Report of Berry Assignments

Zhe Yu

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Introduction

In this berry assignment, I chose the data of raspberry to do cleaning, organizing and some EDA. I tried to find how years, states and chemicals used effected the value of raspberry. Also I found the correlation between different type of chemicals.

Clean data

In this procedure, I selected all the data of raspberry from the raw data. And due to the messy information in column Data Item, 'Domain' and 'Domain Category', I tried to separate them into several independent columns.

```
## select the data of raspberry
rberry <- ag_data %>% filter((Commodity=="RASPBERRIES") & (Period=="YEAR"))
rberry %<>% select(-c(Period, Commodity))

## use '#' to separate 'Data Item' into three parts
rberry$`Data Item` <- str_replace(rberry$`Data Item`,"^RASPBERRIES","RASPBERRIES#")
rberry$`Data Item` <- str_replace(rberry$`Data Item`,"MEASURED IN","#MEASURED IN")
rberry %<>% separate(`Data Item`, c("B","type", "meas"), sep = "#")

## tidy up each new column and continue to separate them
rberry %<>% separate(type, c("Type", "Production"), sep = " - ")
rberry %<>% separate(Type, c("d1", "Type"), sep = ",")
rberry %<>% separate(Production, c("Production", "d2"), sep = ",")
rberry %<>% separate(meas, c("Measures", "Avg"), sep = ", ")

## delete those columns with useless information
rberry %<>% select(-c(B,d1,d2))
rberry[is.na(rberry)] <- " "  ## OK now Data Item has been split into parts

#kable(head(rberry,n=10)) %>% kable_styling(fixed_thead = T, font_size = 10)
head(rberry,n=10)
```

```
## # A tibble: 10 x 9
##     Year State  Type   Production Measures Avg   Domain `Domain Category`  Value
##    <dbl> <chr>  <chr>  <chr>      <chr>    <chr> <chr>  <chr>              <chr>
##  1  2019 CALIF~ " "    ACRES HAR~ " "      " "   TOTAL  NOT SPECIFIED      7,500
##  2  2019 CALIF~ " "    PRODUCTION "MEASUR~ " "   TOTAL  NOT SPECIFIED      143,~
##  3  2019 CALIF~ " "    YIELD      "MEASUR~ " "   TOTAL  NOT SPECIFIED      19,1~
##  4  2019 CALIF~ " BEA~ APPLICATI~ "MEASUR~ " "   CHEMI~ CHEMICAL, FUNGICI~ (D)
##  5  2019 CALIF~ " BEA~ APPLICATI~ "MEASUR~ " "   CHEMI~ CHEMICAL, FUNGICI~ (NA)
##  6  2019 CALIF~ " BEA~ APPLICATI~ "MEASUR~ " "   CHEMI~ CHEMICAL, FUNGICI~ (NA)
##  7  2019 CALIF~ " BEA~ APPLICATI~ "MEASUR~ " "   CHEMI~ CHEMICAL, FUNGICI~ (D)
##  8  2019 CALIF~ " BEA~ APPLICATI~ "MEASUR~ " "   CHEMI~ CHEMICAL, FUNGICI~ 300
##  9  2019 CALIF~ " BEA~ APPLICATI~ "MEASUR~ " "   CHEMI~ CHEMICAL, FUNGICI~ (D)
## 10  2019 CALIF~ " BEA~ APPLICATI~ "MEASUR~ " "   CHEMI~ CHEMICAL, FUNGICI~ (D)
```

```
## onto Domain
```

```
##separate 'Domain' and 'Domain category'
rberry %<>% separate(Domain, c("D_left", "D_right"), sep = ", ")
rberry[is.na(rberry)] <- " "
rberry %<>% separate(`Domain Category`, c("DC_left", "DC_right"), sep = ", ")

## work on DC_left first

rberry %<>% separate(DC_left, c("DC_left_l", "DC_left_r"), sep = ": ")

## now work on DC_right
rberry %<>% separate(DC_right, c("DC_right_l", "DC_right_r"), sep = ": ")
rberry[is.na(rberry)] <- " "

#kable(head(rberry,n=10)) %>% kable_styling(fixed_thead = T, font_size = 10)
head(rberry,n=10)
```

```
## # A tibble: 10 x 13
##     Year State Type  Production Measures Avg   D_left D_right DC_left_l
##    <dbl> <chr> <chr> <chr>      <chr>    <chr> <chr>  <chr>   <chr>
##  1  2019 CALI~ " "   ACRES HAR~ " "      " "   TOTAL  " "     NOT SPEC~
##  2  2019 CALI~ " "   PRODUCTION "MEASUR~ " "   TOTAL  " "     NOT SPEC~
##  3  2019 CALI~ " "   YIELD      "MEASUR~ " "   TOTAL  " "     NOT SPEC~
##  4  2019 CALI~ " BE~ APPLICATI~ "MEASUR~ " "   CHEMI~ "FUNGI~ CHEMICAL
##  5  2019 CALI~ " BE~ APPLICATI~ "MEASUR~ " "   CHEMI~ "FUNGI~ CHEMICAL
##  6  2019 CALI~ " BE~ APPLICATI~ "MEASUR~ " "   CHEMI~ "FUNGI~ CHEMICAL
##  7  2019 CALI~ " BE~ APPLICATI~ "MEASUR~ " "   CHEMI~ "FUNGI~ CHEMICAL
##  8  2019 CALI~ " BE~ APPLICATI~ "MEASUR~ " "   CHEMI~ "FUNGI~ CHEMICAL
##  9  2019 CALI~ " BE~ APPLICATI~ "MEASUR~ " "   CHEMI~ "FUNGI~ CHEMICAL
## 10  2019 CALI~ " BE~ APPLICATI~ "MEASUR~ " "   CHEMI~ "FUNGI~ CHEMICAL
## # ... with 4 more variables: DC_left_r <chr>, DC_right_l <chr>,
## #   DC_right_r <chr>, Value <chr>
```

```
##  OK now we need to eliminate the redundancy
```

```
## fine and remove redundant columns
## remove column rberry$DC_left_l and DC_right_l

rberry %<>%  select(-DC_left_l)
rberry %<>% select(-DC_right_l)

## remove "Chemical" and joint the columns

rberry %<>% mutate(D_left = "CHEMICAL", D_left = "")
rberry %<>% mutate(Chemical=paste(D_left, D_right))
rberry %<>% select(-c(D_left, D_right))

## select columns that want to reserve
rberry %<>% select(Year, State, Type, Production, Measures,Avg, DC_left_r, DC_right_r, Chemical, Value
```

```r
#kable(head(rberry,n=10)) %>% kable_styling(fixed_thead = T, font_size = 10)
head(rberry,n=10)
```

```
## # A tibble: 10 x 10
##     Year State Type  Production Measures Avg   DC_left_r DC_right_r Chemical
##    <dbl> <chr> <chr> <chr>      <chr>    <chr> <chr>     <chr>      <chr>
##  1  2019 CALI~ " "   ACRES HAR~ " "      " "   " "       " "        "  "
##  2  2019 CALI~ " "   PRODUCTION "MEASUR~ " "   " "       " "        "  "
##  3  2019 CALI~ " "   YIELD      "MEASUR~ " "   " "       " "        "  "
##  4  2019 CALI~ " BE~ APPLICATI~ "MEASUR~ " "   " "       "(AZOXYST~ " FUNGI~
##  5  2019 CALI~ " BE~ APPLICATI~ "MEASUR~ " "   " "       "(BACILLU~ " FUNGI~
##  6  2019 CALI~ " BE~ APPLICATI~ "MEASUR~ " "   " "       "(BACILLU~ " FUNGI~
##  7  2019 CALI~ " BE~ APPLICATI~ "MEASUR~ " "   " "       "(BORAX D~ " FUNGI~
##  8  2019 CALI~ " BE~ APPLICATI~ "MEASUR~ " "   " "       "(BOSCALI~ " FUNGI~
##  9  2019 CALI~ " BE~ APPLICATI~ "MEASUR~ " "   " "       "(CALCIUM~ " FUNGI~
## 10  2019 CALI~ " BE~ APPLICATI~ "MEASUR~ " "   " "       "(CAPTAN ~ " FUNGI~
## # ... with 1 more variable: Value <chr>
```

```r
## now let's clean it up
rberry %<>% rename(Chem_family = DC_left_r, Materials = DC_right_r)
rberry %<>% mutate(Chemical = str_trim(paste(Chem_family, Chemical)))
rberry %<>% select(Year, State, Type, Production, Avg, Measures, Materials, Chemical, Value)
#kable(head(rberry,n=10)) %>% kable_styling(fixed_thead = T, font_size = 10)
head(rberry,n=10)
```

```
## # A tibble: 10 x 9
##     Year State  Type  Production  Avg   Measures   Materials     Chemical Value
##    <dbl> <chr>  <chr> <chr>       <chr> <chr>      <chr>         <chr>    <chr>
##  1  2019 CALIF~ " "   ACRES HARV~ " "   " "        " "           ""       7,500
##  2  2019 CALIF~ " "   PRODUCTION  " "   "MEASURED~ " "           ""       143,~
##  3  2019 CALIF~ " "   YIELD       " "   "MEASURED~ " "           ""       19,1~
##  4  2019 CALIF~ " BEA~ APPLICATIO~ " "   "MEASURED~ "(AZOXYSTROB~ "FUNGIC~ (D)
##  5  2019 CALIF~ " BEA~ APPLICATIO~ " "   "MEASURED~ "(BACILLUS A~ "FUNGIC~ (NA)
##  6  2019 CALIF~ " BEA~ APPLICATIO~ " "   "MEASURED~ "(BACILLUS S~ "FUNGIC~ (NA)
##  7  2019 CALIF~ " BEA~ APPLICATIO~ " "   "MEASURED~ "(BORAX DECA~ "FUNGIC~ (D)
##  8  2019 CALIF~ " BEA~ APPLICATIO~ " "   "MEASURED~ "(BOSCALID =~ "FUNGIC~ 300
##  9  2019 CALIF~ " BEA~ APPLICATIO~ " "   "MEASURED~ "(CALCIUM PO~ "FUNGIC~ (D)
## 10  2019 CALIF~ " BEA~ APPLICATIO~ " "   "MEASURED~ "(CAPTAN = 8~ "FUNGIC~ (D)
```

```r
##write.csv(rberry,"rberry.csv",row.names = F)
```

So it is the data that have been cleaned. There are some new columns
Type: Generally a physical attribute of the commodity.
Production: The aspect of a commodity being measured.
Avg: Average.
Measures: The unit associated with the statistic category.
Materials: Categories or partitions within a domain.
Chemical: describes the type of chemical applied to thee commodity.

Organize data

The data was cleaned up, because the majority of raspberry was for application, so I filtered rows of data in the same situation to be prepared for the EDA part.

```r
## look at chemicals being applied to food, and drop "(D)" and "(NA)"
unfood <- rberry %<>% filter(Production=="APPLICATIONS")
unfood %<>% filter(Value != "(D)")
unfood %<>% filter(Value !=  "(NA)")
unfood %<>% filter(Measures == "MEASURED IN LB / ACRE / APPLICATION")
unfood$Value <- as.numeric(unfood$Value)

## just I mentioned before I select year, state, chemical and value,
## and make the dataframe more wider
unfood_1 <- unfood %>%  select(Year, State, Chemical, Value)
unfood_1$Value <- as.numeric(unfood_1$Value)
unfood_1 %<>% pivot_wider(names_from = Chemical, values_from = Value)

## because the using the pivot_wider so some data was a list,
## I change them into sum
for (i in 1:6) {
  f <- as.numeric(unlist(unfood_1$INSECTICIDE[i]))
  unfood_1$INSECTICIDE[i] <- sum(f)
}
for (i in 1:6) {

  f <- as.numeric(unlist(unfood_1$FUNGICIDE[i]))
  unfood_1$FUNGICIDE[i] <- sum(f)
}
for (i in 1:6) {
  f <- as.numeric(unlist(unfood_1$HERBICIDE[i]))
  unfood_1$HERBICIDE[i] <- sum(f)
}
for (i in 1:6) {
  f <- as.numeric(unlist(unfood_1$OTHER[i]))
  unfood_1$OTHER[i] <- sum(f)
}
for (i in 1:6) {
  f <- as.numeric(unlist(unfood_1$`(NITROGEN)`[i]))
  unfood_1$`(NITROGEN)`[i] <- sum(f)
}
for (i in 1:6) {
  f <- as.numeric(unlist(unfood_1$`(PHOSPHATE)`[i]))
  unfood_1$`(PHOSPHATE)`[i] <- sum(f)
}
for (i in 1:6) {
  f <- as.numeric(unlist(unfood_1$`(POTASH)`[i]))
  unfood_1$`(POTASH)`[i] <- sum(f)
}

unfood_1$FUNGICIDE <- as.numeric(unfood_1$FUNGICIDE)
unfood_1$INSECTICIDE <- as.numeric(unfood_1$INSECTICIDE)
unfood_1$HERBICIDE <- as.numeric(unfood_1$HERBICIDE)
unfood_1$OTHER <- as.numeric(unfood_1$OTHER)
unfood_1$`(NITROGEN)` <- as.numeric(unfood_1$`(NITROGEN)`)
unfood_1$`(PHOSPHATE)` <- as.numeric(unfood_1$`(PHOSPHATE)`)
unfood_1$`(POTASH)` <- as.numeric(unfood_1$`(POTASH)`)

#kable(head(rberry,n=10)) %>% kable_styling(fixed_thead = T, font_size = 10)
head(unfood,n=10)
```

```
## # A tibble: 10 x 9
##     Year State  Type   Production  Avg   Measures     Materials   Chemical Value
##    <dbl> <chr>  <chr>  <chr>       <chr> <chr>        <chr>       <chr>    <dbl>
##  1  2019 CALIF~ " BEA~ APPLICATIO~ AVG   MEASURED IN~ (BOSCALID ~ FUNGICI~ 0.358
##  2  2019 CALIF~ " BEA~ APPLICATIO~ AVG   MEASURED IN~ (CYPRODINI~ FUNGICI~ 0.324
##  3  2019 CALIF~ " BEA~ APPLICATIO~ AVG   MEASURED IN~ (FLUDIOXON~ FUNGICI~ 0.216
##  4  2019 CALIF~ " BEA~ APPLICATIO~ AVG   MEASURED IN~ (MYCLOBUTA~ FUNGICI~ 0.079
##  5  2019 CALIF~ " BEA~ APPLICATIO~ AVG   MEASURED IN~ (PYRACLOST~ FUNGICI~ 0.182
##  6  2019 CALIF~ " BEA~ APPLICATIO~ AVG   MEASURED IN~ (ACEQUINOC~ INSECTI~ 0.303
##  7  2019 CALIF~ " BEA~ APPLICATIO~ AVG   MEASURED IN~ (BIFENAZAT~ INSECTI~ 0.501
##  8  2019 CALIF~ " BEA~ APPLICATIO~ AVG   MEASURED IN~ (METHOXYFE~ INSECTI~ 0.129
##  9  2019 CALIF~ " BEA~ APPLICATIO~ AVG   MEASURED IN~ (PYRETHRIN~ INSECTI~ 0.042
## 10  2019 CALIF~ " BEA~ APPLICATIO~ AVG   MEASURED IN~ (SPINETORA~ INSECTI~ 0.077
```

```r
head(unfood_1)
```

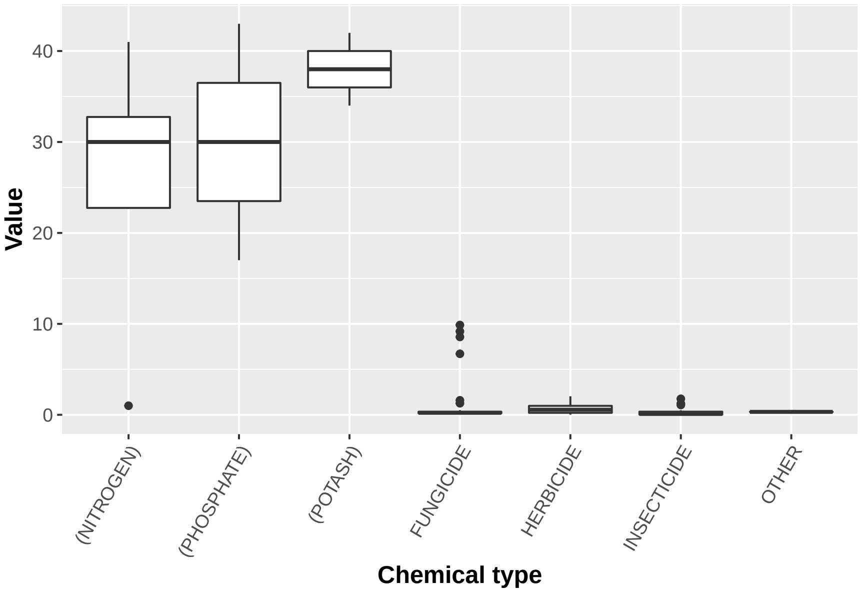
```
## # A tibble: 6 x 9
##    Year State FUNGICIDE INSECTICIDE `(NITROGEN)` HERBICIDE OTHER `(PHOSPHATE)`
##   <dbl> <chr>     <dbl>       <dbl>        <dbl>     <dbl> <dbl>         <dbl>
## 1  2019 CALI~     1.16         1.18            1     0     0                 0
## 2  2019 WASH~     0.536        0.24           30     0.617 0.323             0
## 3  2017 OREG~     9.84         1.25            0     2.81  0                 0
## 4  2017 WASH~    11.6          1.21            0     3.23  0                 0
## 5  2015 OREG~    10.4          1.93           41     2.88  0                17
## 6  2015 WASH~    11.5          1.90           30     2.00  0                43
## # ... with 1 more variable: `(POTASH)` <dbl>
```

The two dataset above, the first one only contains rows with true value in conlumn Value; The second was prepared for EDA to find the correlations in chemical types.

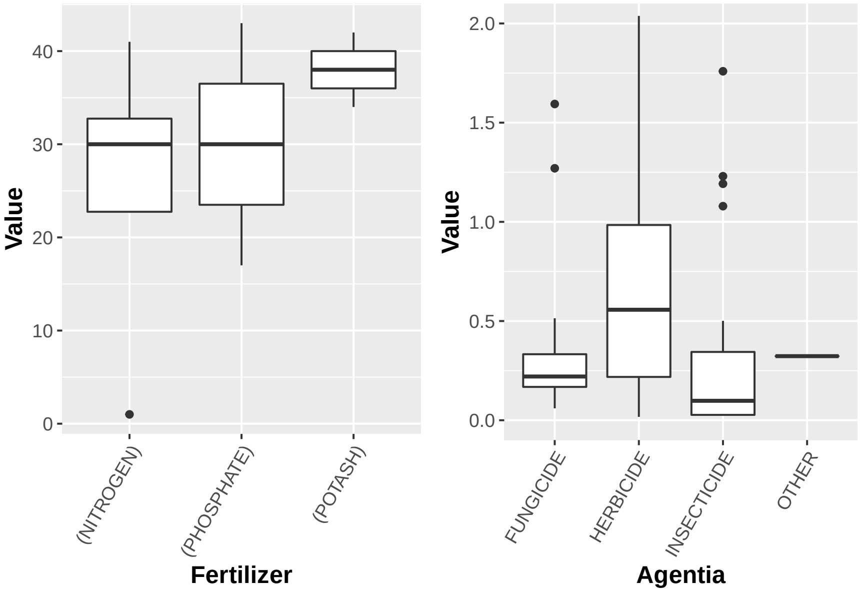
EDA

Chemical type and Value

At first I wanted to draw the boxplot to see the distribution of value by using different type of chemical, but the range of different chemical was not the same. And also there were outliers that make the plot not useful, so I made some adjustment and create another plot.



so I seperated the chemical into to part: agentia and fertilizer. I created an indicate to distinguish them. Two part were drawed separately, but I used grid.arrange function to combine them into same plot. It was clear that the value of raspberry using fertilizer('nitrogen', 'phosphate' and 'potash') was much higher than those using agentia('fungicide', 'herbicide', 'insecticide' and 'other')(becasue 'other' also have a small range so I put it in the agentia).

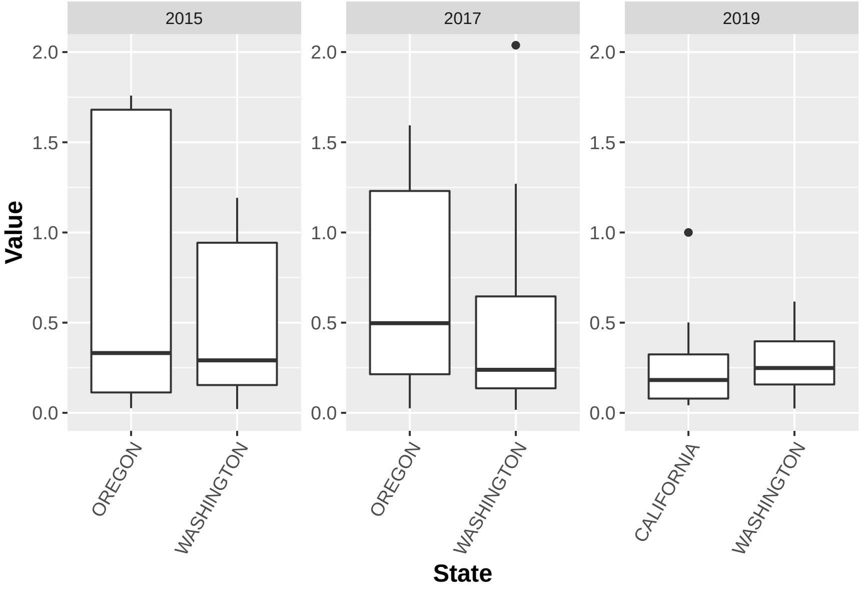


And also can see those outliers here.

```
## # A tibble: 4 x 11
##    Year State Type  Production Avg   Measures Materials Chemical Value
##   <dbl> <chr> <chr> <chr>      <chr> <chr>    <chr>     <chr>    <dbl>
## 1  2017 OREG~ " BE~ APPLICATI~ AVG   MEASURE~ (CALCIUM~ FUNGICI~  6.71
## 2  2017 WASH~ " BE~ APPLICATI~ AVG   MEASURE~ (CALCIUM~ FUNGICI~  8.56
## 3  2015 OREG~ " BE~ APPLICATI~ AVG   MEASURE~ (CALCIUM~ FUNGICI~  9.18
## 4  2015 WASH~ " BE~ APPLICATI~ AVG   MEASURE~ (CALCIUM~ FUNGICI~  9.88
## # ... with 2 more variables: Chemicaltype <chr>, Variables <chr>
```

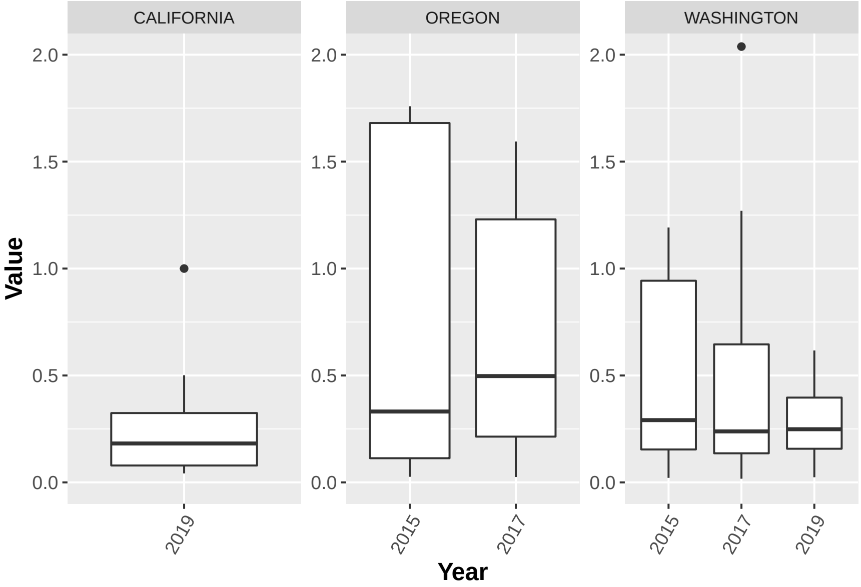
state and value

Look at 2015, the median of value of Oregon and Washington was much the same, around 0.26, but the value of Washington was closer. In 2017, the median of value in Oregon was almost two times of that in Washington. In 2019, there was no obvious difference between the situation of California and Washington.



Year and Value

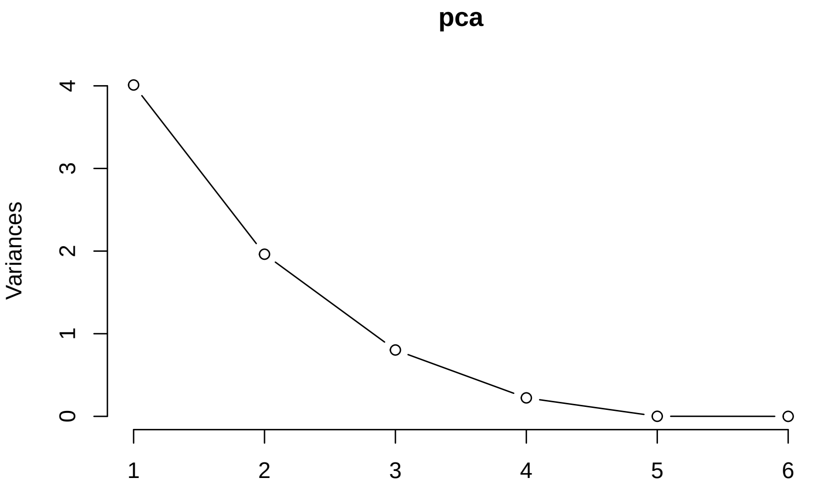
The dataset only have one year of value in California so there is no much to discuss. It seems that Oregon improves a lot from 2015 to 2017, for the median of value in 2017 was almost two times of that in 2015. And the value was closer as well. The same with Oregon, Washington also decreased the range of value, but there was not increasing in median, and even the median decreased in each year.



Correlations between chemical type.

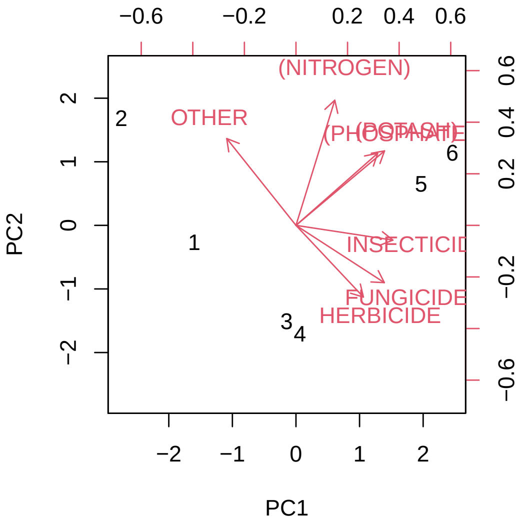
> Without going into too much detail, Principal Component Analysis (PCA) can thus be used to reduce the dimensions of the data into fewer components that would retain as much of the variability expressed by the original data as possible. The fewer components would assist in describing the relationship between the original variables by projecting them onto a two-dimensional grid allowing for easier visualization from which similar types of chemical may be grouped together.

```
## Importance of components:
##                           PC1    PC2    PC3     PC4     PC5       PC6
## Standard deviation     2.0025 1.4008 0.8962 0.47286 0.03009 1.135e-16
## Proportion of Variance 0.5729 0.2803 0.1147 0.03194 0.00013 0.000e+00
## Cumulative Proportion  0.5729 0.8532 0.9679 0.99987 1.00000 1.000e+00
```



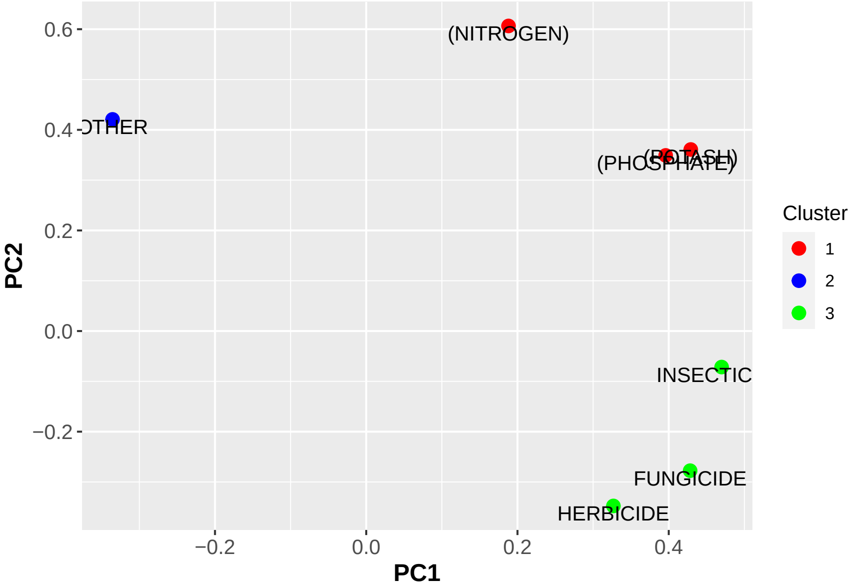
The PCA provided 6 components and 90% of the total variance was attributed to the first 4 components. See in plot above.

```
biplot(pca2.1, scale = 0)
```



And in the biplot I can see the relationship between each variables. The size of the angle between vectors determines the correlation of the variables, which is the desired indicator to achieve the objective for this analysis. A small angle indicates a strong positive correlation, 90 degrees represents no correlation and 180 degrees represents a negative correlation.

For example, Phosphate and potash is almost coincide; others and herbicide have negative correlation. Phosphate and potash have no relationship with herbicide and others.



In this plot, it is clear that chemical can be separate into to three part, just I mentioned before, apart from ‘other’, fertilizer(‘nitrogen’, ‘phosphate’ and ‘potash’) gathered as cluster1, and agentia(‘fungicide’, ‘herbicide’, ‘insecticide’) gathered as cluster3.

Conclusion(What I learned)

In this assignment, cleaning data is a big and important job for the data is a little bit messy in some columns. At first, I couldn’t understand meaning of each column, So I went to the website USDA to find more information. When cleaning the data, I had to be patient and careful enough, and knew what I actually want. In the EDA part, I met lots of difficulties, such as how to put two plots with different scales together, how to use kable to show the dataframe without overflow and the plot is not what I expected, so on. Sometimes, I gave up, but most of time I found the solution from textbook or the Internet. And I realized that the type of column is really important for plots(such as character, numeric etc). There are much more difficulties when I did the shiny app. But most of them had been resolved. Finally, I still have two questions:(a)how to use kable? I tried it but the data frame is too wide so it go out of the page.(b)And how to change the font size of datatable in shiny? I think the default font-size is too big, but I haven't found the solution. I believe that next time I will be better!

Github
shiny app

Citation

[1] Exploratory data analysis into the relationship between different types of crime in London [2] R for Data Science
[3] tutorial for grid.arrange
[4] dmorison/eda-relationships-between-crime-london
[5] USDA
[6] datatables
[7] tutorial for shiny app
[8] tutorial for HTML
[9] questions on stackoverflow