Exploratory Data Analysis - Incidents of Cancer

9/26/2018

Introduction

Given a Data Set for cancer incidences for a select group of counties…. this study attempts to explore the relationships between the outcome variable : Annual Incident Count and other key independent variables.

```
raw_data<-read.csv("cancer.csv")  #Assumes file in current working directory
cancer<-raw_data #Keep one copy of raw data as is
str(cancer)
```

```
## 'data.frame':    3047 obs. of  30 variables:
##  $ X                    : int  1 2 3 4 5 6 7 8 9 10 ...
##  $ avgAnnCount          : num  1397 173 102 427 57 ...
##  $ medIncome            : int  61898 48127 49348 44243 49955 52313 37782 40189 42579 60397 ...
##  $ popEst2015           : int  260131 43269 21026 75882 10321 61023 41516 20848 13088 843954 ...
##  $ povertyPercent       : num  11.2 18.6 14.6 17.1 12.5 15.6 23.2 17.8 22.3 13.1 ...
##  $ binnedInc            : Factor w/ 10 levels "(34218.1, 37413.8]",..: 9 6 6 4 6 7 2 2 3 8 ...
##  $ MedianAge            : num  39.3 33 45 42.8 48.3 45.4 42.6 51.7 49.3 35.8 ...
##  $ MedianAgeMale        : num  36.9 32.2 44 42.2 47.8 43.5 42.2 50.8 48.4 34.7 ...
##  $ MedianAgeFemale      : num  41.7 33.7 45.8 43.4 48.9 48 43.5 52.5 49.8 37 ...
##  $ Geography            : Factor w/ 3047 levels "Abbeville County, South Carolina",..: 1459 1460 1464
##  $ AvgHouseholdSize     : num  2.54 2.34 2.62 2.52 2.34 2.58 2.42 2.24 2.38 2.65 ...
##  $ PercentMarried       : num  52.5 44.5 54.2 52.7 57.8 50.4 54.1 52.7 55.9 50 ...
##  $ PctNoHS18_24         : num  11.5 6.1 24 20.2 14.9 29.9 26.1 27.3 34.7 15.6 ...
##  $ PctHS18_24           : num  39.5 22.4 36.6 41.2 43 35.1 41.4 33.9 39.4 36.3 ...
##  $ PctSomeCol18_24      : num  42.1 64 NA 36.1 40 NA NA 36.5 NA NA ...
##  $ PctBachDeg18_24      : num  6.9 7.5 9.5 2.5 2 4.5 5.8 2.2 1.4 7.1 ...
##  $ PctHS25_Over         : num  23.2 26 29 31.6 33.4 30.4 29.8 31.6 32.2 28.8 ...
##  $ PctBachDeg25_Over    : num  19.6 22.7 16 9.3 15 11.9 11.9 11.3 12 16.2 ...
##  $ PctEmployed16_Over   : num  51.9 55.9 45.9 48.3 48.2 44.1 51.8 40.9 39.5 56.6 ...
##  $ PctUnemployed16_Over: num  8 7.8 7 12.1 4.8 12.9 8.9 8.9 10.3 9.2 ...
##  $ PctPrivateCoverage   : num  75.1 70.2 63.7 58.4 61.6 60 49.5 55.8 55.5 69.9 ...
##  $ PctEmpPrivCoverage   : num  41.6 43.6 34.9 35 35.1 32.6 28.3 25.9 29.9 44.4 ...
##  $ PctPublicCoverage    : num  32.9 31.1 42.1 45.3 44 43.2 46.4 50.9 48.1 31.4 ...
##  $ PctWhite             : num  81.8 89.2 90.9 91.7 94.1 ...
##  $ PctBlack             : num  2.595 0.969 0.74 0.783 0.27 ...
##  $ PctAsian             : num  4.822 2.246 0.466 1.161 0.666 ...
##  $ PctOtherRace         : num  1.843 3.741 2.747 1.363 0.492 ...
##  $ PctMarriedHouseholds: num  52.9 45.4 54.4 51 54 ...
##  $ BirthRate            : num  6.12 4.33 3.73 4.6 6.8 ...
##  $ deathRate            : num  165 161 175 195 144 ...
```

There are 31 variables across 3047 observations in this data set

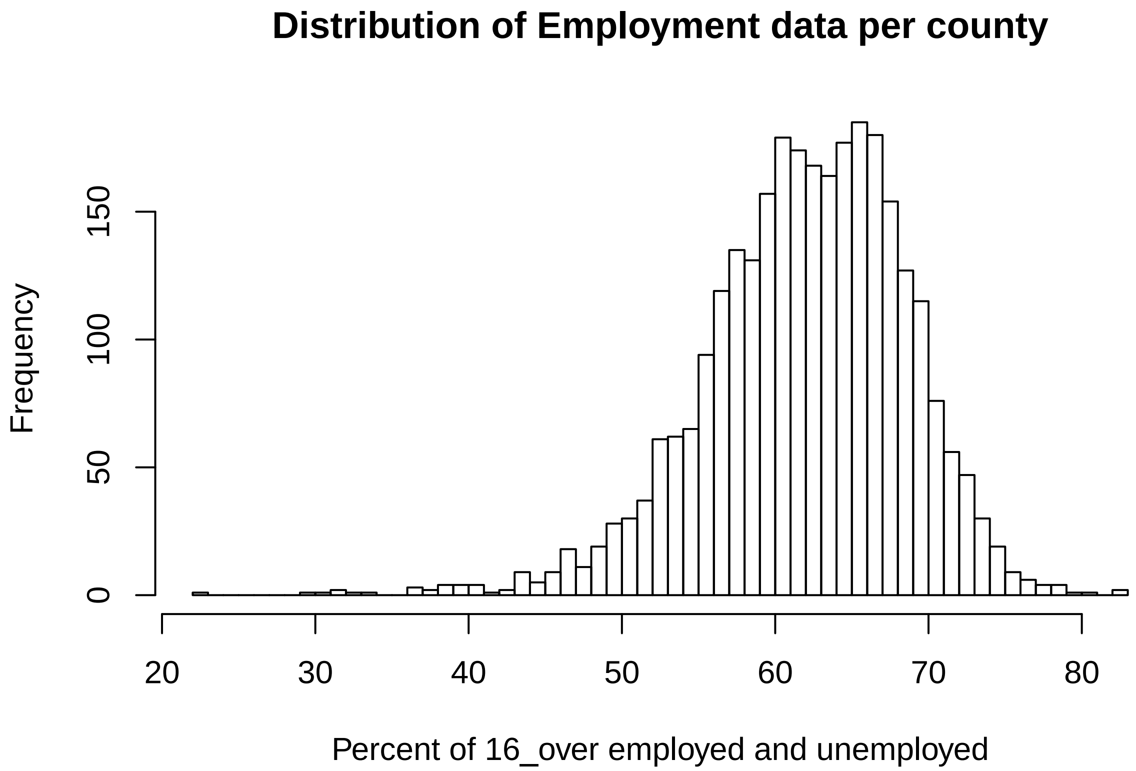
```
summary(cancer)
```

```
##        X           avgAnnCount        medIncome        popEst2015
##  Min.   :   1.0   Min.   :    6.0   Min.   : 22640   Min.   :     827
##  1st Qu.: 762.5   1st Qu.:   76.0   1st Qu.: 38882   1st Qu.:   11684
##  Median :1524.0   Median :  171.0   Median : 45207   Median :   26643
##  Mean   :1524.0   Mean   :  606.3   Mean   : 47063   Mean   :  102637
##  3rd Qu.:2285.5   3rd Qu.:  518.0   3rd Qu.: 52492   3rd Qu.:   68671
##  Max.   :3047.0   Max.   :38150.0   Max.   :125635   Max.   :10170292
##
##  povertyPercent               binnedInc      MedianAge
##  Min.   : 3.20   (45201, 48021.6]  : 306   Min.   : 22.30
##  1st Qu.:12.15   (54545.6, 61494.5]: 306   1st Qu.: 37.70
##  Median :15.90   [22640, 34218.1]  : 306   Median : 41.00
##  Mean   :16.88   (42724.4, 45201]  : 305   Mean   : 45.27
##  3rd Qu.:20.40   (48021.6, 51046.4]: 305   3rd Qu.: 44.00
##  Max.   :47.40   (51046.4, 54545.6]: 305   Max.   :624.00
##                  (Other)           :1214
##  MedianAgeMale   MedianAgeFemale                              Geography
##  Min.   :22.40   Min.   :22.30   Abbeville County, South Carolina:   1
##  1st Qu.:36.35   1st Qu.:39.10   Acadia Parish, Louisiana        :   1
##  Median :39.60   Median :42.40   Accomack County, Virginia       :   1
##  Mean   :39.57   Mean   :42.15   Ada County, Idaho               :   1
##  3rd Qu.:42.50   3rd Qu.:45.30   Adair County, Iowa              :   1
##  Max.   :64.70   Max.   :65.70   Adair County, Kentucky          :   1
##                                  (Other)                         :3041
##  AvgHouseholdSize PercentMarried   PctNoHS18_24     PctHS18_24
##  Min.   :0.0221   Min.   :23.10   Min.   : 0.00   Min.   : 0.0
##  1st Qu.:2.3700   1st Qu.:47.75   1st Qu.:12.80   1st Qu.:29.2
##  Median :2.5000   Median :52.40   Median :17.10   Median :34.7
##  Mean   :2.4797   Mean   :51.77   Mean   :18.22   Mean   :35.0
##  3rd Qu.:2.6300   3rd Qu.:56.40   3rd Qu.:22.70   3rd Qu.:40.7
##  Max.   :3.9700   Max.   :72.50   Max.   :64.10   Max.   :72.5
##
##  PctSomeCol18_24 PctBachDeg18_24   PctHS25_Over   PctBachDeg25_Over
##  Min.   : 7.10   Min.   : 0.000   Min.   : 7.50   Min.   : 2.50
##  1st Qu.:34.00   1st Qu.: 3.100   1st Qu.:30.40   1st Qu.: 9.40
##  Median :40.40   Median : 5.400   Median :35.30   Median :12.30
##  Mean   :40.98   Mean   : 6.158   Mean   :34.80   Mean   :13.28
##  3rd Qu.:46.40   3rd Qu.: 8.200   3rd Qu.:39.65   3rd Qu.:16.10
##  Max.   :79.00   Max.   :51.800   Max.   :54.80   Max.   :42.20
##  NA's   :2285
##  PctEmployed16_Over PctUnemployed16_Over PctPrivateCoverage
##  Min.   :17.60      Min.   : 0.400       Min.   :22.30
##  1st Qu.:48.60      1st Qu.: 5.500       1st Qu.:57.20
##  Median :54.50      Median : 7.600       Median :65.10
##  Mean   :54.15      Mean   : 7.852       Mean   :64.35
##  3rd Qu.:60.30      3rd Qu.: 9.700       3rd Qu.:72.10
##  Max.   :80.10      Max.   :29.400       Max.   :92.30
##  NA's   :152
##  PctEmpPrivCoverage PctPublicCoverage    PctWhite         PctBlack
##  Min.   :13.5       Min.   :11.20     Min.   : 10.20   Min.   : 0.0000
##  1st Qu.:34.5       1st Qu.:30.90     1st Qu.: 77.30   1st Qu.: 0.6207
##  Median :41.1       Median :36.30     Median : 90.06   Median : 2.2476
##  Mean   :41.2       Mean   :36.25     Mean   : 83.65   Mean   : 9.1080
##  3rd Qu.:47.7       3rd Qu.:41.55     3rd Qu.: 95.45   3rd Qu.:10.5097
##  Max.   :70.7       Max.   :65.10     Max.   :100.00   Max.   :85.9478
##
##     PctAsian        PctOtherRace     PctMarriedHouseholds   BirthRate
##  Min.   : 0.0000   Min.   : 0.0000   Min.   :22.99        Min.   : 0.000
##  1st Qu.: 0.2542   1st Qu.: 0.2952   1st Qu.:47.76       1st Qu.: 4.521
##  Median : 0.5498   Median : 0.8262   Median :51.67       Median : 5.381
##  Mean   : 1.2540   Mean   : 1.9835   Mean   :51.24       Mean   : 5.640
##  3rd Qu.: 1.2210   3rd Qu.: 2.1780   3rd Qu.:55.40       3rd Qu.: 6.494
##  Max.   :42.6194   Max.   :41.9303   Max.   :78.08       Max.   :21.326
##
##    deathRate
##  Min.   : 59.7
##  1st Qu.:161.2
##  Median :178.1
##  Mean   :178.7
##  3rd Qu.:195.2
##  Max.   :362.8
##
```

```
Emp.UnEmp<-cancer$PctEmployed16_Over+cancer$PctUnemployed16_Over
summary(Emp.UnEmp)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##   22.40   58.00   62.50   62.01   66.60   82.70     152
```

```
hist(Emp.UnEmp,breaks="fd",main="Distribution of Employment data per county",xlab="Percent of 16_over em
```



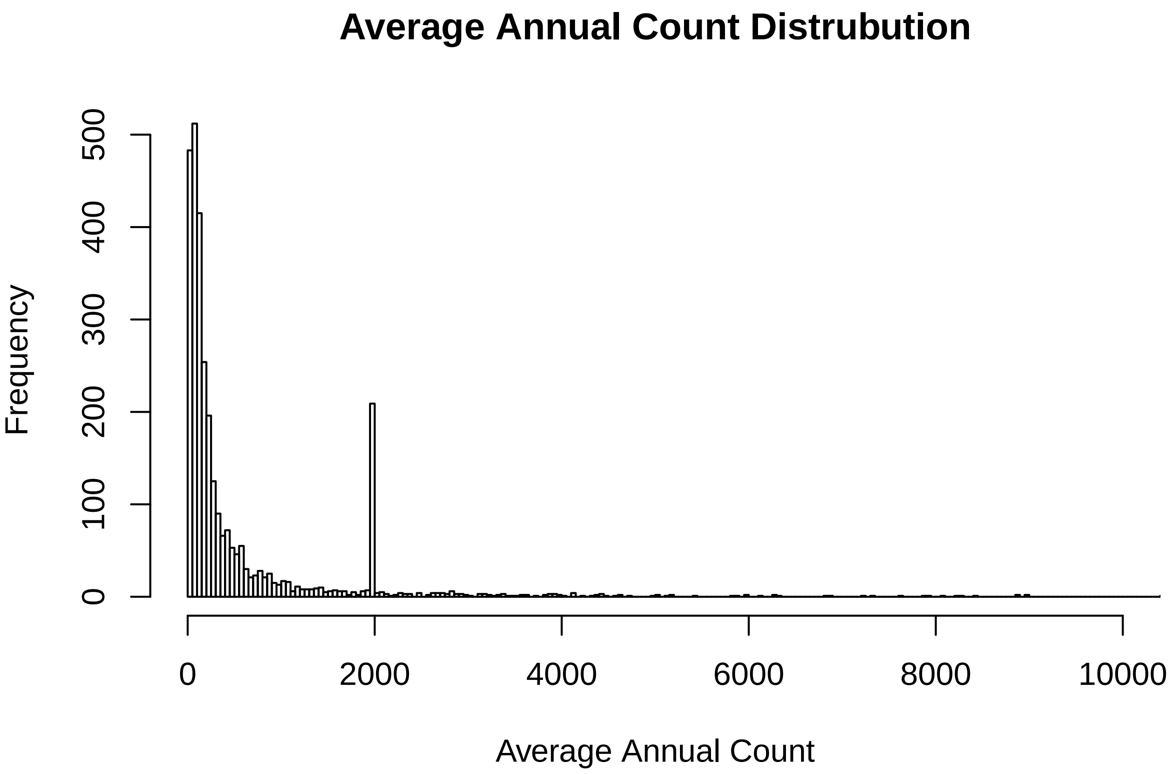
There are 2 variables with null values: PctSomeCol18_24 and PctEmployed16_Over The sum of the variables percentage employed and unemployed over 16 has a surprisingly broad distribution around the mean of 62.01, when one would expect it to be close to (if not) 100%. We will keep those aside and look at other variables

```
#Annual Indident Rate is better expressed as a percentage of county population
cancer$AnnCountPercent<-with(cancer,100*avgAnnCount/popEst2015)
summary(cancer$AnnCountPercent)
```

```
##      Min.    1st Qu.    Median      Mean    3rd Qu.      Max.
##   0.09281   0.48020   0.56240   2.32400   0.64870 236.80000
```

```
#Look for where the outlier might be coming from

hist(cancer$avgAnnCount,breaks="fd",main="Average Annual Count Distrubution",xlab="Average Annual Count
```



```
outliers<-cancer[cancer$AnnCountPercent>50,] #Assuming anything over 50% incident rate has to be an err
summary(outliers$avgAnnCount)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    1963    1963    1963    1963    1963    1963
```

```
#Clearly all of these have the exact same erroneous value for Average Annual Count.
error_value<-outliers[1,"avgAnnCount"]
cancer$avgAnnCount[cancer$avgAnnCount==error_value]<-NA
summary(cancer$avgAnnCount)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##       6      71     153     508     396   38150     206
```

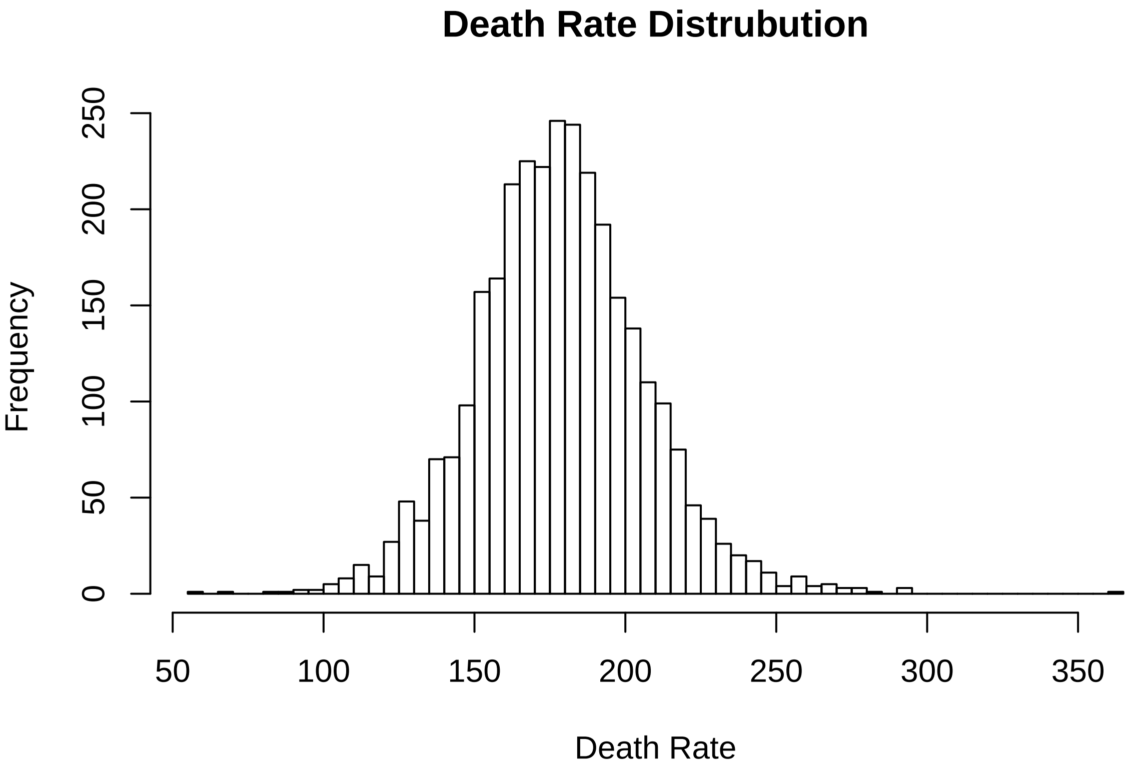
```
cancer$AnnCountPercent<-with(cancer,100*avgAnnCount/popEst2015) #Recalculate percentages
summary(cancer$AnnCountPercent)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##  0.1403  0.4747  0.5532  0.5507  0.6283  1.4050     206
```

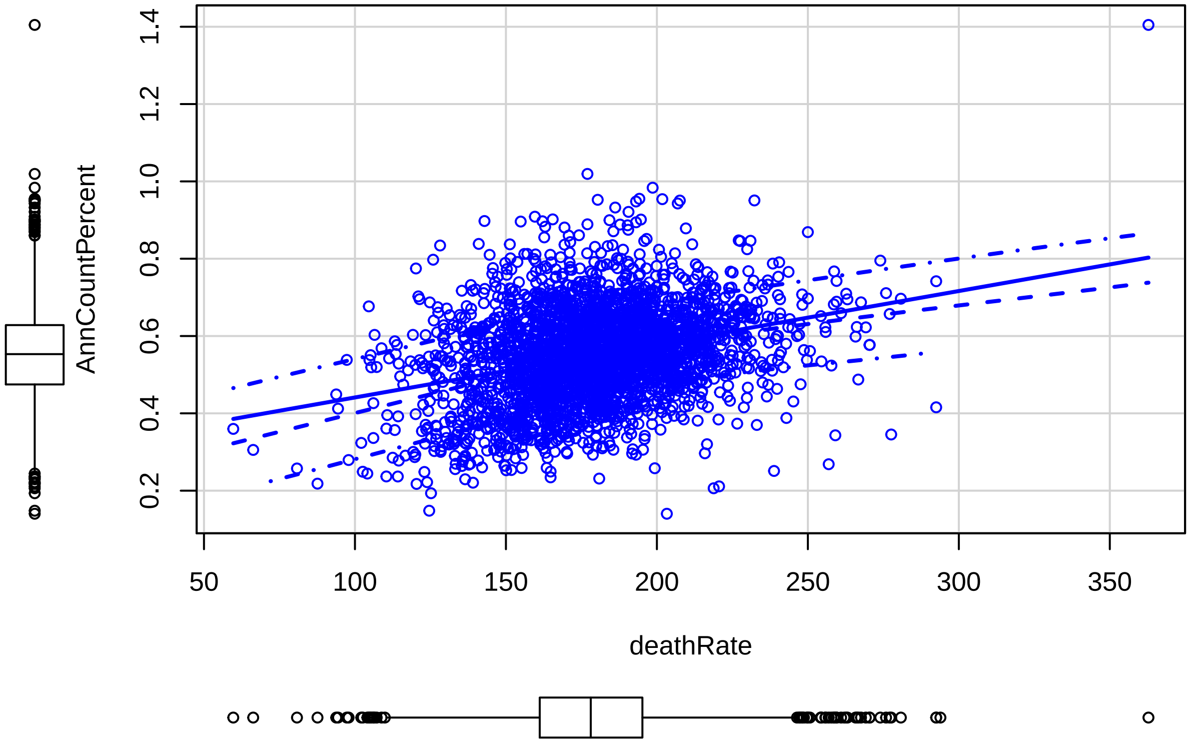
```
summary(cancer$deathRate)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    59.7   161.2   178.1   178.7   195.2   362.8
```

```
hist(cancer$deathRate,breaks="fd",main="Death Rate Distrubution",xlab="Death Rate")
```



```
scatterplot(AnnCountPercent~deathRate,data=cancer)
```



Prep final data set for analysis

It is clear that the annual count percent has some outliers given that max % >100 (can’t be more incidents than the population) Plotting the Avg annual count shows a big spike in values

```
hist(cancer$avgAnnCount,100000)
```

Try with smaller range

```
hist(cancer$avgAnnCount,100000,xlim=c(1900,2010)) #Get these outlier values
```

```
cleandata<-subset(cancer,avgAnnCount>1970 & avgAnnCount>1960) hist(cleandata$avgAnnCount,100000)
```

“‘

Analysis of Key Relationships

Explore how your outcome variable is related to the other variables in your dataset. Make sure to use visualizations to understand the nature of each bivariate relationship. What transformations can you apply to clarify the relationships you see in the data? Be sure to justify each transformation you use.

Analysis of Secondary Effects (10 pts)

What secondary variables might have confounding effects on the relationships you have identified? Ex- plain how these variables affect your understanding of the data.

Conclusion (20 pts)

Summarize your exploratory analysis. What can you conclude based on your analysis? 2