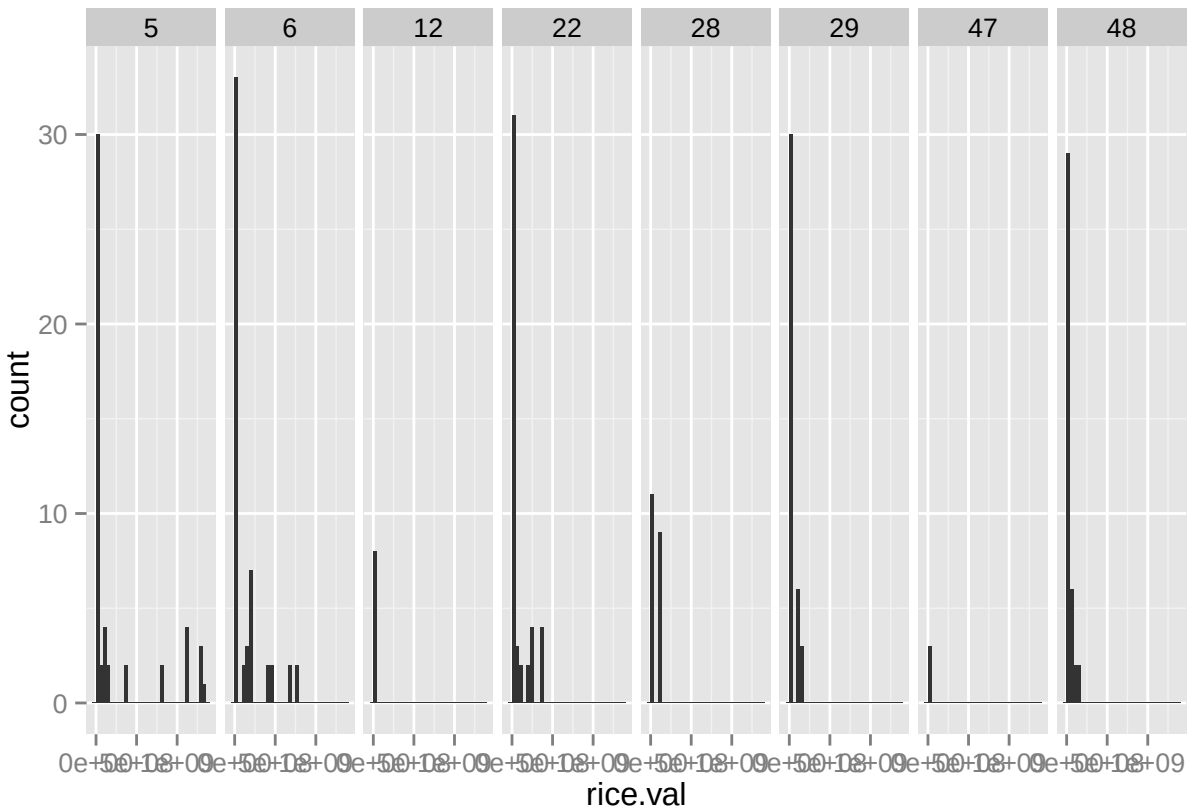
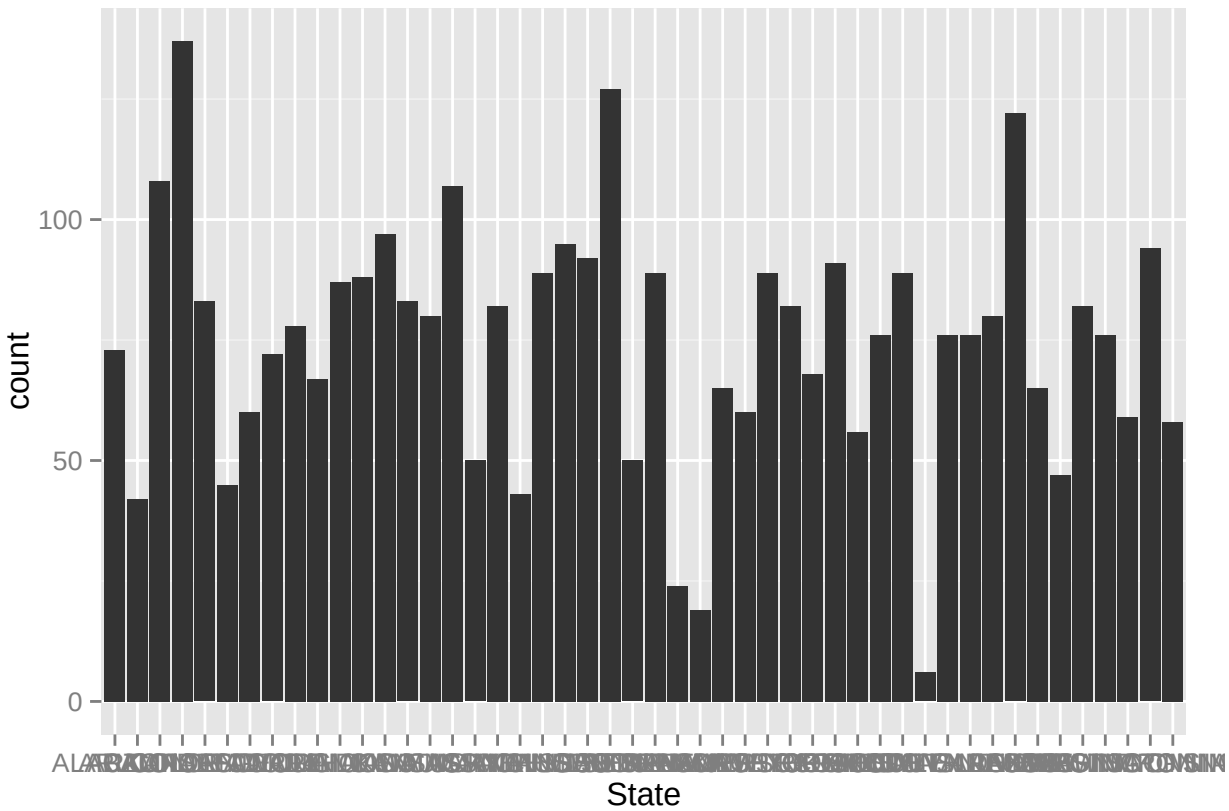
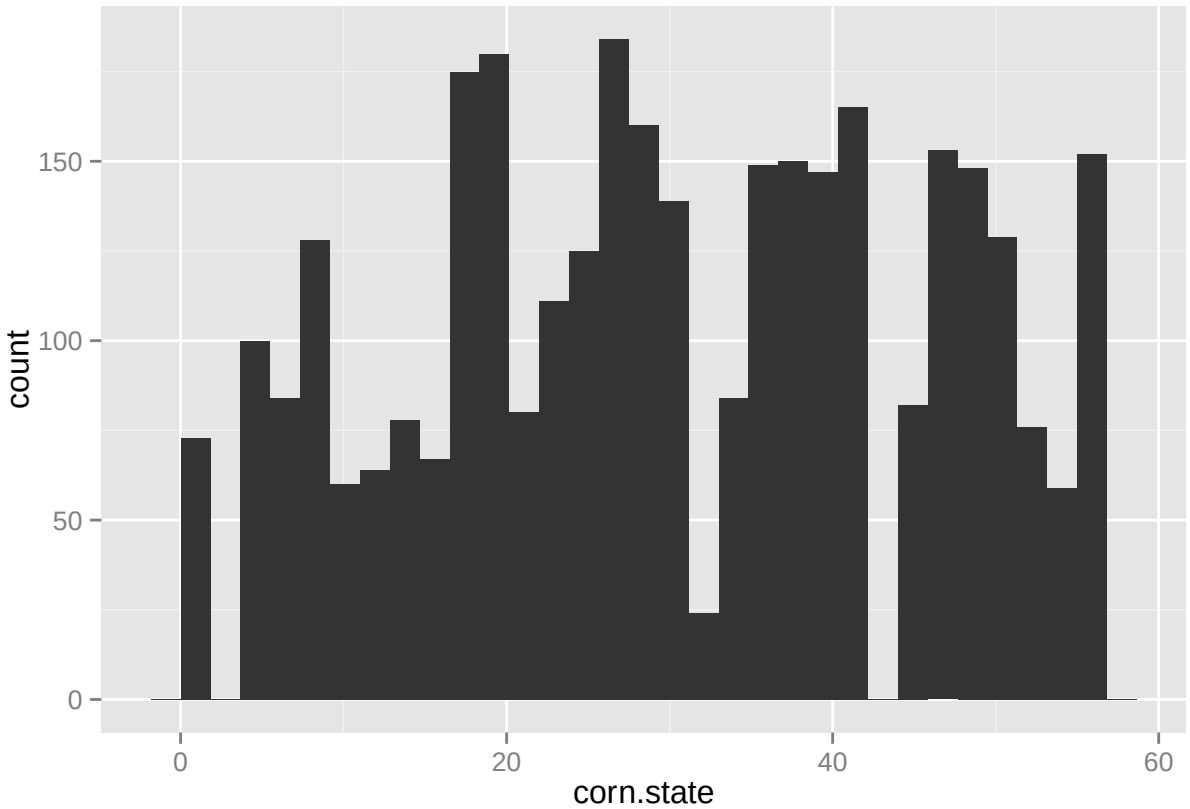




```
ggplot(data, aes(x = State)) + geom_bar()
```



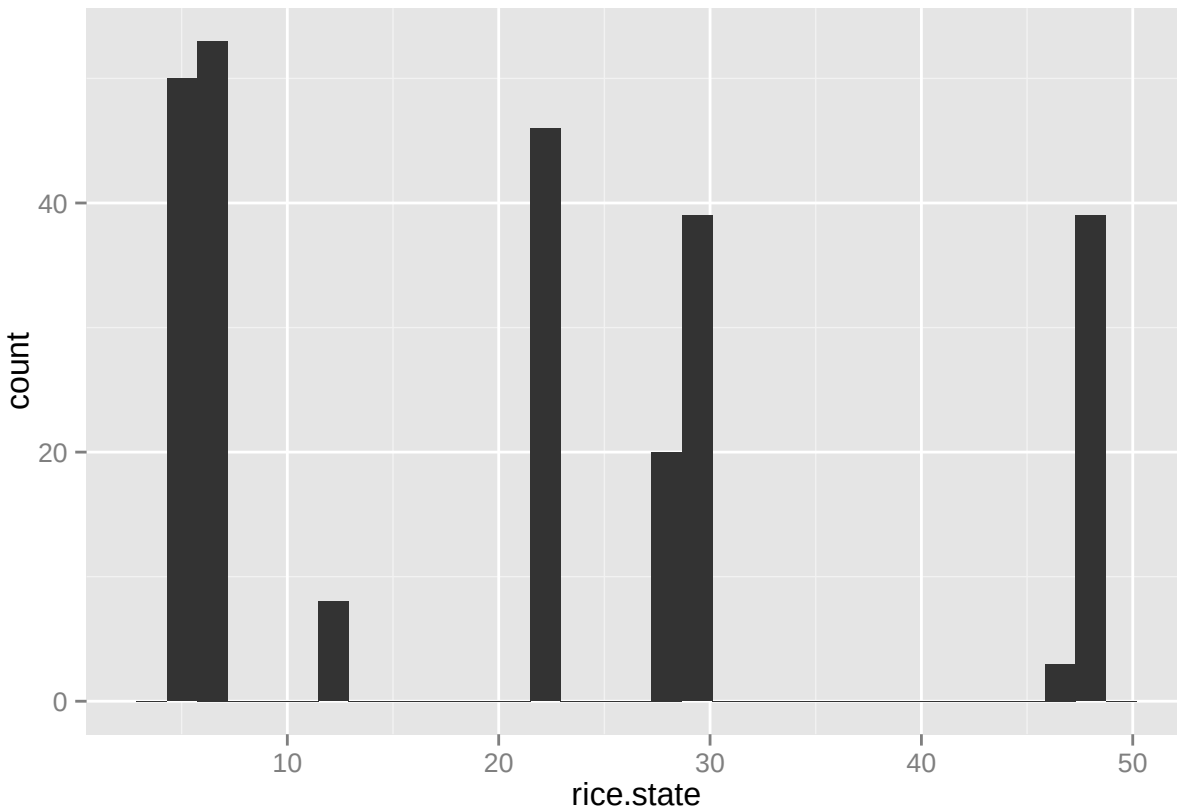
```r
ggplot(corn1, aes(x = corn.state)) + geom_bar()
```

```
## stat_bin: binwidth defaulted to range/30. Use 'binwidth = x' to adjust this.
```




```r
ggplot(rice1, aes(x = rice.state)) + geom_bar()
```

```
## stat_bin: binwidth defaulted to range/30. Use 'binwidth = x' to adjust this.
```

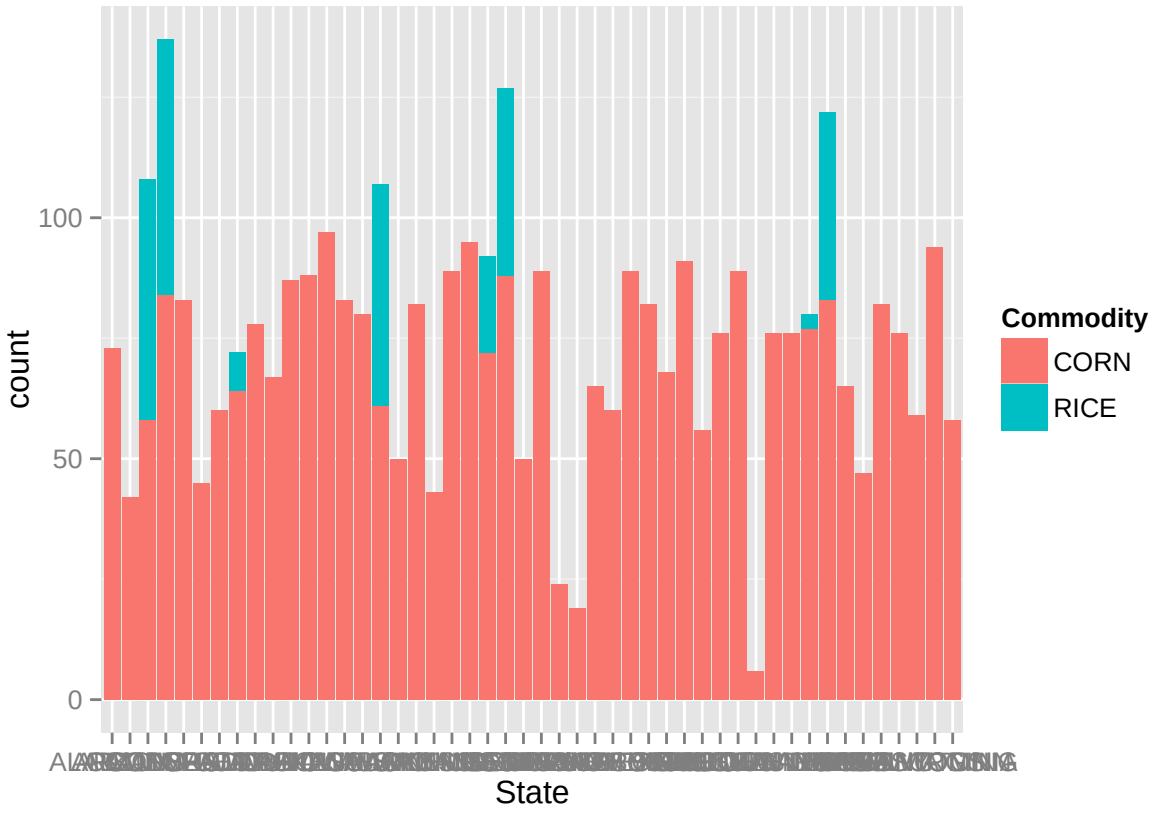



```r
# use bar chart to display two categorical variables
# now we see the corn and rice counts for each state
with(data, table(Commodity, State))
```

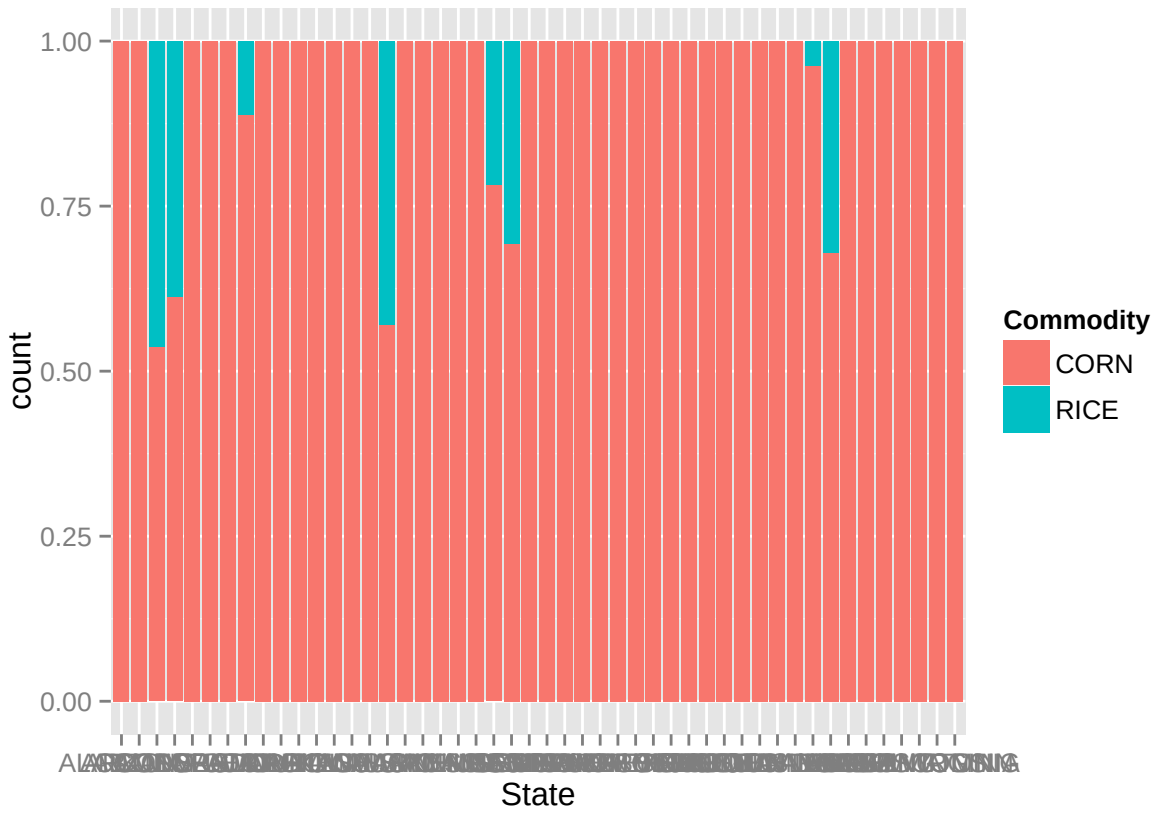
```
##          State
## Commodity ALABAMA ARIZONA ARKANSAS CALIFORNIA COLORADO CONNECTICUT
##      CORN      73      42       58         84       83          45
##      RICE       0       0       50         53        0           0
##          State
## Commodity DELAWARE FLORIDA GEORGIA HAWAII IDAHO ILLINOIS INDIANA IOWA
##      CORN       60      64      78      0    67       87      88   97
##      RICE        0       8       0      0     0        0       0    0
##          State
## Commodity KANSAS KENTUCKY LOUISIANA MAINE MARYLAND MASSACHUSETTS MICHIGAN
##      CORN     83       80        61    50       82            43       89
##      RICE      0        0        46     0        0             0        0
##          State
## Commodity MINNESOTA MISSISSIPPI MISSOURI MONTANA NEBRASKA NEVADA
##      CORN        95          72       88      50       89     24
##      RICE         0          20       39       0        0      0
##          State
## Commodity NEW HAMPSHIRE NEW JERSEY NEW MEXICO NEW YORK NORTH CAROLINA
##      CORN             19         65         60       89             82
##      RICE              0          0          0        0              0
##          State
## Commodity NORTH DAKOTA OHIO OKLAHOMA OREGON PENNSYLVANIA RHODE ISLAND
##      CORN           68   91       56     76           89            6
##      RICE            0    0        0      0            0            0
```

```
##          State
## Commodity SOUTH CAROLINA SOUTH DAKOTA TENNESSEE TEXAS UTAH VERMONT
##      CORN             76           76        77    83   65      47
##      RICE              0            0         3    39    0       0
##          State
## Commodity VIRGINIA WASHINGTON WEST VIRGINIA WISCONSIN WYOMING
##      CORN       82         76            59        94      58
##      RICE        0          0             0         0       0
```

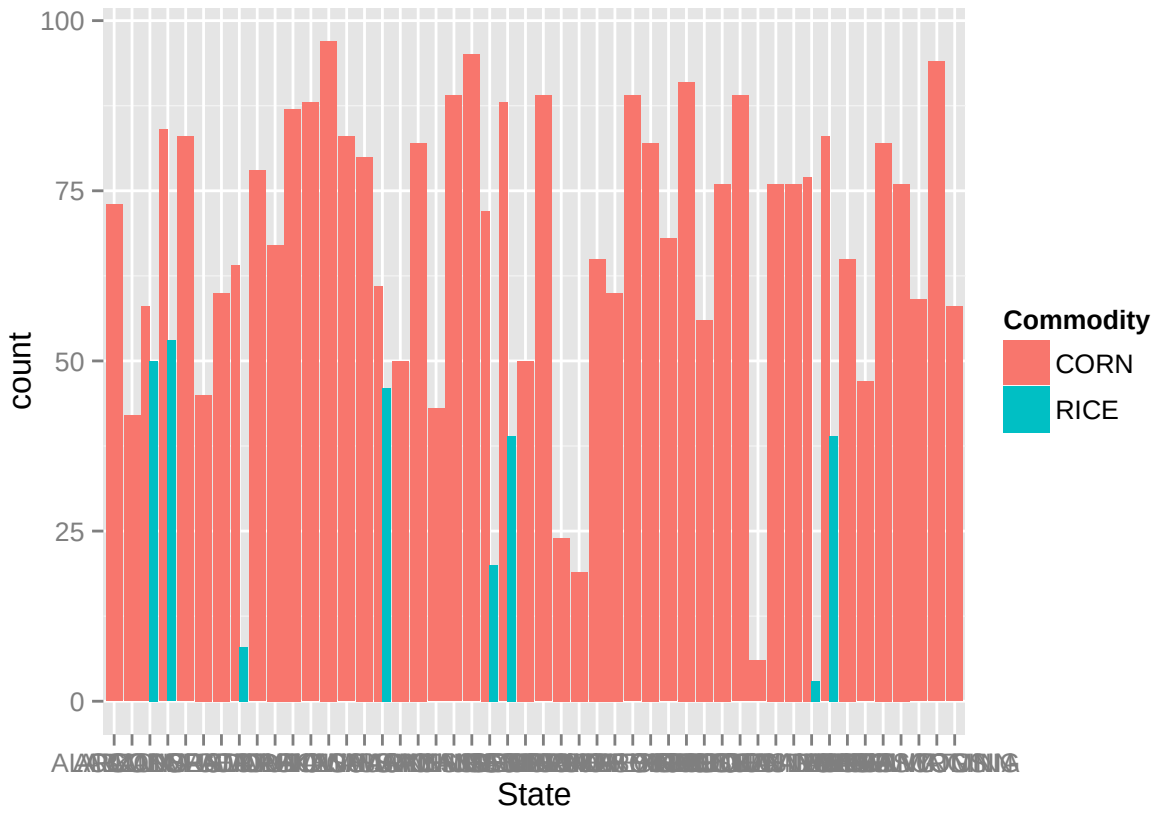
```r
ggplot(data, aes(x = State, fill = Commodity)) + geom_bar()
```




```r
# look at the proportion of corn and rice in each state
ggplot(data, aes(x = State, fill = Commodity)) + geom_bar(position = "fill")
```




```r
# have separate bars for each commodity
ggplot(data, aes(x = State, fill = Commodity)) + geom_bar(position = "dodge")
```



```r
# transform ANSI into quantitative variable
# histogram of count of observations in each state
as.numeric(as.character(data$State.ANSI))
```

```
##    [1]  6  6  6  6  6  6  6  6  6  6  6  6  8  8  8  8  8  8  8  8 13 13 16
##   [24] 16 16 16 17 17 17 17 18 18 18 18 18 19 19 19 19 19 19 19 19 19 19 20
##   [47] 20 20 20 20 20 21 21 21 21 23 23 23 23 23 24 24 24 24 24 24 25 25 26
##   [70] 26 26 26 26 26 27 27 27 27 27 27 27 27 27 27 29 29 29 29 29 29 29 29
##   [93] 29 29 31 31 31 31 31 31 31 31 31 31 32 32 32 32 36 36 36 36 36 36 36
##  [116] 36 37 37 38 38 39 39 39 39 39 41 41 41 41 41 41 42 42 42 42 42 42 46
##  [139] 46 47 47 47 47 48 48 48 48 48 48 48 48 48 48 53 53 55 55 55 55 55 55
##  [162] 55 55 55 55 56 56 56 56  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1
##  [185]  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1
##  [208]  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1  1
##  [231]  1  1  1  1  1  1  1  1  1  1  1  1  4  4  4  4  4  4  4  4  4  4  4
##  [254]  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4  4
##  [277]  4  4  4  4  4  4  4  4  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5
##  [300]  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5
##  [323]  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5
##  [346]  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5
##  [369]  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5  5
##  [392]  5  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6
##  [415]  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6
##  [438]  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6
##  [461]  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6
##  [484]  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6  6
##  [507]  6  6  6  6  6  6  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8  8
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##  [622]  9  9  9  9  9  9  9 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10
##  [645] 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10
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##  [921] 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17
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##  [967] 17 17 17 17 17 17 17 17 17 17 17 17 17 18 18 18 18 18 18 18 18 18 18
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## [1243] 21 21 21 21 21 21 21 21 21 21 21 21 21 21 21 21 21 21 21 21 21 21 21
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## [3037] 48 48 48 48 48 48 48 48 48 48 48 48 48 48 48 48 48 48 48 48 49 49
## [3060] 49 49 49 49 49 49 49 49 49 49 49 49 49 49 49 49 49 49 49 49 49 49 49
## [3083] 49 49 49 49 49 49 49 49 49 49 49 49 49 49 49 49 49 49 49 49 49 49 49
## [3106] 49 49 49 49 49 49 49 49 49 49 49 49 49 49 49 49 49 50 50 50 50 50 50
## [3129] 50 50 50 50 50 50 50 50 50 50 50 50 50 50 50 50 50 50 50 50 50 50 50
## [3152] 50 50 50 50 50 50 50 50 50 50 50 50 50 50 50 50 50 51 51 51 51 51 51 51
## [3175] 51 51 51 51 51 51 51 51 51 51 51 51 51 51 51 51 51 51 51 51 51 51 51
## [3198] 51 51 51 51 51 51 51 51 51 51 51 51 51 51 51 51 51 51 51 51 51 51 51
## [3221] 51 51 51 51 51 51 51 51 51 51 51 51 51 51 51 51 51 51 51 51 51 51 51
## [3244] 51 51 51 51 53 53 53 53 53 53 53 53 53 53 53 53 53 53 53 53 53 53 53
## [3267] 53 53 53 53 53 53 53 53 53 53 53 53 53 53 53 53 53 53 53 53 53 53 53
## [3290] 53 53 53 53 53 53 53 53 53 53 53 53 53 53 53 53 53 53 53 53 53 53 53
## [3313] 53 53 53 53 53 54 54 54 54 54 54 54 54 54 54 54 54 54 54 54 54 54 54
## [3336] 54 54 54 54 54 54 54 54 54 54 54 54 54 54 54 54 54 54 54 54 54 54 54
## [3359] 54 54 54 54 54 54 54 54 54 54 54 54 54 54 54 54 54 55 55 55 55 55
## [3382] 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55
## [3405] 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55
## [3428] 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55
## [3451] 55 55 55 55 55 55 56 56 56 56 56 56 56 56 56 56 56 56 56 56 56 56 56
## [3474] 56 56 56 56 56 56 56 56 56 56 56 56 56 56 56 56 56 56 56 56 56 56 56
## [3497] 56 56 56 56 56 56 56 56 56 56 56 56 56 56  6  6  6  6  6  8  8  8  8
## [3520] 17 17 17 18 18 18 19 19 19 19 19 20 21 21 23 23 24 24 26 26 26 27 27
## [3543] 27 27 27 29 31 31 31 36 36 36 37 38 38 39 39 39 39 39 41 41 41 42 42
## [3566] 42 46 46 48 48 48 48 50 50 51 51 53 53 53 53 55 55 55 55
```
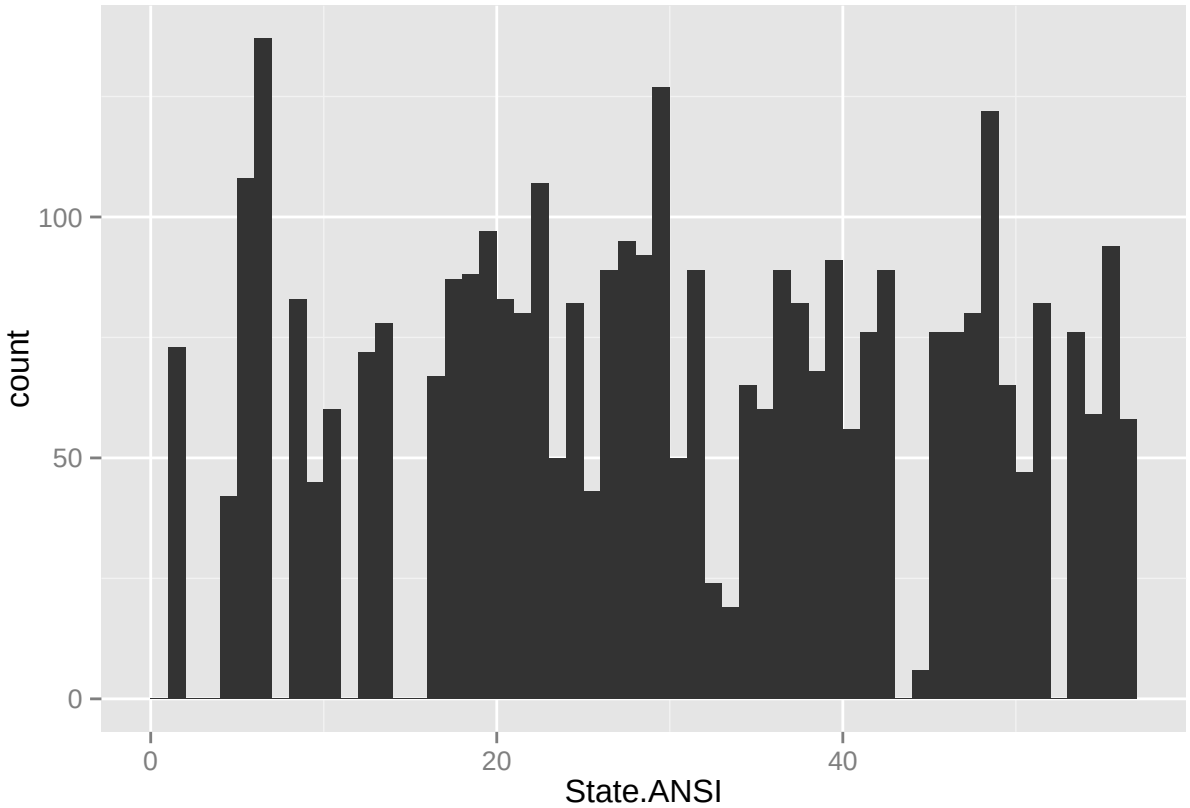
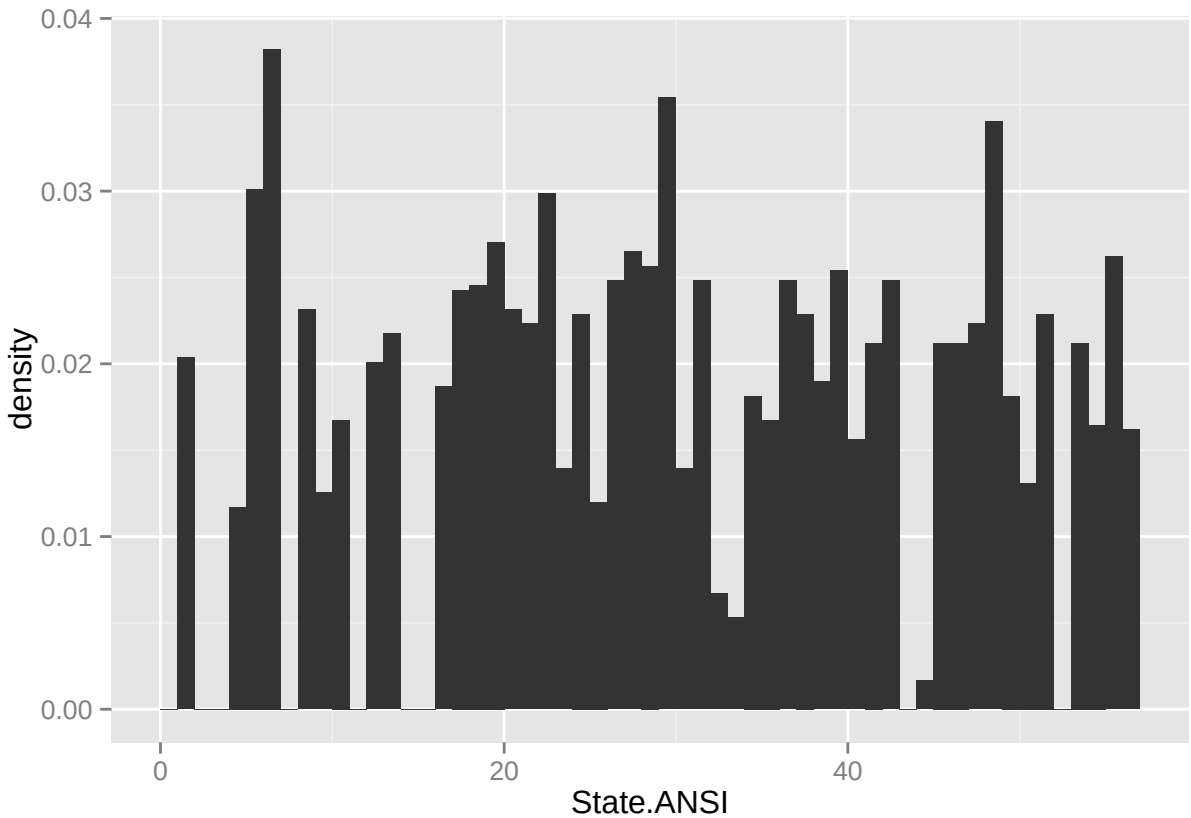
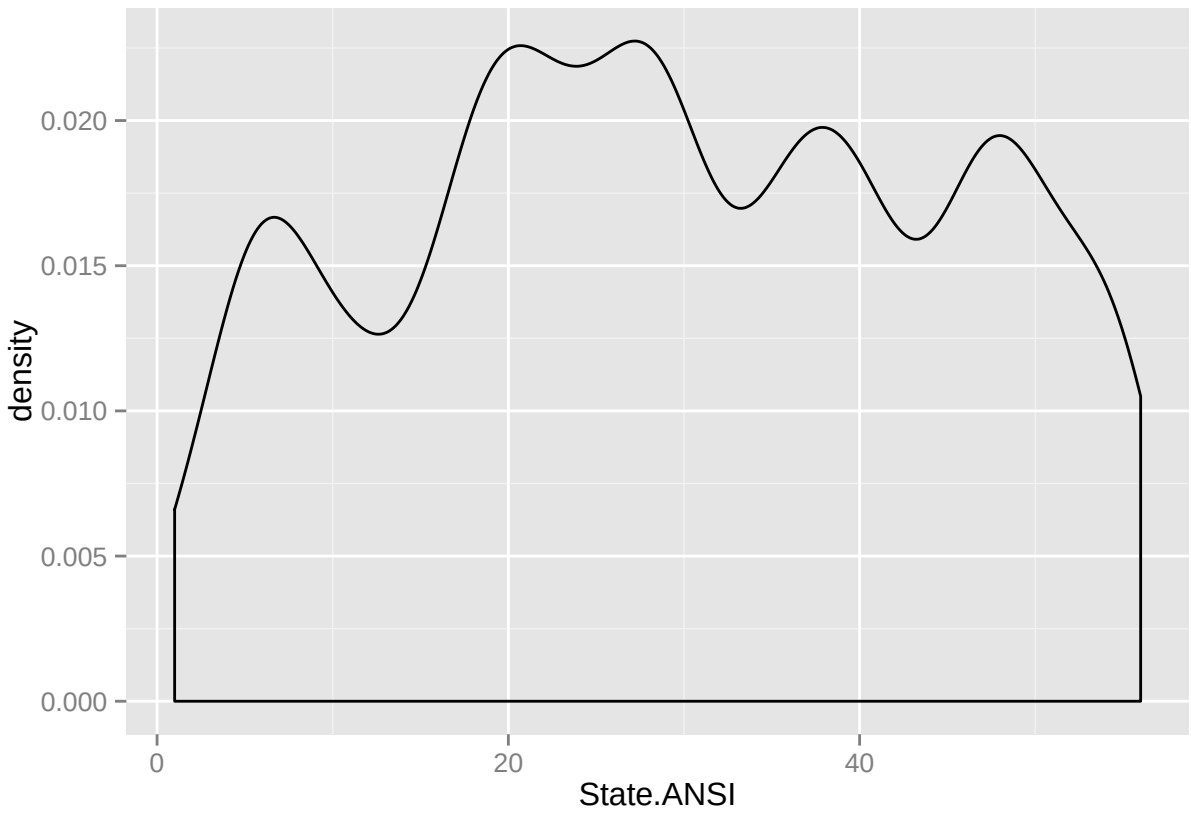

```r
ggplot(data, aes(x = State.ANSI)) + geom_histogram(binwidth=1)
```



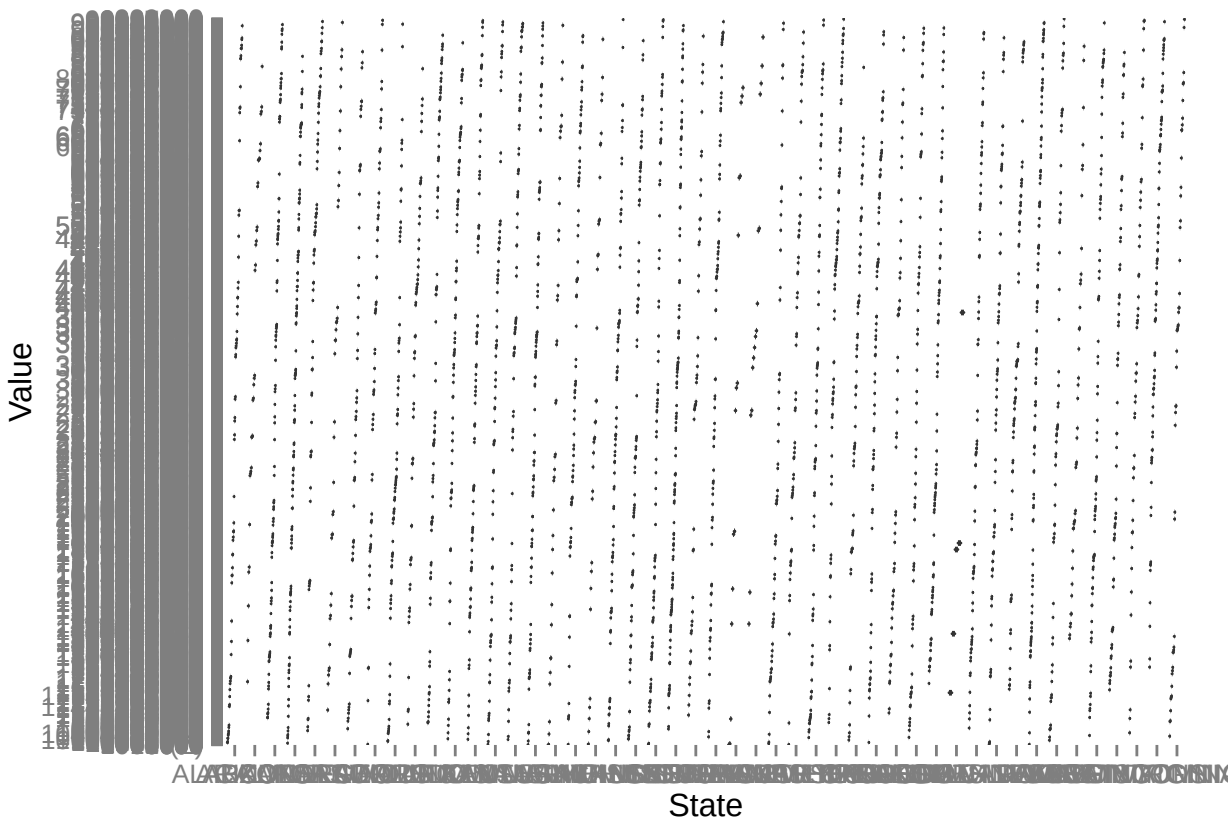

```r
# present the histogram in a way that makes the total area equals to 1
ggplot(data, aes(x = State.ANSI)) + geom_histogram(binwidth=1, aes(y = ..density..))
```



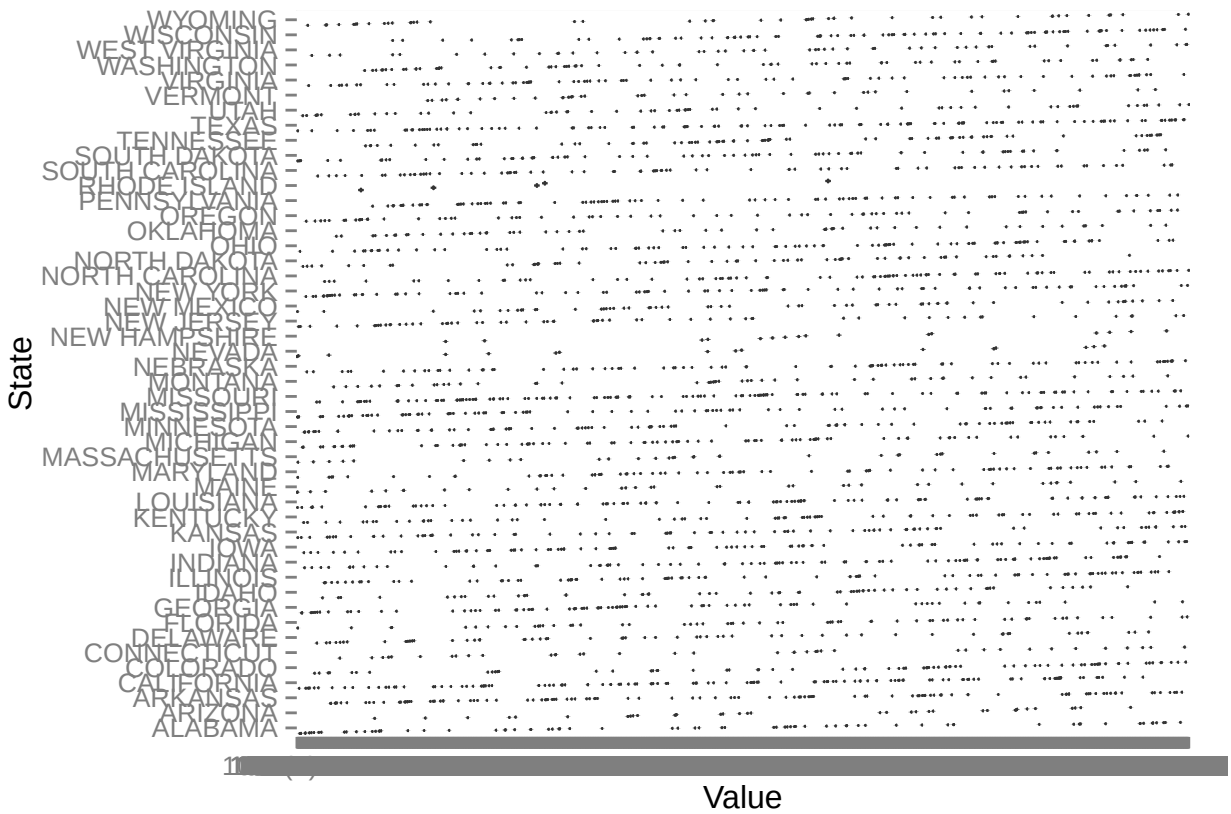

```r
# use density plot to produce smooth graph
ggplot(data, aes(x = State.ANSI)) + geom_density()
```



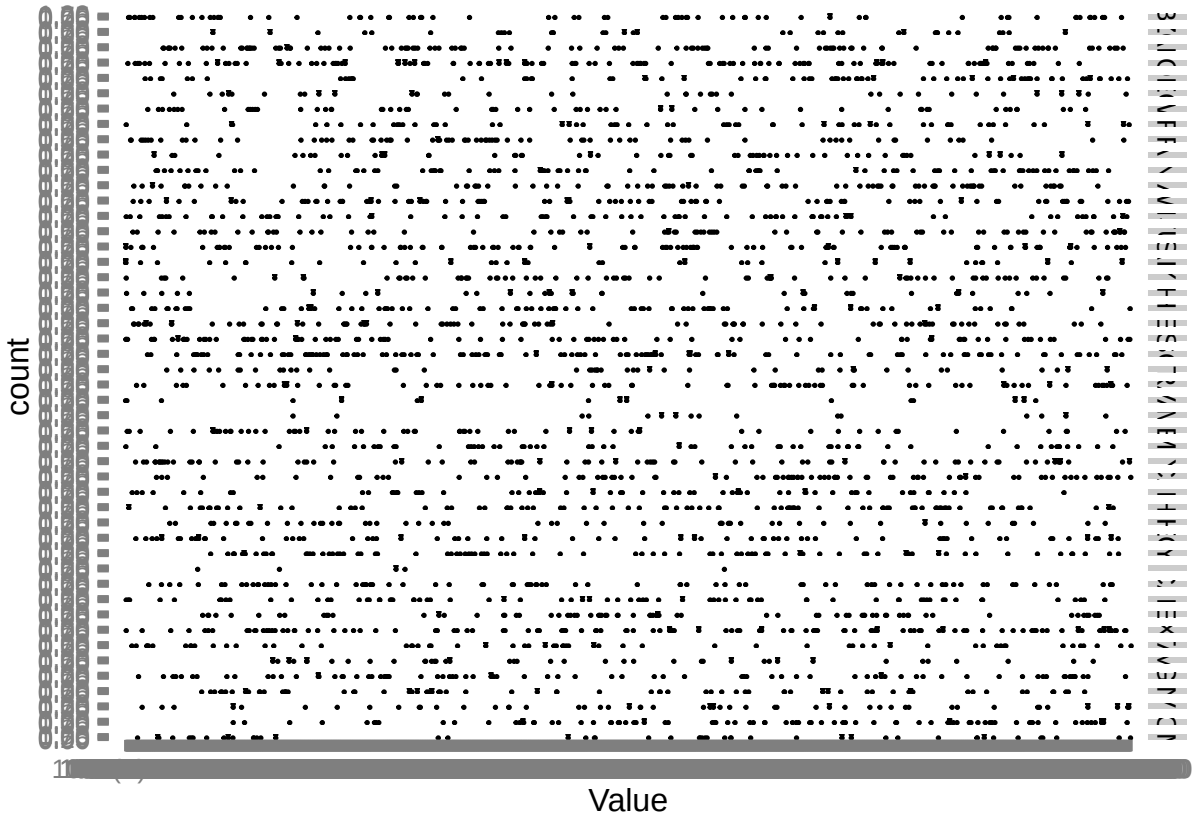

```r
# use box and whisker plot for comparing two distributions
ggplot(data, aes(x = State, y = Value)) + geom_boxplot()
```



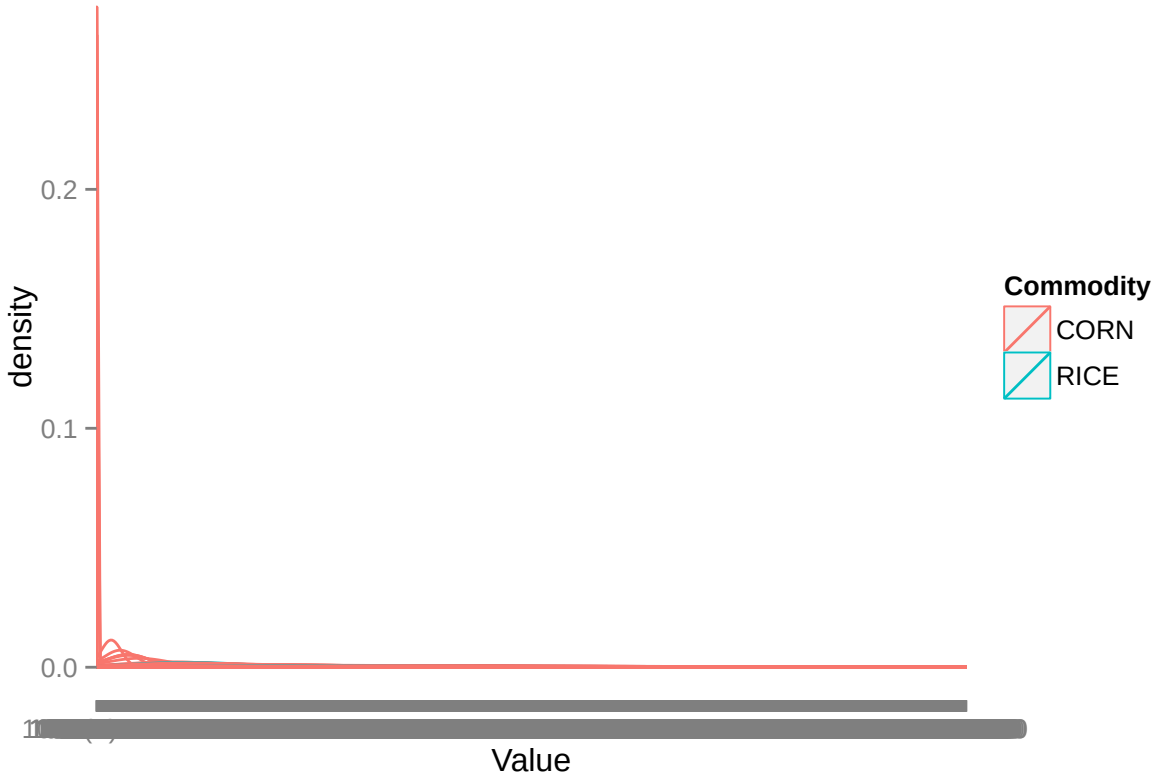

```r
# flip the coordinates so that the Value variable is horizontal
ggplot(data, aes(x = State, y = Value)) + geom_boxplot() + coord_flip()
```



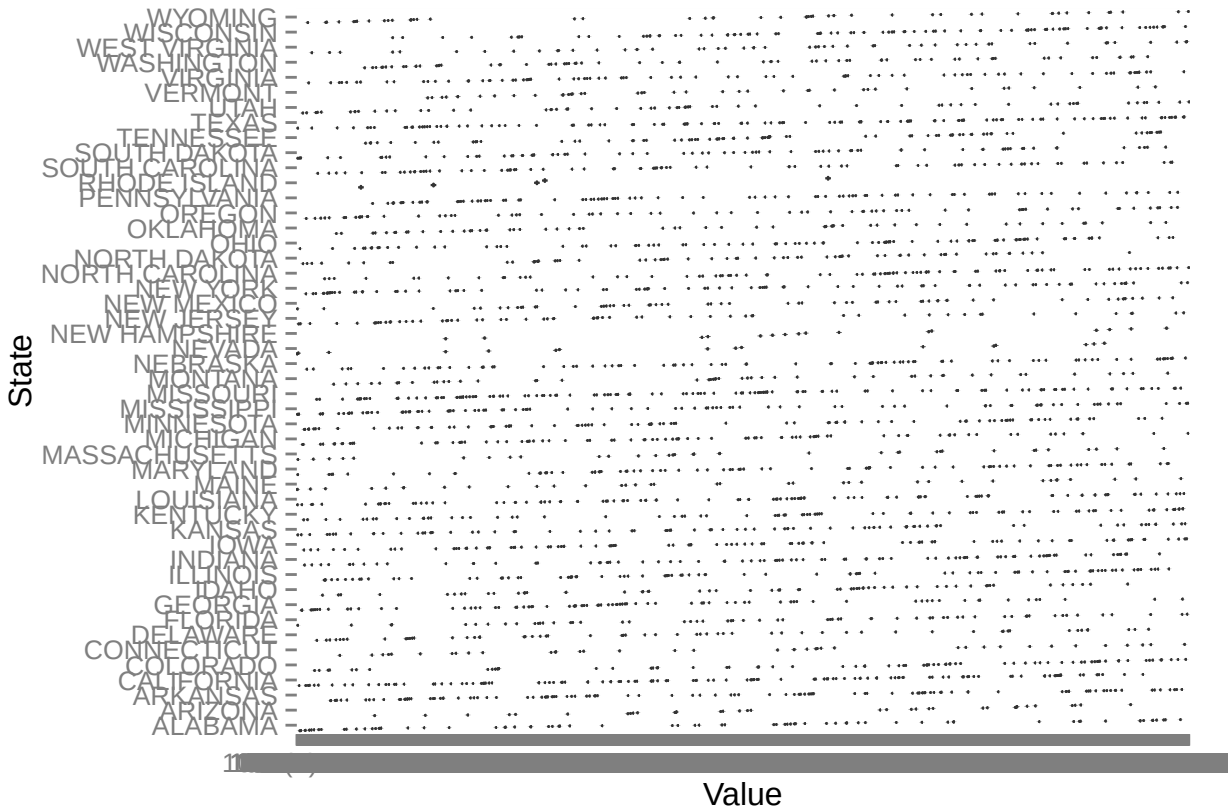

```r
# first separate the value by states
# then make a separate dotplot for each state
ggplot(data, aes(x = Value)) + geom_dotplot(dotsize = .1) + facet_grid(State~.)
```




```r
# compare corn and rice values in a sinple density plot
ggplot(data, aes(x = Value, color = Commodity)) + geom_density()
```




```r
# generate side-by-side boxplot to examine values for each state
ggplot(data, aes(x = State, y = Value)) + geom_boxplot() + coord_flip()
```



```r
# use scatterplot to look at the CV in each state
as.numeric(as.character(data$CV....))
```

```
## Warning: NAs introduced by coercion
```

```
##    [1] 55.8 55.8 55.8 55.8 83.6 83.6 83.6 83.6 71.6 71.6 71.6 71.6 74.5
##   [14] 74.5 79.6 79.6 70.0 70.2 70.0 70.2 82.9 82.9 61.0 61.0 61.7 61.7
##   [27] 77.2 78.3 11.0 10.9 10.9 69.9 69.9 69.9 69.9 32.4 32.4 21.9 21.9
##   [40] 21.8 21.8 85.5 85.5 85.5 85.5 35.5 35.5 10.3 10.3 10.3 10.3 66.3
##   [53] 66.3 63.6 63.6 66.3 84.6 84.6 84.6 84.6 94.7 94.7 66.7 66.8 66.3
##   [66] 66.4 66.7 66.3 77.2 78.3 11.0 11.0 10.9 10.9 56.1 56.1 18.1 18.1
##   [79] 18.1 18.1   NA   NA   NA   NA 77.2 78.3 11.0 11.0 10.9 10.9 69.9
##   [92] 69.9 69.9 69.9 35.5 35.5 10.3 10.3 10.3 10.3   NA   NA   NA   NA
##  [105] 70.0   NA 70.0   NA 86.1 86.1 37.2 37.2 36.7 36.7 55.6 55.6 63.6
##  [118] 63.6 10.3 10.3 19.4 84.5 84.5 84.5 84.5 61.7 61.7 64.7 64.7 64.7
##  [131] 64.7 24.3 24.3 39.3 39.3 39.3 39.3 10.3 10.3 66.3 66.3 63.6 63.6
##  [144]   NA   NA   NA   NA   NA   NA   NA   NA 27.3 27.3 85.8 85.8 56.2
##  [157] 56.2 26.5 26.5 26.5 26.5 43.6 43.6 43.6 43.6 74.5 74.5 79.6 79.6
##  [170] 27.8 27.4 17.2 30.2 36.0 25.1 13.0 26.7  9.6 26.0  9.6 42.8 28.7
##  [183] 63.2 68.5 19.9 12.6 30.4 12.7 10.3 14.2  9.4 33.2 24.8 16.8 43.7
##  [196]   NA 13.9 34.5 67.5 17.3  9.2 27.2   NA 55.8 66.8 13.1 13.0 32.3
##  [209] 26.1 17.1 44.0   NA 11.7 33.9 76.8 16.5 12.8 28.8   NA 54.5 76.3
##  [222]  4.1  6.9 51.5 13.8  6.1 19.7   NA 32.9 15.0 39.2  0.6  2.8 14.7
##  [235]  6.6 20.4   NA 38.2 15.9  0.6  2.3  3.0 96.7   NA   NA   NA 16.5
##  [248]   NA 85.3   NA   NA 85.3 25.2   NA 99.4 39.3 77.2   NA 25.3   NA
##  [261] 91.7 25.3   NA 99.4   NA 75.5 75.4   NA 25.3   NA   NA 25.3 35.8
##  [274] 52.4 41.1 58.0 83.5 24.7 35.6 52.4 40.9 57.9 30.1 30.8 48.3   NA
##  [287]   NA   NA   NA 15.3   NA   NA   NA   NA   NA 49.0   NA   NA   NA
##  [300] 15.3   NA   NA   NA   NA 31.0   NA   NA   NA   NA   NA   NA   NA
##  [313] 31.0   NA   NA   NA   NA 31.9   NA   NA   NA   NA   NA   NA 79.9
##  [326] 31.9   NA   NA   NA 81.0  6.8 18.5 18.6   NA  8.5 51.7 83.7  7.6
##  [339] 18.4 56.0  8.1  7.3 48.9   NA   NA 99.3 21.0 20.7   NA   NA   NA
##  [352]   NA 86.9 49.2   NA   NA 20.7   NA   NA   NA 34.2 61.1 96.0   NA
##  [365]   NA 88.0 51.2 34.2   NA   NA   NA 51.2 35.2 69.6 81.4   NA   NA
##  [378]  8.6 35.1 88.8   NA   NA  8.6  3.4 32.9 35.2 10.4 12.2  3.8 31.5
##  [391]  3.9  3.5  6.2 23.4 15.1 11.0 12.5  9.4  5.9  6.5 13.5  5.3  6.3
##  [404] 44.6 10.1 11.7 11.4  5.9  6.7 16.9  5.3 23.5  3.0 27.0 10.8 17.5
##  [417] 11.8  8.5 17.3 13.2  5.6 24.3  3.1 11.7  8.2 16.9  5.6 23.5  3.3
##  [430] 28.3 10.5 17.5 13.1  8.3 17.3 15.3  5.4 24.3  3.4 10.8  8.1 19.0
##  [443]  5.3  3.2  3.7  5.5 11.4  8.7  6.3  9.2  5.4 17.8  8.5 22.1  3.1
##  [456]  3.7  5.7  8.5  6.1  9.1  4.6 18.6  3.1  3.1 15.4 20.1 14.1 15.1
##  [469] 25.3  8.1 11.9  5.1  4.2 12.4 15.4 34.5 14.4 15.1 11.9  4.2 13.1
##  [482]  8.5 49.3  7.5 43.0 10.3 70.2 18.3 10.5  8.5  7.5 10.5  8.2 44.3
##  [495]  9.6 42.7  9.8 66.4 22.9  8.6  8.2 25.0  8.6  3.7  8.4 24.8  2.1
##  [508]  3.7  8.5 25.4  3.5  3.6  6.8 53.9 14.7  8.5 17.4 20.3  1.7 26.7
##  [521] 16.3 42.8  8.3 11.3  6.8 16.8 22.6 21.6  1.6 28.3 16.5  8.2 16.7
##  [534] 37.1  4.1 12.6 11.2 30.9 12.6  9.3 23.0  7.7 19.4 50.9  4.1 11.2
##  [547]  9.4 11.0 19.6 25.3  3.9 12.4 10.5 35.1  9.1 10.0 18.1  6.6 18.5
##  [560] 45.0  3.9 10.6 10.1  7.7 18.5  3.1 23.8 70.8 10.0 10.0 13.2  5.5
##  [573] 13.6  3.1 22.9 75.2 10.2 10.2 12.1  5.5 12.3  2.8  2.9  2.3   NA
##  [586] 27.7 36.6 12.2 26.1 15.9 38.0 12.3 33.5  4.1 82.9  5.4 86.3 32.9
##  [599]  9.2 28.9 33.5   NA  5.6 21.9 10.1 42.0 41.1  5.4 87.6   NA 28.3
##  [612]  9.2 70.8 28.3 33.5  5.6 21.8 10.1 36.5 41.1 17.9  1.9  7.8 33.7
```

```
##  [625] 13.8  8.2  6.1  7.5 25.1 69.2 72.8 73.2 24.2 31.6 16.2 57.9 38.9
##  [638] 75.0 15.5 52.4 71.6 43.0 43.3   NA 37.2 15.6 73.1 24.8 60.9 40.6
##  [651]   NA 85.2 96.0 65.6 62.9 24.9 45.6 85.9 95.8 60.2 24.9 62.7 40.2
##  [664]   NA 94.8 87.3 57.6 65.6 25.0 46.1 93.5 88.0 63.1  9.7  1.4 85.7
##  [677] 85.7 53.1   NA 11.9 11.0  1.4 88.6 88.6   NA  5.5 10.8  8.7 11.6
##  [690] 37.5 28.4 31.7 18.7 51.3 25.5 15.3 12.6 49.5 83.5 19.0 67.6 34.2
##  [703] 17.2 53.6 21.4 32.4 21.5 39.6 37.4 18.3 43.4 34.6 12.5 73.8 21.3
##  [716] 26.0 20.9 41.3 13.7 52.1 21.4 29.0 27.5 35.3 34.6 17.1 44.0 34.5
##  [729] 12.5 73.8 21.3 34.8 20.5 41.3 13.7 16.5  2.6 28.0 13.3 10.9 91.2
##  [742] 44.8 90.5 45.9 15.6  2.6 14.0 11.6   NA   NA 12.3 10.9  1.2  1.2
##  [755]  1.2  1.2  1.2  1.2  1.2  1.2  2.0 15.6  8.1  9.5 27.4  8.6  1.9
##  [768] 12.3  7.9 14.7  4.3 10.7  2.0 15.4 40.9 13.3  1.9 15.0  9.2 31.0
##  [781]  4.5 31.6  9.5  0.9  8.2  4.4 11.3  7.7  4.6 11.0  6.7  3.9 10.0
##  [794]  1.0  4.9  4.8 11.5  4.1  9.2  1.1  8.2  4.8 14.2  7.8  3.2 12.0
##  [807]  5.9  3.6  9.1  1.1  5.2  3.3 10.2  3.8  2.4  0.8  1.4  7.9  2.2
##  [820]  2.3 10.5  4.6 23.2  1.3 55.5  1.5  2.6  0.9  0.7  2.3  2.4 16.3
##  [833]  5.9  1.2  1.5  1.5 10.0 51.0 13.6 25.8 15.2 22.9 12.3 12.9 13.3
##  [846] 17.2 17.4  9.9 10.2 29.1 15.0 26.3 12.4 18.4 13.4 17.3 11.0 18.5
##  [859]  9.5  9.1 15.7 31.0  9.8 19.8 11.1 11.3 15.7 13.7 20.3 11.0 18.5
##  [872]  8.5  8.8 20.2 31.0 11.4 16.3 11.1 10.3 20.5 15.4 16.9 10.0 12.4
##  [885] 12.4  6.2  7.5  8.1 57.4  2.4 10.2 17.5 12.7 12.7  7.5  8.1  7.9
##  [898]  5.4  5.1  2.4  7.7  5.2  4.0  4.1  5.8  1.3  4.6  3.4  7.3  2.3
##  [911]  4.6  2.4 25.0  6.2  6.6  7.3  1.3  5.5  3.6 17.0  2.2 12.0  8.9
##  [924]  1.1  8.3  6.6  7.5  5.4  2.6  7.4  4.5  1.8 19.6  1.1  6.8  2.6
##  [937]  5.7  1.8  8.1  1.1  7.1  6.7  7.2  5.6  2.6  7.9  4.6  1.8 11.3
##  [950]  1.1  6.9  2.6  5.4  1.8  1.5  8.5 10.1  8.5 20.3  6.4  6.9 12.1
##  [963]  5.0 21.8 41.9 31.1  1.5  8.4  8.9 25.6 25.6  7.5  7.2 11.3  5.0
##  [976] 20.3 32.9  1.5  1.5  2.1 13.2  7.7  5.3  5.4 14.8  1.6 13.1  7.5
##  [989]  5.1  2.1 10.3  2.1 57.7 11.8  9.5 19.6  1.6 15.5  7.7 17.4  2.2
## [1002] 15.4 17.4  1.2 10.3 12.9 17.1  5.4  1.7 14.2  6.4  1.7 17.6  1.2
## [1015] 13.0  1.7  7.9  1.7 18.3  1.2 10.7 12.7 16.3  6.3  1.9 14.1  5.5
## [1028]  1.7 17.3  1.2 12.8  1.9  7.1  1.7  1.1  2.6  8.6 46.5  2.8 51.1
## [1041] 14.2 14.9  2.0  7.7  1.6 13.0  1.1  2.4 66.0  1.0 72.2 22.1 19.9
## [1054]  2.0  7.9  1.8 14.7  1.1  1.0  5.5 18.2 12.8 21.0 34.4 46.5 10.4
## [1067] 43.5 24.9  7.6  6.8  6.8  5.5 28.6 32.1 44.6 53.0 10.4 46.6 25.3
## [1080] 25.6  6.8 17.2 24.3 25.3 15.8 47.4 17.2 13.4 14.0 18.1  3.6 32.3
## [1093] 23.3 25.3 48.4 14.0  3.7 32.3 16.2 29.8 10.8 48.3 16.0 13.5 12.6
## [1106] 16.7  3.4 34.7 22.5 29.7 48.8 12.6  3.4 34.7  4.2  1.8   NA 13.1
## [1119] 12.9 12.9  9.0 18.9  4.9 18.9  6.6 84.7  9.6  4.4  1.4 14.7 18.2
## [1132] 18.2 11.6 20.4  8.4 18.9  6.0   NA  9.5  5.5  5.3 20.3 43.4 18.7
## [1145] 14.2 11.7 13.6 12.1 10.5 17.9 20.0 17.7 18.5 21.8 40.6 18.2 19.3
## [1158] 12.5 21.2 26.7 60.0 20.2   NA 12.2 24.1  8.3  8.7 20.1  7.4  4.9
## [1171] 13.1 11.2 10.3 50.1 24.1 10.0  4.4 23.6 10.4 19.7 25.0  6.8 10.6
## [1184] 20.4 10.1  8.7 13.1 14.2 11.3 30.7 25.0 12.0  8.9 27.2 11.5 13.7
## [1197] 16.7 55.7 57.2 40.2 15.7 18.4 38.4 10.9 73.7   NA  7.8 14.6 16.9
## [1210] 44.0 16.6 19.5 28.0  9.2  6.5 14.8 13.9  2.8 43.0 20.8 13.0 18.2
## [1223] 16.7  5.4 18.9 13.8 13.9 11.5  9.6  2.7 65.2 66.3 58.8  5.4 30.6
## [1236] 23.1 13.8 39.2  5.1 13.9 16.2 35.6  7.1 15.7 36.8  8.0  4.5 32.9
## [1249]  5.1 24.0 15.7 19.2  4.8 39.8  5.2 12.1 16.4 37.7 10.5 14.1 38.8
## [1262]  8.3  2.3 32.1  5.2 23.8 13.8 17.5  2.5  3.1 16.8  6.0  7.7  8.5
## [1275] 13.7  7.0  3.6 16.0  2.6  5.1  3.6  4.4  3.2  7.9 31.8  3.5 12.9
## [1288]  3.2  3.2  3.8  3.2 41.1   NA 47.8 50.8 42.3 13.0 31.0 25.6 18.4
## [1301] 57.4 11.8 48.8 41.2 45.1 51.6 14.8 31.0 31.0 18.4 11.9 59.0  8.3
## [1314] 42.4 17.7 83.1 67.5 16.1 66.4 74.1 15.4 44.7  8.3 17.9 15.5 84.5
```

```
## [1327] 15.4  9.3 47.6 25.0 76.9 32.7 66.1 68.1 13.7 44.7  9.3 25.5 32.4
## [1340] 69.5 13.7  5.4 17.0 22.9  3.1 49.5  5.5 17.1 22.9  3.2  5.4  5.4
## [1353] 15.4 85.5 39.6 51.1 23.0 33.0 11.1 41.6 15.3 33.9 13.1 65.9 15.4
## [1366] 55.2 26.9 44.9 11.1 57.1 14.9 13.0 43.7 10.6 74.7 45.3 15.0 43.0
## [1379] 11.7 10.5 15.0 12.0 66.6 45.7 25.3 45.8  6.3 12.0 12.6 25.4 47.2
## [1392]  6.3  4.5 28.8 28.8  4.4  4.3  4.4  5.6   NA 17.1 17.3 11.1 14.6
## [1405] 78.4  8.6 76.4   NA 10.6  0.8 32.3 25.1 47.8 52.2 82.2 11.9 40.0
## [1418] 64.9 13.3  0.8 32.0 20.4 87.3 48.5 82.2 12.1 40.0 53.5 13.3 44.7
## [1431]  5.5 12.0   NA 46.5 46.5  3.0   NA 50.8  5.6  2.3  8.4  9.6 37.4
## [1444] 24.9 54.7 40.0 55.7  7.2 22.5  8.1 25.6  7.5 44.3  9.6 65.1 54.7
## [1457] 75.3 13.1  9.1  7.9 40.1 34.9  5.9 12.8 20.8 39.4 52.9 13.1 53.8
## [1470]   NA 24.5 32.5  5.8 23.8 14.0   NA 25.9 41.4  4.9 11.4 18.9 36.9
## [1483] 54.8  9.3 53.5   NA 25.5 33.0  4.8 19.4  9.9   NA 26.9  3.7  2.0
## [1496]  2.7  3.3  3.2 12.3  3.2 30.9  4.4  7.5 12.7  5.2  1.8  3.3  3.9
## [1509]  3.9   NA   NA  3.7 14.2  5.8  3.8 47.9 31.2 32.8 37.0   NA 64.0
## [1522] 97.4 43.9 41.1 42.8 70.2 21.6 26.1 30.1 33.3 43.6   NA 88.9 31.0
## [1535] 37.1 46.1 42.9 64.6 21.6 26.8 30.0 33.3 44.2   NA 77.4 34.5 37.1
## [1548] 46.1 37.0  5.7  7.4 17.7 28.2 38.2 25.5 20.0  3.1 22.7  5.5  4.6
## [1561]  6.1  4.3  1.6 10.5  5.1  6.0  2.8  5.4  3.1 18.3  9.1  6.2  1.6
## [1574] 11.2  5.9  2.7 12.9 14.0  1.3  8.4  3.8 14.0  3.3  3.9  8.1  3.3
## [1587]  1.5 17.9  1.3  3.8  4.0  6.0  1.5 12.6  1.3  8.1  3.8 12.8  3.3
## [1600]  3.8  8.8  3.2  1.7 15.6  1.3  3.8  3.9  5.3  1.7  1.4  3.3 32.4
## [1613] 13.0  4.5  4.5 11.9 15.1  2.1  3.4 25.4 31.8  3.0  1.2  3.5 39.1
## [1626] 17.3  5.0  5.0 15.8 16.1  2.1  3.3 26.2  4.2  1.2  1.3  2.5 15.4
## [1639] 24.1 12.9 27.8 53.1  8.7 57.6 26.6 36.4  2.7 40.5  2.5 36.9  8.9
## [1652] 52.2 75.5  8.7 70.3 28.8 55.9  2.7 41.2 10.5  5.1 23.3 79.4 22.7
## [1665] 33.7  9.6 25.1 64.1  4.9 26.9  5.1 83.1  9.7 66.4  4.9 10.0  5.4
## [1678] 23.5 81.3 22.7 33.9  6.1 26.8 65.2  6.5 24.6  5.4 84.1  6.2 66.4
## [1691]  6.5  3.8  5.2 21.1  5.7  8.0  8.0 12.8 29.8  2.9  1.5  3.6 23.9
## [1704] 24.3  5.1  4.8  7.8  7.8 19.2 35.3  3.0  1.6  3.5 24.5  4.7  3.5
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## [1730] 49.2 28.1 41.8 30.0 61.6 62.1 87.3 35.3 27.3 27.3 37.7 48.7 33.8
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## [1756] 37.2 54.3 32.9 35.9 29.6 25.2   NA 32.4 28.6 43.5 38.0 42.2   NA
## [1769]  7.5 44.4 31.6  9.6 16.7  7.5 20.5 10.6 62.1  6.1  7.6 47.4 10.1
## [1782] 17.8  8.0 31.0 10.1  6.1  6.7  6.7 44.3 14.6   NA 93.8 44.5 14.6
## [1795]   NA 93.8 12.8 15.4   NA 15.3 70.3   NA  3.7 23.1  3.7 23.1  3.6
## [1808]  3.5  1.5 20.6  8.6  4.5  9.2  3.7  1.0  4.6  2.3  7.2  2.4  5.4
## [1821]  1.5  9.4 29.1 10.0  1.0 14.7  4.1  2.6 25.3  6.6  0.8  5.0  2.5
## [1834]  8.7  4.4  2.1 15.5  3.6  1.3 11.0  0.8  3.0  2.1  6.9  1.3  4.6
## [1847]  0.8  5.0  2.1  7.3  3.1  2.0  9.9  3.4  1.3 14.1  0.8  2.4  2.3
## [1860]  6.1  1.3  1.0  1.8  9.8 13.4  5.7  4.1  1.8  0.7  2.7 59.3  5.2
## [1873]  1.0  0.1 10.9 13.5  1.1 10.3  4.9  1.3  0.5  1.6  4.2  0.9  0.9
## [1886]  4.1 22.1 32.7  0.2 35.5 31.8 22.2   NA  4.1  0.2 35.0 23.4  0.3
## [1899] 65.4 52.2 25.7 23.2 47.5  9.3  0.3 48.8 24.7 51.2  9.4  0.3 47.0
## [1912] 40.0 22.7 19.0 54.7 10.1  0.3 39.2 20.2 51.2 10.1  3.7  3.6  3.7
## [1925] 10.1 75.5 50.7 34.6 28.3  6.3 42.1 20.7 14.2 46.3 10.8 41.7  6.3
## [1938] 72.1 23.1 14.3  4.7 57.1 13.7 47.4 22.8  8.6  4.7 12.1 16.7 36.5
## [1951]  8.3  4.3 14.5 38.4 24.6  8.3  4.3 12.1 17.3 36.5  7.9  6.5 10.9
## [1964] 10.9  7.3 33.1 23.4  7.2 11.3 11.3  8.6 33.1  4.7  3.9 17.6 25.6
## [1977] 27.7  9.7 16.2 13.0  4.7 13.7  7.9 18.2 13.8 11.3 17.8 34.1 15.2
## [1990] 17.0 13.4  4.7 13.7  7.9 18.5 14.4 21.9 40.5  9.0 25.2 12.8 37.3
## [2003] 22.3  3.5 33.0 23.7 16.3   NA  9.0 12.3  3.6 15.2 16.4 35.0  9.4
## [2016] 22.6 13.4 33.4 20.3  3.3 26.1 25.2 16.9 81.5  9.4 13.3  3.3 15.5
```

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## [2042] 32.4  6.5  6.5  6.5 11.2  1.0 17.0  6.8  6.4 59.5   NA 78.5 26.7
## [2055] 92.6 24.0 73.8 54.4 58.1 26.7   NA 73.8 54.4 58.1 91.5   NA 36.3
## [2068] 36.3 26.2 27.2 62.5 14.8  6.1  0.2 18.7 28.0 54.9 28.0  0.4  0.2
## [2081]  0.2 22.8 28.0 54.7 28.3  0.2  0.4  1.2  4.1  9.2 17.1  7.6 11.7
## [2094] 14.1 16.7  6.4 23.9  7.2 18.3  7.4 11.2  8.8 16.4 34.7 26.2 27.6
## [2107]  6.3  7.5 10.3  1.7 14.2 12.6 12.1 10.6  7.9 11.8 17.9  9.5 16.2
## [2120]  1.7 12.2  7.7 14.2  9.6 10.3  1.7 14.0 16.6 12.1  9.7 10.4 11.5
## [2133] 16.3  9.4 16.2  1.8 16.7 10.0 14.9  9.5  3.1 10.4  7.1  4.5  4.5
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## [2185] 13.1 94.2  4.7 13.9 41.7   NA 15.0 10.3 25.3 11.8  4.7 47.0  9.6
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## [2224] 20.6 11.1 10.9  9.0 40.7 21.9 26.1 12.1 33.3 10.1 12.2 33.0 22.7
## [2237]  9.6  9.7 15.1 13.6  7.6  8.9 14.4 13.2 13.8 32.5  9.7 18.8 10.2
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## [2406]  8.7 32.7 21.7  7.1 37.8 11.0 29.3 75.0  2.1 10.0  7.5 14.0 29.5
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```

```
## [2731] 18.6  7.4 21.4 13.1 25.8 11.5 17.7  7.1 61.8 29.9 26.4  7.4 41.8
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## [2770] 10.8  9.5 10.1 25.2  5.3 14.1 17.1 15.8 10.3  7.9 68.2  6.7  8.5
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## [2796]  9.7  0.1 92.2  6.4  4.2  3.8  4.7 25.9 32.2 14.1 15.1 15.5  2.4
## [2809] 15.2 17.3 18.5 13.0 16.0  4.7 18.2 19.6 18.1  2.4 18.3 19.2 14.6
## [2822] 43.5  4.0 16.5 24.1 31.7  8.4 29.6 30.3  7.9  3.5 37.6  4.0 25.4
## [2835] 29.8 11.4  3.5 31.3  4.1 13.2 24.8 28.9  7.9 32.2 21.4  6.4  3.5
## [2848] 31.8  4.1 25.8 32.4  8.6  3.5  2.7  9.3  9.3  4.5  9.1 15.9  5.5
## [2861]  0.5 43.3  1.6  2.7  9.3  9.3  4.1  9.8 14.7  5.3  1.6  2.6  2.7
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## [2900] 52.8 24.1  1.0 22.3  4.3 76.1 53.2 23.0  1.5 56.2 17.3 33.6 71.6
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## [2939] 26.8  2.7 17.3 24.8  2.3 27.4  7.8  5.1 83.7 83.7 83.7  8.7 23.8
## [2952] 38.6 22.2  8.6 21.4 33.5 24.8 43.3 27.4  8.9 28.7 44.0 34.8  8.6
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## [2978] 19.3 40.9  8.6 27.2 17.4 24.7 19.4 30.8  8.9  9.8 25.7 27.4 15.7
## [2991] 19.3 10.9 18.3 14.9 43.3  8.9 27.6 19.5 22.1 14.9  7.3 11.5 69.4
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## [3017] 15.0 13.4 73.9  2.3  6.9  6.7 16.6 70.5 50.3 21.0   NA 81.3 84.1
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## [3069]  8.2 14.4 34.9 46.3 19.6 10.7 17.9  7.2 20.7 15.9 12.0 10.1 33.5
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## [3134]  1.1 33.1 15.2   NA 53.6 15.1 50.3 18.1 10.6  1.1 29.9 10.7  1.1
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## [3212] 10.8  2.3 25.2  3.6  6.7  2.5 26.2  2.4  1.1  2.8  5.3  3.0  2.1
## [3225] 14.7 16.5  4.7 20.0 43.3  5.5 13.5  5.8 19.5 12.1  1.0  0.2  1.8
## [3238]  3.2 29.4 17.7  7.0 41.2 53.7  7.3  8.3  2.3  2.2 11.5 51.7 25.6
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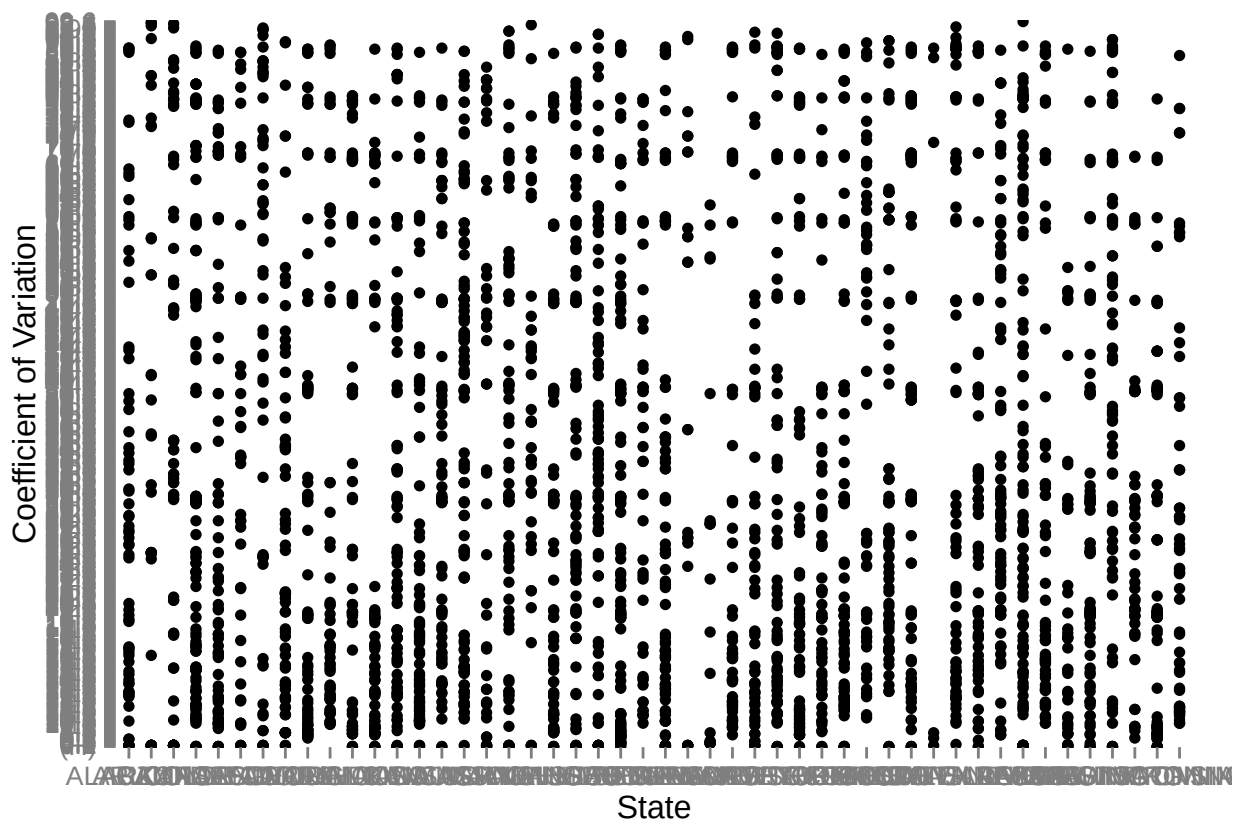
## [3368] 18.3  1.8  1.7  0.7 16.1 21.8  1.8  2.2  3.3  1.2 10.7  4.4  2.4
## [3381]  2.2  2.7  1.1  2.5  2.2  4.4  1.7  4.4  1.3  3.8  4.6  2.6  1.1
## [3394]  2.9  2.2  1.7 21.1  8.6  0.7  5.2  2.1  4.9  3.8  1.9  5.0  2.6
## [3407]  1.1 18.9  0.7  2.3  1.9  4.4  1.0  6.8  0.6  5.3  2.1  4.7  4.0
## [3420]  1.9  4.7  2.6  1.1 18.6  0.7  2.3  1.8  4.4  1.0  1.0  3.7  5.0
```

```
## [3433]  7.5  4.3 30.8  4.3  2.2  2.6  1.5  3.7  2.1 10.2 13.4  0.9  3.8
## [3446]  7.2  4.5  4.5  3.7  3.2  1.6  5.2  1.7 17.9  0.9  1.0 18.5 43.0
## [3459] 23.8 21.8 11.4 23.4 25.7 11.2 38.5 18.7 44.5 58.1 46.4 11.0 34.7
## [3472] 11.7 13.2 58.9 10.1 23.8 11.2 26.6 20.8 13.4 11.7 11.5 32.3 23.3
## [3485] 14.9 58.9 10.1 23.5 10.8 26.1 25.5 15.1 11.6 11.2 32.3 28.4 11.0
## [3498] 28.7 28.7 15.8 39.6 89.9 16.8 10.4 29.6 29.6 15.8 39.6  6.0  6.3
## [3511]   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA
## [3524]   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA
## [3537]   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA
## [3550]   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA
## [3563]   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA   NA
## [3576]   NA   NA   NA   NA   NA   NA   NA   NA   NA
```

```r
ggplot(data, aes(x=State, y=CV....)) + geom_point() + ylab("Coefficient of Variation")
```