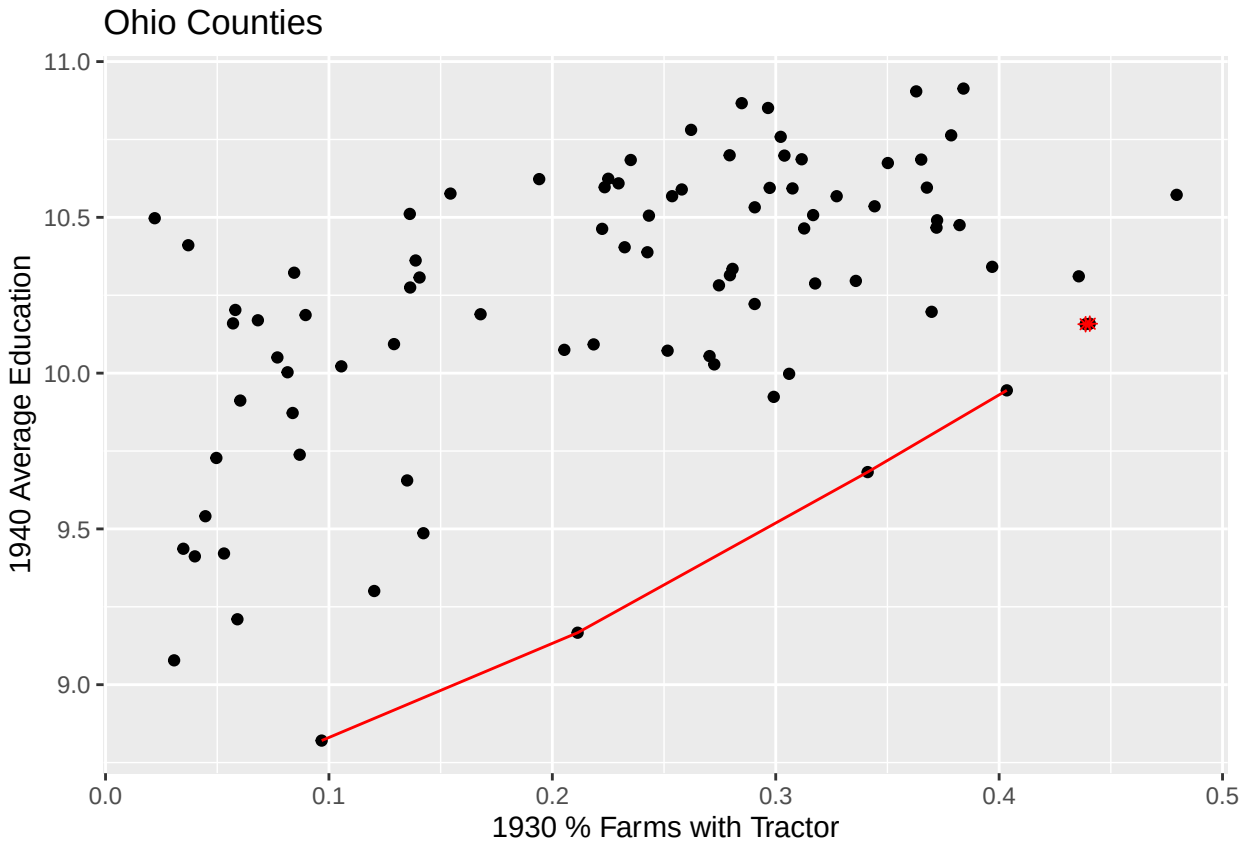
Ohio

Analysis of Ohio Education and Tractor Data

```
## Parsed with column specification:
## cols(
##   X1 = col_integer(),
##   X = col_integer(),
##   year = col_integer(),
##   state = col_integer(),
##   county = col_integer(),
##   name = col_character(),
##   percent_farm_tractor = col_double(),
##   stateAbb = col_character(),
##   fips = col_integer(),
##   colorID = col_integer()
## )
## Parsed with column specification:
## cols(
##   X1 = col_integer(),
##   X = col_integer(),
##   year = col_integer(),
##   state = col_integer(),
##   county = col_integer(),
##   name = col_character(),
##   percent_farm_tractor = col_double(),
##   stateAbb = col_character(),
##   fips = col_integer(),
##   colorID = col_integer()
## )
```

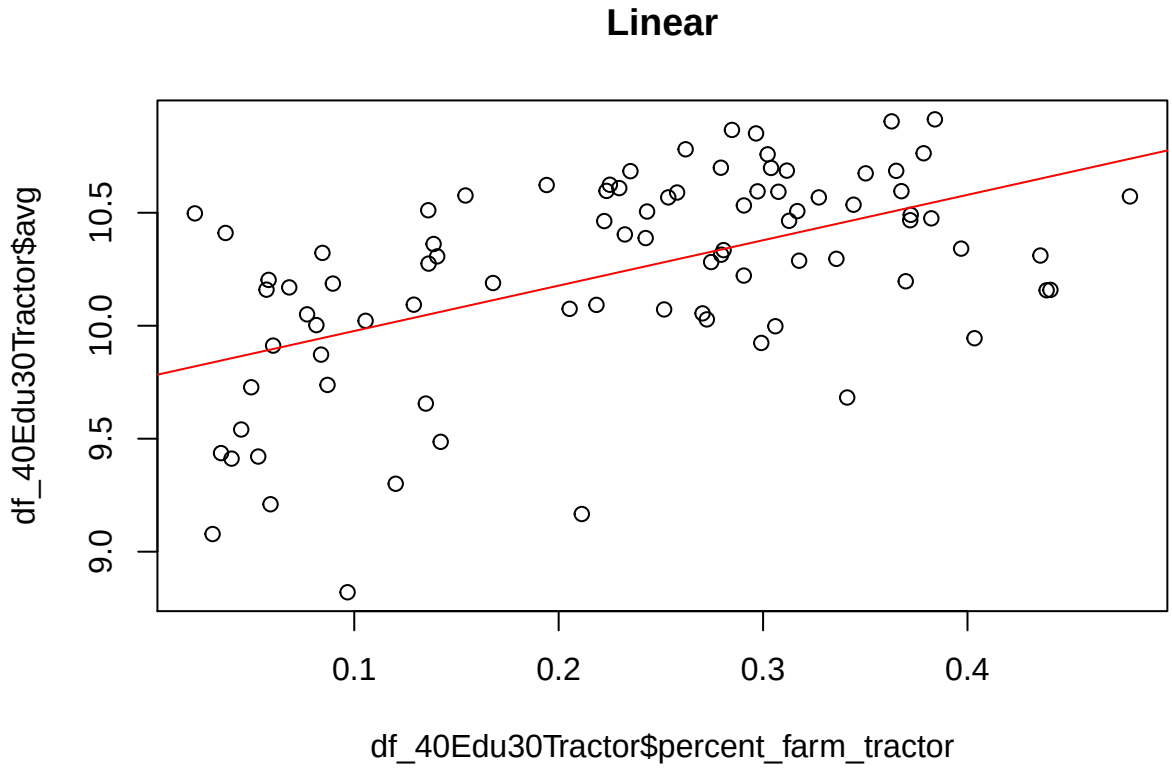
Exploratory Plots of Average Education by County Vs. % of Farms with Tractors

Ohio 1940 Average Education Vs. Ohio 1930 % of Farms with Tractor



Linear Model 1940 Avg. Edu vs 1930 % Farm w/ Tractor

```
ohEduModLinear <- lm(avg ~ percent_farm_tractor, data = df_40Edu30Tractor)
plot(df_40Edu30Tractor$percent_farm_tractor, df_40Edu30Tractor$avg, main = "Linear")
abline(ohEduModLinear, col = "red")
```

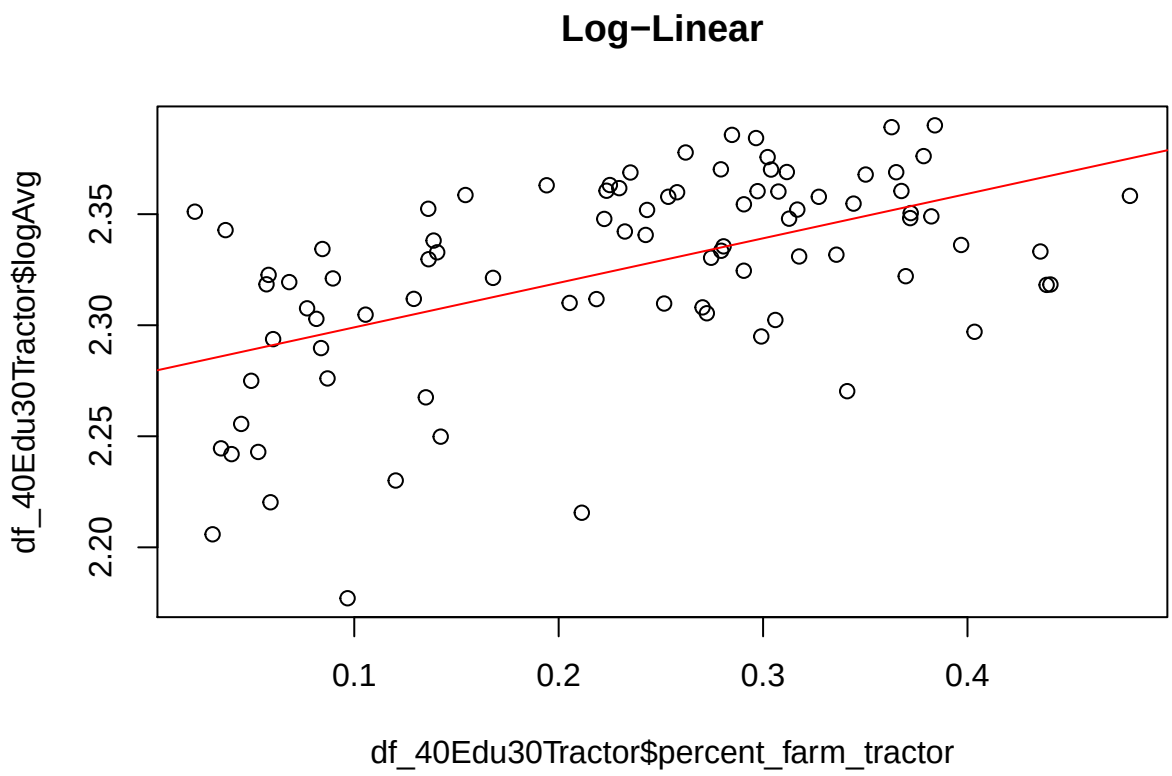



```
summary(ohEduModLinear)
```

```
##
## Call:
## lm(formula = avg ~ percent_farm_tractor, data = df_40Edu30Tractor)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -1.14966 -0.22211  0.06822  0.28365  0.67705
##
## Coefficients:
##                     Estimate Std. Error t value Pr(>|t|)
## (Intercept)           9.7760     0.0882 110.833  < 2e-16 ***
## percent_farm_tractor  2.0083     0.3401   5.906 7.03e-08 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.383 on 85 degrees of freedom
## Multiple R-squared:  0.2909, Adjusted R-squared:  0.2826
## F-statistic: 34.88 on 1 and 85 DF,  p-value: 7.025e-08
```

Log-Linear Model 1940 Avg. Edu vs 1930 % Farm w/ Tractor

```
df_40Edu30Tractor$logAvg <- log(df_40Edu30Tractor$avg)
ohEduModLogLinear <- lm(logAvg ~ percent_farm_tractor, data = df_40Edu30Tractor)
plot(df_40Edu30Tractor$percent_farm_tractor, df_40Edu30Tractor$logAvg, main = "Log-Linear")
abline(ohEduModLogLinear, col = "red")
```

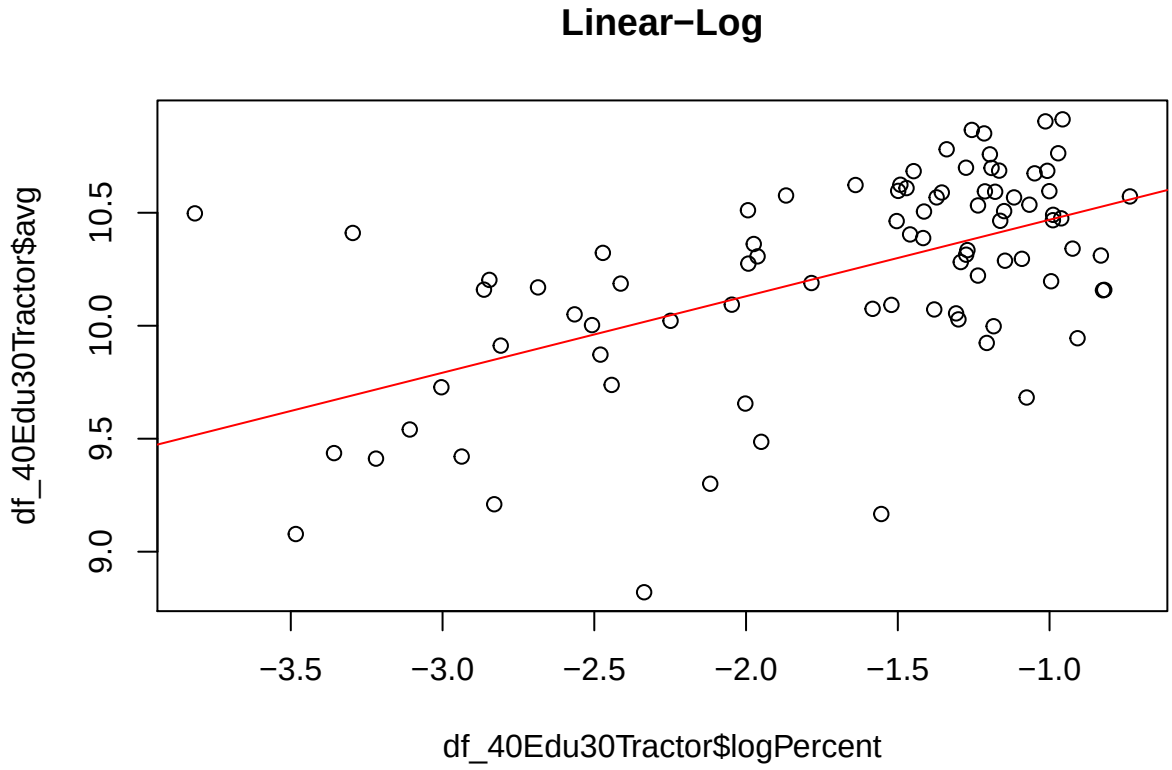



```
summary(ohEduModLogLinear)
```

```
##
## Call:
## lm(formula = logAvg ~ percent_farm_tractor, data = df_40Edu30Tractor)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.121302 -0.021393  0.007532  0.027990  0.067698
##
## Coefficients:
##                     Estimate Std. Error t value Pr(>|t|)
## (Intercept)          2.279001   0.008841  257.76  < 2e-16 ***
## percent_farm_tractor 0.200427   0.034087    5.88 7.85e-08 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.03839 on 85 degrees of freedom
## Multiple R-squared:  0.2891, Adjusted R-squared:  0.2808
## F-statistic: 34.57 on 1 and 85 DF,  p-value: 7.848e-08
```

Linear-Log Model 1940 Avg. Edu vs 1930 % Farm w/ Tractor

```
df_40Edu30Tractor$logPercent <- log(df_40Edu30Tractor$percent_farm_tractor)
ohEduModLinearLog <- lm(avg ~ logPercent, data = df_40Edu30Tractor)
plot(df_40Edu30Tractor$logPercent, df_40Edu30Tractor$avg, main = "Linear-Log")
abline(ohEduModLinearLog, col = "red")
```

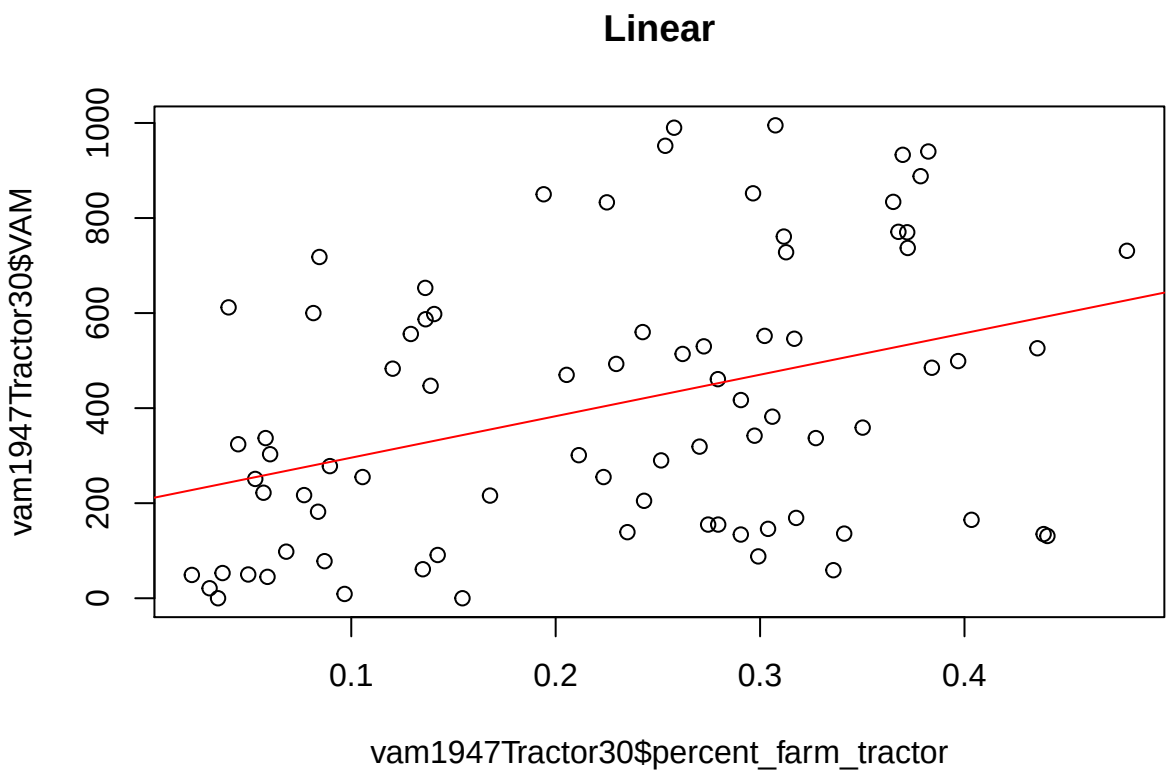



```
summary(ohEduModLinearLog)
```

```
##
## Call:
## lm(formula = avg ~ logPercent, data = df_40Edu30Tractor)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -1.19632 -0.21516  0.05499  0.27234  0.98138
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) 10.80745    0.09983 108.255  < 2e-16 ***
## logPercent   0.33845    0.05417   6.248 1.59e-08 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.3766 on 85 degrees of freedom
## Multiple R-squared:  0.3147, Adjusted R-squared:  0.3067
## F-statistic: 39.04 on 1 and 85 DF,  p-value: 1.589e-08
```

Linear Model VAM 1947 vs Percent 1930

```
vam47Tractor30Mod <- lm(VAM ~ percent_farm_tractor, data = vam1947Tractor30)
plot(vam1947Tractor30$percent_farm_tractor, vam1947Tractor30$VAM, main = "Linear")
abline(vam47Tractor30Mod, col = "red")
```




```
summary(vam47Tractor30Mod)
```

```
##
## Call:
## lm(formula = VAM ~ percent_farm_tractor, data = vam1947Tractor30)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -462.10 -208.32  -45.39  235.30  556.35
##
## Coefficients:
##                     Estimate Std. Error t value Pr(>|t|)
## (Intercept)           208.46      62.12   3.356 0.001226 **
## percent_farm_tractor  873.07     241.54   3.615 0.000531 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 267.9 on 78 degrees of freedom
## Multiple R-squared:  0.1435, Adjusted R-squared:  0.1325
## F-statistic: 13.07 on 1 and 78 DF,  p-value: 0.000531
```

Residuals from VAM 47 vs. Percent 30

```
vam47Residuals <-data.frame(vam47Tractor30Mod$residuals, vam1947Tractor30$county, vam1947Tractor30)
vam47Residuals
```

```
##    vam47Tractor30Mod.residuals vam1947Tractor30.county  fips county
## 1                  -214.994273                      10 39001     10
## 2                   428.070892                      30 39003     30
```

```
## 3                472.063509                  50 39005     50
## 4                 84.058441                  70 39007     70
## 5               -169.993062                  90 39009     90
## 6                 61.007663                 110 39011    110
## 7                -58.614924                 130 39013    130
## 8               -206.340345                 150 39015    150
## 9                401.695552                 170 39017    170
## 10                -8.633830                 190 39019    190
## 11              -125.520252                 210 39021    210
## 13              -265.328863                 250 39025    250
## 14              -316.779148                 270 39027    270
## 15               266.818266                 290 39029    290
## 16               435.831153                 310 39031    310
## 17               384.628013                 330 39033    330
## 19              -328.143794                 370 39037    370
## 20               -55.972853                 390 39039    390
## 21              -148.513357                 410 39041    410
## 22               306.763656                 430 39043    430
## 23                82.250417                 450 39045    450
## 24              -395.688823                 470 39047    470
## 25                79.681637                 490 39049    490
## 26              -157.187923                 510 39051    510
## 27              -214.256282                 530 39053    530
## 28              -138.113593                 550 39055    550
## 29              -327.773284                 570 39057    570
## 30               -36.279397                 590 39059    590
## 32               -58.745962                 630 39063    630
## 33              -293.189494                 650 39065    650
## 34               -99.582105                 670 39067    670
## 35              -462.100049                 690 39069    690
## 36              -139.027462                 710 39071    710
## 37                41.890732                 730 39073    730
## 38              -241.680920                 750 39075    750
## 39              -155.190608                 770 39077    770
## 40                76.527608                 790 39079    790
## 41               234.802219                 810 39081    810
## 42               325.634939                 830 39083    830
## 43               280.482618                 850 39085    850
## 44               368.636885                 870 39087    870
## 45               117.350774                 890 39089    890
## 46              -274.716377                 910 39091    910
## 47               349.053411                 930 39093    930
## 48               518.069785                 950 39095    950
## 49              -370.307338                 970 39097    970
## 50               522.121661                 990 39099    990
## 51               203.560118                1010 39101   1010
## 52                 8.646107                1030 39103   1030
## 53              -201.757571                1050 39105   1050
## 54               -93.612800                1070 39107   1070
## 55               246.516899                1090 39109   1090
## 56              -238.855979                1110 39111   1110
## 58              -187.791582                1150 39115   1150
## 59              -343.259852                1170 39117   1170
## 60               320.415170                1190 39119   1190
```

```
## 61                -178.672979                    1210 39121   1210
## 62                 -62.817490                    1230 39123   1230
## 63                -456.480284                    1250 39125   1250
## 64                 -45.595543                    1270 39127   1270
## 65                -283.910975                    1310 39131   1310
## 66                  76.702578                    1330 39133   1330
## 67                -442.686375                    1350 39135   1350
## 68                -381.604269                    1370 39137   1370
## 70                 -91.948146                    1410 39141   1410
## 71                 241.547837                    1430 39143   1430
## 72                 169.538758                    1450 39145   1450
## 73                 397.767524                    1470 39147   1470
## 74                 236.782384                    1490 39149   1490
## 75                 556.350539                    1510 39151   1510
## 78                 259.489252                    1570 39157   1570
## 79                -215.824224                    1590 39159   1590
## 80                -126.027018                    1610 39161   1610
## 81                  -3.748685                    1630 39163   1630
## 82                  83.648255                    1650 39165   1650
## 83                  77.822668                    1670 39167   1670
## 84                 139.775195                    1690 39169   1690
## 85                 -45.180167                    1710 39171   1710
## 86                 103.929477                    1730 39173   1730
## 87                -297.484334                    1750 39175   1750
##          avg year.x state.x       name percent_farm_tractor stateAbb
## 1   9.209961   1930      39      ADAMS           0.05903146       OH
## 2  10.623929   1930      39      ALLEN           0.22503726       OH
## 3  10.622720   1930      39    ASHLAND           0.19412039       OH
## 4  10.609148   1930      39  ASHTABULA           0.22963305       OH
## 5  10.169675   1930      39     ATHENS           0.06819313       OH
## 6  10.507224   1930      39   AUGLAIZE           0.31674026       OH
## 7  10.050313   1930      39    BELMONT           0.07692308       OH
## 8   9.738122   1930      39      BROWN           0.08691702       OH
## 9  10.196781   1930      39     BUTLER           0.36978534       OH
## 10 10.186483   1930      39    CARROLL           0.08954394       OH
## 11 10.054731   1930      39  CHAMPAIGN           0.27038425       OH
## 13  9.655556   1930      39   CLERMONT           0.13500993       OH
## 14 10.287815   1930      39    CLINTON           0.31764146       OH
## 15 10.306936   1930      39 COLUMBIANA           0.14056832       OH
## 16 10.322308   1930      39  COSHOCTON           0.08442982       OH
## 17 10.851064   1930      39   CRAWFORD           0.29655823       OH
## 19 10.221900   1930      39      DARKE           0.29056995       OH
## 20 10.341207   1930      39   DEFIANCE           0.39689471       OH
## 21 10.596730   1930      39   DELAWARE           0.22341568       OH
## 22 10.685484   1930      39       ERIE           0.36512580       OH
## 23 10.074779   1930      39  FAIRFIELD           0.20536013       OH
## 24  9.944751   1930      39    FAYETTE           0.40344168       OH
## 25 10.758445   1930      39   FRANKLIN           0.30222372       OH
## 26 10.567867   1930      39     FULTON           0.32727273       OH
## 27  9.078111   1930      39     GALLIA           0.03069700       OH
## 28 10.072043   1930      39     GEAUGA           0.25159236       OH
## 29 10.698218   1930      39     GREENE           0.30389016       OH
## 30 10.159635   1930      39   GUERNSEY           0.05706727       OH
## 32 10.913314   1930      39    HANCOCK           0.38403563       OH
```

```
## 33 10.281763   1930      39     HARDIN          0.27458694       OH
## 34  9.872080   1930      39   HARRISON          0.08375778       OH
## 35 10.158685   1930      39      HENRY          0.44056493       OH
## 36 10.189036   1930      39   HIGHLAND          0.16788079       OH
## 37  9.911968   1930      39    HOCKING          0.06030856       OH
## 38  9.486194   1930      39     HOLMES          0.14228546       OH
## 39 10.674342   1930      39      HURON          0.35018345       OH
## 40  9.540707   1930      39    JACKSON          0.04468912       OH
## 41 10.093175   1930      39  JEFFERSON          0.12913288       OH
## 42 10.511027   1930      39       KNOX          0.13619677       OH
## 43 10.686385   1930      39       LAKE          0.31161473       OH
## 44  9.411918   1930      39   LAWRENCE          0.03998243       OH
## 45 10.361612   1930      39    LICKING          0.13881301       OH
## 46 10.684086   1930      39      LOGAN          0.23510204       OH
## 47 10.763259   1930      39     LORAIN          0.37853851       OH
## 48 10.592837   1930      39      LUCAS          0.30750605       OH
## 49  9.682366   1930      39    MADISON          0.34115409       OH
## 50 10.567978   1930      39   MAHONING          0.25361367       OH
## 51 10.490716   1930      39     MARION          0.37223123       OH
## 52 10.699282   1930      39     MEDINA          0.27935677       OH
## 53  9.727691   1930      39      MEIGS          0.04959729       OH
## 54  9.997748   1930      39     MERCER          0.30599711       OH
## 55 10.464348   1930      39      MIAMI          0.31272085       OH
## 56  9.436264   1930      39     MONROE          0.03482003       OH
## 58 10.410557   1930      39     MORGAN          0.03703704       OH
## 59 10.576296   1930      39     MORROW          0.15440238       OH
## 60 10.002766   1930      39  MUSKINGUM          0.08147014       OH
## 61 10.497222   1930      39      NOBLE          0.02201122       OH
## 62 10.310724   1930      39     OTTAWA          0.43565976       OH
## 63 10.157001   1930      39   PAULDING          0.43870968       OH
## 64 10.021769   1930      39      PERRY          0.10553544       OH
## 65  8.820574   1930      39       PIKE          0.09673367       OH
## 66 10.780847   1930      39    PORTAGE          0.26211135       OH
## 67 10.296046   1930      39     PREBLE          0.33586132       OH
## 68  9.923810   1930      39     PUTNAM          0.29911504       OH
## 70  9.166793   1930      39       ROSS          0.21131448       OH
## 71 10.595465   1930      39   SANDUSKY          0.36766376       OH
## 72  9.300681   1930      39     SCIOTO          0.12027158       OH
## 73 10.475133   1930      39     SENECA          0.38230211       OH
## 74 10.466939   1930      39     SHELBY          0.37197665       OH
## 75 10.589506   1930      39      STARK          0.25793304       OH
## 78 10.274903   1930      39 TUSCARAWAS          0.13636364       OH
## 79 10.505435   1930      39      UNION          0.24324324       OH
## 80 10.594572   1930      39   VAN WERT          0.29730849       OH
## 81  9.421053   1930      39     VINTON          0.05302326       OH
## 82 10.028030   1930      39     WARREN          0.27248201       OH
## 83 10.202782   1930      39 WASHINGTON          0.05809575       OH
## 84 10.387983   1930      39      WAYNE          0.24255668       OH
## 85 10.532258   1930      39   WILLIAMS          0.29061161       OH
## 86 10.572193   1930      39       WOOD          0.47947411       OH
## 87 10.314286   1930      39    WYANDOT          0.27950617       OH
##    colorID.x   logAvg logPercent   X.1     X        polyname RUCC
## 1          1 2.220286 -2.8296848 10023 10023      ohio,adams    9
## 2          4 2.363109 -1.4914893 10028 10028      ohio,allen    3
```

```
## 3          3 2.362995 -1.6392767 10033 10033    ohio,ashland    6
## 4          4 2.361717 -1.4712727 10038 10038  ohio,ashtabula    4
## 5          2 2.319410 -2.6854114 10043 10043     ohio,athens    7
## 6          5 2.352063 -1.1496732 10047 10047   ohio,auglaize    6
## 7          2 2.307604 -2.5649494 10052 10052    ohio,belmont    2
## 8          2 2.276048 -2.4428014 10057 10057      ohio,brown    9
## 9          6 2.322072 -0.9948326 10059 10059     ohio,butler    3
## 10         2 2.321062 -2.4130259 10067 10067    ohio,carroll    6
## 11         4 2.308043 -1.3079112 10073 10073  ohio,champaign    6
## 13         2 2.267533 -2.0024070 10079 10079   ohio,clermont    8
## 14         5 2.330960 -1.1468320 10088 10088    ohio,clinton    6
## 15         3 2.332817 -1.9620617 10092 10092 ohio,columbiana    4
## 16         2 2.334307 -2.4718346 10098 10098  ohio,coshocton    7
## 17         5 2.384263 -1.2155117 10102 10102   ohio,crawford    7
## 19         5 2.324533 -1.2359109 10112 10112      ohio,darke    6
## 20         6 2.336137 -0.9240842 10116 10116   ohio,defiance    7
## 21         4 2.360545 -1.4987212 10121 10121   ohio,delaware    6
## 22         6 2.368886 -1.0075133 10125 10125       ohio,erie    4
## 23         4 2.310035 -1.5829901 10133 10133  ohio,fairfield    4
## 24         6 2.297045 -0.9077233 10136 10136    ohio,fayette    6
## 25         5 2.375691 -1.1965877 10143 10143   ohio,franklin    2
## 26         5 2.357818 -1.1169614 10147 10147     ohio,fulton    6
## 27         1 2.205866 -3.4835903 10151 10151     ohio,gallia    6
## 28         4 2.309764 -1.3799451 10158 10158     ohio,geauga    4
## 29         5 2.370077 -1.1910890 10162 10162     ohio,greene    2
## 30         1 2.318423 -2.8635245 10167 10167   ohio,guernsey    6
## 32         6 2.389984 -0.9570199 10174 10174    ohio,hancock    4
## 33         5 2.330372 -1.2924873 10183 10183     ohio,hardin    6
## 34         2 2.289711 -2.4798262 10185 10185   ohio,harrison    6
## 35         7 2.318329 -0.8196974 10193 10193      ohio,henry    6
## 36         3 2.321312 -1.7845011 10196 10196   ohio,highland    7
## 37         1 2.293743 -2.8082813 10202 10202    ohio,hocking    7
## 38         3 2.249838 -1.9499200 10207 10207     ohio,holmes    6
## 39         6 2.367843 -1.0492981 10213 10213      ohio,huron    6
## 40         1 2.255568 -3.1080252 10217 10217    ohio,jackson    6
## 41         2 2.311859 -2.0469134 10223 10223  ohio,jefferson    2
## 42         2 2.352425 -1.9936546 10228 10228       ohio,knox    7
## 43         5 2.368970 -1.1659877 10233 10233       ohio,lake    1
## 44         1 2.241977 -3.2193153 10238 10238   ohio,lawrence    3
## 45         3 2.338108 -1.9746275 10243 10243    ohio,licking    4
## 46         4 2.368755 -1.4477356 10248 10248      ohio,logan    7
## 47         6 2.376138 -0.9714375 10250 10250     ohio,lorain    3
## 48         5 2.360178 -1.1792605 10258 10258      ohio,lucas    2
## 49         6 2.270306 -1.0754210 10259 10259    ohio,madison    6
## 50         4 2.357828 -1.3719432 10268 10268   ohio,mahoning    2
## 51         6 2.350491 -0.9882400 10273 10273     ohio,marion    5
## 52         5 2.370177 -1.2752656 10278 10278     ohio,medina    6
## 53         1 2.274977 -3.0038191 10280 10280      ohio,meigs    7
## 54         5 2.302360 -1.1841796 10288 10288     ohio,mercer    7
## 55         5 2.347974 -1.1624443 10291 10291      ohio,miami    6
## 56         1 2.244560 -3.3575624 10297 10297     ohio,monroe    8
## 58         1 2.342820 -3.2958369 10305 10305     ohio,morgan    9
## 59         3 2.358615 -1.8681932 10309 10309     ohio,morrow    9
## 60         2 2.302862 -2.5075187 10314 10314  ohio,muskingum    5
```

```
## 61         1 2.351111 -3.8162029 10320 10320      ohio,noble    8
## 62         7 2.333185 -0.8308937 10324 10324     ohio,ottawa    6
## 63         7 2.318163 -0.8239174 10329 10329   ohio,paulding    9
## 64         2 2.304760 -2.2487085 10336 10336      ohio,perry    7
## 65         2 2.177087 -2.3357938 10347 10347       ohio,pike    9
## 66         4 2.377771 -1.3389859 10353 10353    ohio,portage    6
## 67         5 2.331760 -1.0910569 10357 10357     ohio,preble    6
## 68         5 2.294937 -1.2069270 10362 10362     ohio,putnam    6
## 70         4 2.215588 -1.5544078 10371 10371       ohio,ross    5
## 71         6 2.360426 -1.0005864 10374 10374   ohio,sandusky    7
## 72         2 2.230088 -2.1180029 10381 10381     ohio,scioto    4
## 73         6 2.349004 -0.9615441 10386 10386     ohio,seneca    7
## 74         6 2.348222 -0.9889242 10391 10391     ohio,shelby    7
## 75         4 2.359863 -1.3550553 10397 10397      ohio,stark    2
## 78         3 2.329704 -1.9924302 10412 10412 ohio,tuscarawas    6
## 79         4 2.351893 -1.4136933 10417 10417      ohio,union    6
## 80         5 2.360342 -1.2129850 10423 10423   ohio,van wert    6
## 81         1 2.242947 -2.9370247 10428 10428     ohio,vinton    9
## 82         5 2.305384 -1.3001827 10432 10432     ohio,warren    6
## 83         1 2.322660 -2.8456628 10438 10438 ohio,washington    7
## 84         4 2.340650 -1.4165199 10443 10443      ohio,wayne    6
## 85         5 2.354443 -1.2357676 10448 10448   ohio,williams    7
## 86         8 2.358227 -0.7350654 10451 10451       ohio,wood    6
## 87         5 2.333530 -1.2747309 10457 10457    ohio,wyandot    7
##               County VAM year.y state.y state.low        county.low
## 1       Adams County  45   1947    Ohio      ohio      adams county
## 2       Allen County 833   1947    Ohio      ohio      allen county
## 3     Ashland County 850   1947    Ohio      ohio    ashland county
## 4   Ashtabula County 493   1947    Ohio      ohio  ashtabula county
## 5      Athens County  98   1947    Ohio      ohio     athens county
## 6    Auglaize County 546   1947    Ohio      ohio   auglaize county
## 7     Belmont County 217   1947    Ohio      ohio    belmont county
## 8       Brown County  78   1947    Ohio      ohio      brown county
## 9      Butler County 933   1947    Ohio      ohio     butler county
## 10    Carroll County 278   1947    Ohio      ohio    carroll county
## 11  Champaign County 319   1947    Ohio      ohio  champaign county
## 13   Clermont County  61   1947    Ohio      ohio   clermont county
## 14    Clinton County 169   1947    Ohio      ohio    clinton county
## 15 Columbiana County 598   1947    Ohio      ohio columbiana county
## 16  Coshocton County 718   1947    Ohio      ohio  coshocton county
## 17   Crawford County 852   1947    Ohio      ohio   crawford county
## 19      Darke County 134   1947    Ohio      ohio      darke county
## 20   Defiance County 499   1947    Ohio      ohio   defiance county
## 21   Delaware County 255   1947    Ohio      ohio   delaware county
## 22       Erie County 834   1947    Ohio      ohio       erie county
## 23  Fairfield County 470   1947    Ohio      ohio  fairfield county
## 24    Fayette County 165   1947    Ohio      ohio    fayette county
## 25   Franklin County 552   1947    Ohio      ohio   franklin county
## 26     Fulton County 337   1947    Ohio      ohio     fulton county
## 27     Gallia County  21   1947    Ohio      ohio     gallia county
## 28     Geauga County 290   1947    Ohio      ohio     geauga county
## 29     Greene County 146   1947    Ohio      ohio     greene county
## 30   Guernsey County 222   1947    Ohio      ohio   guernsey county
## 32    Hancock County 485   1947    Ohio      ohio    hancock county
```

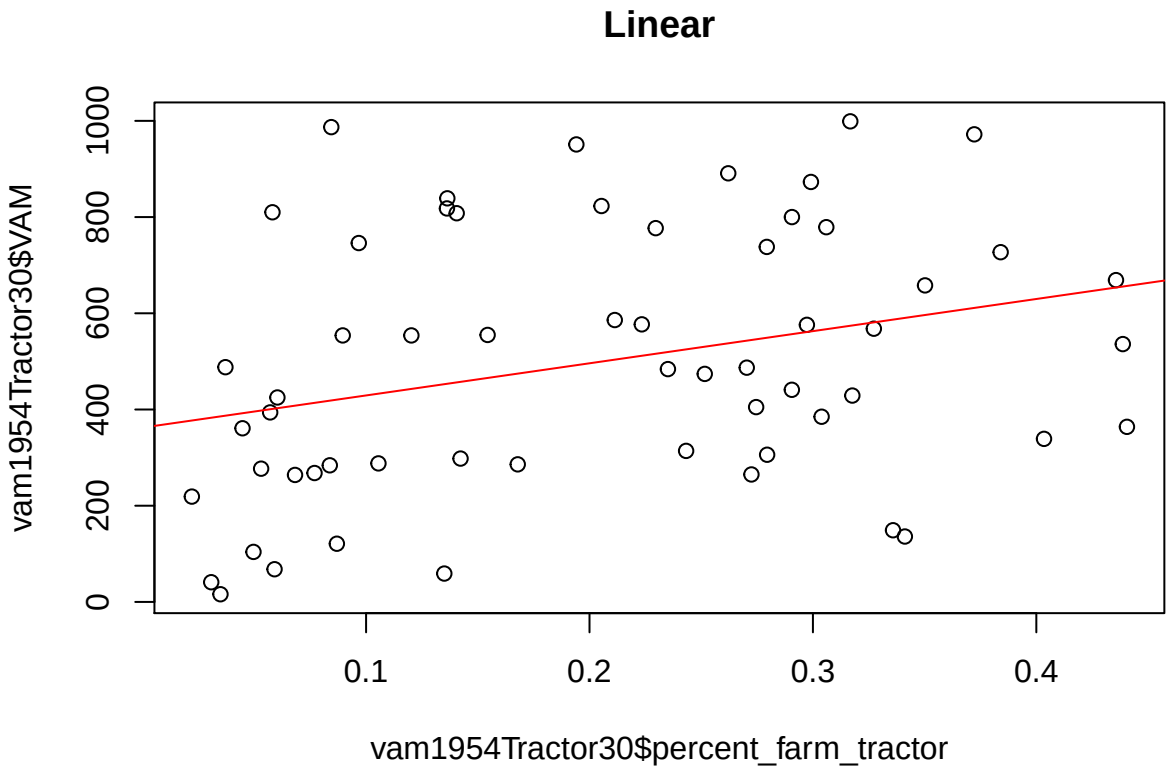
```
## 33     Hardin County 155   1947    Ohio      ohio     hardin county
## 34   Harrison County 182   1947    Ohio      ohio   harrison county
## 35      Henry County 131   1947    Ohio      ohio      henry county
## 36   Highland County 216   1947    Ohio      ohio   highland county
## 37    Hocking County 303   1947    Ohio      ohio    hocking county
## 38     Holmes County  91   1947    Ohio      ohio     holmes county
## 39      Huron County 359   1947    Ohio      ohio      huron county
## 40    Jackson County 324   1947    Ohio      ohio    jackson county
## 41  Jefferson County 556   1947    Ohio      ohio  jefferson county
## 42       Knox County 653   1947    Ohio      ohio       knox county
## 43       Lake County 761   1947    Ohio      ohio       lake county
## 44   Lawrence County 612   1947    Ohio      ohio   lawrence county
## 45    Licking County 447   1947    Ohio      ohio    licking county
## 46      Logan County 139   1947    Ohio      ohio      logan county
## 47     Lorain County 888   1947    Ohio      ohio     lorain county
## 48      Lucas County 995   1947    Ohio      ohio      lucas county
## 49    Madison County 136   1947    Ohio      ohio    madison county
## 50   Mahoning County 952   1947    Ohio      ohio   mahoning county
## 51     Marion County 737   1947    Ohio      ohio     marion county
## 52     Medina County 461   1947    Ohio      ohio     medina county
## 53      Meigs County  50   1947    Ohio      ohio      meigs county
## 54     Mercer County 382   1947    Ohio      ohio     mercer county
## 55      Miami County 728   1947    Ohio      ohio      miami county
## 56     Monroe County   0   1947    Ohio      ohio     monroe county
## 58     Morgan County  53   1947    Ohio      ohio     morgan county
## 59     Morrow County   0   1947    Ohio      ohio     morrow county
## 60  Muskingum County 600   1947    Ohio      ohio  muskingum county
## 61      Noble County  49   1947    Ohio      ohio      noble county
## 62     Ottawa County 526   1947    Ohio      ohio     ottawa county
## 63   Paulding County 135   1947    Ohio      ohio   paulding county
## 64      Perry County 255   1947    Ohio      ohio      perry county
## 65       Pike County   9   1947    Ohio      ohio       pike county
## 66    Portage County 514   1947    Ohio      ohio    portage county
## 67     Preble County  59   1947    Ohio      ohio     preble county
## 68     Putnam County  88   1947    Ohio      ohio     putnam county
## 70       Ross County 301   1947    Ohio      ohio       ross county
## 71   Sandusky County 771   1947    Ohio      ohio   sandusky county
## 72     Scioto County 483   1947    Ohio      ohio     scioto county
## 73     Seneca County 940   1947    Ohio      ohio     seneca county
## 74     Shelby County 770   1947    Ohio      ohio     shelby county
## 75      Stark County 990   1947    Ohio      ohio      stark county
## 78 Tuscarawas County 587   1947    Ohio      ohio tuscarawas county
## 79      Union County 205   1947    Ohio      ohio      union county
## 80   Van Wert County 342   1947    Ohio      ohio   van wert county
## 81     Vinton County 251   1947    Ohio      ohio     vinton county
## 82     Warren County 530   1947    Ohio      ohio     warren county
## 83 Washington County 337   1947    Ohio      ohio washington county
## 84      Wayne County 560   1947    Ohio      ohio      wayne county
## 85   Williams County 417   1947    Ohio      ohio   williams county
## 86       Wood County 731   1947    Ohio      ohio       wood county
## 87    Wyandot County 155   1947    Ohio      ohio    wyandot county
##    colorID.y   color
## 1          1 #FF0000
## 2         13 #3F0CF9
```

```
## 3         13 #3F0CF9
## 4          8 #A61DE0
## 5          2 #F20420
## 6          9 #951DF1
## 7          4 #D90C60
## 8          2 #F20420
## 9         14 #2A08FB
## 10         5 #CC1180
## 11         5 #CC1180
## 13         1 #FF0000
## 14         3 #E50840
## 15         9 #951DF1
## 16        11 #6A15F5
## 17        13 #3F0CF9
## 19         2 #F20420
## 20         8 #A61DE0
## 21         4 #D90C60
## 22        13 #3F0CF9
## 23         7 #B319C0
## 24         3 #E50840
## 25         9 #951DF1
## 26         5 #CC1180
## 27         1 #FF0000
## 28         5 #CC1180
## 29         3 #E50840
## 30         4 #D90C60
## 32         8 #A61DE0
## 33         3 #E50840
## 34         3 #E50840
## 35         2 #F20420
## 36         4 #D90C60
## 37         5 #CC1180
## 38         2 #F20420
## 39         6 #BF15A0
## 40         5 #CC1180
## 41         9 #951DF1
## 42        10 #8019F3
## 43        12 #5511F7
## 44         9 #951DF1
## 45         7 #B319C0
## 46         3 #E50840
## 47        14 #2A08FB
## 48        15 #1504FD
## 49         2 #F20420
## 50        14 #2A08FB
## 51        11 #6A15F5
## 52         7 #B319C0
## 53         1 #FF0000
## 54         6 #BF15A0
## 55        11 #6A15F5
## 56         1 #FF0000
## 58         1 #FF0000
## 59         1 #FF0000
## 60         9 #951DF1
```

```
## 61          1 #FF0000
## 62          8 #A61DE0
## 63          2 #F20420
## 64          4 #D90C60
## 65          1 #FF0000
## 66          8 #A61DE0
## 67          1 #FF0000
## 68          2 #F20420
## 70          5 #CC1180
## 71         12 #5511F7
## 72          8 #A61DE0
## 73         14 #2A08FB
## 74         12 #5511F7
## 75         15 #1504FD
## 78          9 #951DF1
## 79          4 #D90C60
## 80          6 #BF15A0
## 81          4 #D90C60
## 82          8 #A61DE0
## 83          5 #CC1180
## 84          9 #951DF1
## 85          7 #B319C0
## 86         11 #6A15F5
## 87          3 #E50840
```

Linear Model VAM 1947 vs Percent 1930

```
vam54Tractor30Mod <- lm(VAM ~ percent_farm_tractor, data = vam1954Tractor30)
plot(vam1954Tractor30$percent_farm_tractor, vam1954Tractor30$VAM, main = "Linear")
abline(vam54Tractor30Mod, col = "red")
```




```
summary(vam54Tractor30Mod)
```

```
##
## Call:
## lm(formula = VAM ~ percent_farm_tractor, data = vam1954Tractor30)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -454.38 -169.97  -31.25  200.52  568.19
##
## Coefficients:
##                     Estimate Std. Error t value Pr(>|t|)
## (Intercept)           362.38      66.15   5.478 1.01e-06 ***
## percent_farm_tractor  668.33     278.94   2.396   0.0199 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 260.4 on 57 degrees of freedom
## Multiple R-squared:  0.0915, Adjusted R-squared:  0.07556
## F-statistic: 5.741 on 1 and 57 DF,  p-value: 0.01988
```

Residuals from VAM 47 vs. Percent 30

```
vam54Residuals <-data.frame(vam54Tractor30Mod$residuals, vam1954Tractor30$county, vam1954Tractor30)
vam54Residuals
```

```
##    vam54Tractor30Mod.residuals vam1954Tractor30.county  fips county
## 1                 -333.830662                       10 39001     10
## 3                  458.885693                       50 39005     50
```

```
## 4          261.151609          70 39007     70
## 5         -143.953658          90 39009     90
## 6          424.935463         110 39011    110
## 7         -145.788121         130 39013    130
## 8         -299.467348         150 39015    150
## 10         131.777011         190 39019    190
## 11         -56.083542         210 39021    210
## 13        -393.609159         250 39025    250
## 14        -145.666833         270 39027    270
## 15         351.676015         290 39029    290
## 16         568.194913         310 39031    310
## 19        -115.574195         370 39037    370
## 21          65.306846         410 39041    410
## 23         323.373865         450 39045    450
## 24        -293.009476         470 39047    470
## 26         -13.103671         510 39051    510
## 27        -341.893966         530 39053    530
## 28         -56.524400         550 39055    550
## 29        -180.476459         570 39057    570
## 30          -6.517941         590 39059    590
## 32         107.960123         630 39063    630
## 33        -140.892311         650 39065    650
## 34        -134.355942         670 39067    670
## 35        -292.819961         690 39069    690
## 36        -188.577663         710 39071    710
## 37          22.315820         730 39073    730
## 38        -159.471598         750 39075    750
## 39          61.584464         770 39077    770
## 40         -31.245282         790 39079    790
## 42         364.597642         830 39083    830
## 46         -35.503469         910 39091    910
## 49        -454.380967         970 39097    970
## 51         360.849329        1010 39101   1010
## 52         188.919881        1030 39103   1030
## 53        -291.525545        1050 39105   1050
## 54         212.115409        1070 39107   1070
## 56        -369.649499        1110 39111   1110
## 58         100.868815        1150 39115   1150
## 59          89.430331        1170 39117   1170
## 61        -158.089019        1210 39121   1210
## 62          15.458297        1230 39123   1230
## 63        -119.580046        1250 39125   1250
## 64        -144.910548        1270 39127   1270
## 65         318.971916        1310 39131   1310
## 66         353.445466        1330 39133   1330
## 67        -437.843665        1350 39135   1350
## 68         310.714882        1370 39137   1370
## 70          82.394415        1410 39141   1410
## 72         111.240883        1450 39145   1450
## 78         385.486120        1570 39157   1570
## 79        -210.944458        1590 39159   1590
## 80          14.922253        1610 39161   1610
## 81        -120.815214        1630 39163   1630
## 82        -279.485532        1650 39165   1650
```

```
## 83                 408.794698                   1670 39167   1670
## 85                 243.397962                   1710 39171   1710
## 87                -243.179970                   1750 39175   1750
##          avg year.x state.x       name percent_farm_tractor stateAbb
## 1   9.209961   1930      39      ADAMS           0.05903146       OH
## 3  10.622720   1930      39    ASHLAND           0.19412039       OH
## 4  10.609148   1930      39  ASHTABULA           0.22963305       OH
## 5  10.169675   1930      39     ATHENS           0.06819313       OH
## 6  10.507224   1930      39   AUGLAIZE           0.31674026       OH
## 7  10.050313   1930      39    BELMONT           0.07692308       OH
## 8   9.738122   1930      39      BROWN           0.08691702       OH
## 10 10.186483   1930      39    CARROLL           0.08954394       OH
## 11 10.054731   1930      39  CHAMPAIGN           0.27038425       OH
## 13  9.655556   1930      39   CLERMONT           0.13500993       OH
## 14 10.287815   1930      39    CLINTON           0.31764146       OH
## 15 10.306936   1930      39 COLUMBIANA           0.14056832       OH
## 16 10.322308   1930      39  COSHOCTON           0.08442982       OH
## 19 10.221900   1930      39      DARKE           0.29056995       OH
## 21 10.596730   1930      39   DELAWARE           0.22341568       OH
## 23 10.074779   1930      39  FAIRFIELD           0.20536013       OH
## 24  9.944751   1930      39    FAYETTE           0.40344168       OH
## 26 10.567867   1930      39     FULTON           0.32727273       OH
## 27  9.078111   1930      39     GALLIA           0.03069700       OH
## 28 10.072043   1930      39     GEAUGA           0.25159236       OH
## 29 10.698218   1930      39     GREENE           0.30389016       OH
## 30 10.159635   1930      39   GUERNSEY           0.05706727       OH
## 32 10.913314   1930      39    HANCOCK           0.38403563       OH
## 33 10.281763   1930      39     HARDIN           0.27458694       OH
## 34  9.872080   1930      39   HARRISON           0.08375778       OH
## 35 10.158685   1930      39      HENRY           0.44056493       OH
## 36 10.189036   1930      39   HIGHLAND           0.16788079       OH
## 37  9.911968   1930      39    HOCKING           0.06030856       OH
## 38  9.486194   1930      39     HOLMES           0.14228546       OH
## 39 10.674342   1930      39      HURON           0.35018345       OH
## 40  9.540707   1930      39    JACKSON           0.04468912       OH
## 42 10.511027   1930      39       KNOX           0.13619677       OH
## 46 10.684086   1930      39      LOGAN           0.23510204       OH
## 49  9.682366   1930      39    MADISON           0.34115409       OH
## 51 10.490716   1930      39     MARION           0.37223123       OH
## 52 10.699282   1930      39     MEDINA           0.27935677       OH
## 53  9.727691   1930      39      MEIGS           0.04959729       OH
## 54  9.997748   1930      39     MERCER           0.30599711       OH
## 56  9.436264   1930      39     MONROE           0.03482003       OH
## 58 10.410557   1930      39     MORGAN           0.03703704       OH
## 59 10.576296   1930      39     MORROW           0.15440238       OH
## 61 10.497222   1930      39      NOBLE           0.02201122       OH
## 62 10.310724   1930      39     OTTAWA           0.43565976       OH
## 63 10.157001   1930      39   PAULDING           0.43870968       OH
## 64 10.021769   1930      39      PERRY           0.10553544       OH
## 65  8.820574   1930      39       PIKE           0.09673367       OH
## 66 10.780847   1930      39    PORTAGE           0.26211135       OH
## 67 10.296046   1930      39     PREBLE           0.33586132       OH
## 68  9.923810   1930      39     PUTNAM           0.29911504       OH
## 70  9.166793   1930      39       ROSS           0.21131448       OH
```

```
## 72  9.300681   1930      39     SCIOTO           0.12027158       OH
## 78 10.274903   1930      39 TUSCARAWAS           0.13636364       OH
## 79 10.505435   1930      39      UNION           0.24324324       OH
## 80 10.594572   1930      39   VAN WERT           0.29730849       OH
## 81  9.421053   1930      39     VINTON           0.05302326       OH
## 82 10.028030   1930      39     WARREN           0.27248201       OH
## 83 10.202782   1930      39 WASHINGTON           0.05809575       OH
## 85 10.532258   1930      39   WILLIAMS           0.29061161       OH
## 87 10.314286   1930      39    WYANDOT           0.27950617       OH
##    colorID.x   logAvg logPercent   X.1     X        polyname RUCC
## 1          1 2.220286 -2.8296848 10021 10021      ohio,adams    9
## 3          3 2.362995 -1.6392767 10031 10031    ohio,ashland    6
## 4          4 2.361717 -1.4712727 10036 10036  ohio,ashtabula    4
## 5          2 2.319410 -2.6854114 10042 10042     ohio,athens    7
## 6          5 2.352063 -1.1496732 10044 10044   ohio,auglaize    6
## 7          2 2.307604 -2.5649494 10051 10051    ohio,belmont    2
## 8          2 2.276048 -2.4428014 10058 10058      ohio,brown    9
## 10         2 2.321062 -2.4130259 10066 10066    ohio,carroll    6
## 11         4 2.308043 -1.3079112 10071 10071  ohio,champaign    6
## 13         2 2.267533 -2.0024070 10081 10081   ohio,clermont    8
## 14         5 2.330960 -1.1468320 10087 10087    ohio,clinton    6
## 15         3 2.332817 -1.9620617 10089 10089 ohio,columbiana    4
## 16         2 2.334307 -2.4718346 10095 10095  ohio,coshocton    7
## 19         5 2.324533 -1.2359109 10110 10110      ohio,darke    6
## 21         4 2.360545 -1.4987212 10123 10123   ohio,delaware    6
## 23         4 2.310035 -1.5829901 10131 10131  ohio,fairfield    4
## 24         6 2.297045 -0.9077233 10138 10138    ohio,fayette    6
## 26         5 2.357818 -1.1169614 10144 10144     ohio,fulton    6
## 27         1 2.205866 -3.4835903 10149 10149     ohio,gallia    6
## 28         4 2.309764 -1.3799451 10155 10155     ohio,geauga    4
## 29         5 2.370077 -1.1910890 10159 10159     ohio,greene    2
## 30         1 2.318423 -2.8635245 10165 10165   ohio,guernsey    6
## 32         6 2.389984 -0.9570199 10178 10178    ohio,hancock    4
## 33         5 2.330372 -1.2924873 10181 10181     ohio,hardin    6
## 34         2 2.289711 -2.4798262 10187 10187   ohio,harrison    6
## 35         7 2.318329 -0.8196974 10190 10190      ohio,henry    6
## 36         3 2.321312 -1.7845011 10198 10198   ohio,highland    7
## 37         1 2.293743 -2.8082813 10200 10200    ohio,hocking    7
## 38         3 2.249838 -1.9499200 10205 10205     ohio,holmes    6
## 39         6 2.367843 -1.0492981 10210 10210      ohio,huron    6
## 40         1 2.255568 -3.1080252 10214 10214    ohio,jackson    6
## 42         2 2.352425 -1.9936546 10225 10225       ohio,knox    7
## 46         4 2.368755 -1.4477356 10245 10245      ohio,logan    7
## 49         6 2.270306 -1.0754210 10263 10263    ohio,madison    6
## 51         6 2.350491 -0.9882400 10272 10272     ohio,marion    5
## 52         5 2.370177 -1.2752656 10277 10277     ohio,medina    6
## 53         1 2.274977 -3.0038191 10279 10279      ohio,meigs    7
## 54         5 2.302360 -1.1841796 10287 10287     ohio,mercer    7
## 56         1 2.244560 -3.3575624 10296 10296     ohio,monroe    8
## 58         1 2.342820 -3.2958369 10308 10308     ohio,morgan    9
## 59         3 2.358615 -1.8681932 10312 10312     ohio,morrow    9
## 61         1 2.351111 -3.8162029 10322 10322      ohio,noble    8
## 62         7 2.333185 -0.8308937 10328 10328     ohio,ottawa    6
## 63         7 2.318163 -0.8239174 10333 10333   ohio,paulding    9
```

```
## 64         2 2.304760 -2.2487085 10335 10335      ohio,perry    7
## 65         2 2.177087 -2.3357938 10346 10346       ohio,pike    9
## 66         4 2.377771 -1.3389859 10349 10349    ohio,portage    6
## 67         5 2.331760 -1.0910569 10354 10354     ohio,preble    6
## 68         5 2.294937 -1.2069270 10360 10360     ohio,putnam    6
## 70         4 2.215588 -1.5544078 10369 10369       ohio,ross    5
## 72         2 2.230088 -2.1180029 10382 10382     ohio,scioto    4
## 78         3 2.329704 -1.9924302 10411 10411 ohio,tuscarawas    6
## 79         4 2.351893 -1.4136933 10414 10414      ohio,union    6
## 80         5 2.360342 -1.2129850 10419 10419   ohio,van wert    6
## 81         1 2.242947 -2.9370247 10426 10426     ohio,vinton    9
## 82         5 2.305384 -1.3001827 10433 10433     ohio,warren    6
## 83         1 2.322660 -2.8456628 10435 10435 ohio,washington    7
## 85         5 2.354443 -1.2357676 10446 10446   ohio,williams    7
## 87         5 2.333530 -1.2747309 10456 10456    ohio,wyandot    7
##               County VAM year.y state.y state.low        county.low
## 1       Adams County  68   1954    Ohio      ohio      adams county
## 3     Ashland County 951   1954    Ohio      ohio    ashland county
## 4   Ashtabula County 777   1954    Ohio      ohio  ashtabula county
## 5      Athens County 264   1954    Ohio      ohio     athens county
## 6    Auglaize County 999   1954    Ohio      ohio   auglaize county
## 7     Belmont County 268   1954    Ohio      ohio    belmont county
## 8       Brown County 121   1954    Ohio      ohio      brown county
## 10    Carroll County 554   1954    Ohio      ohio    carroll county
## 11  Champaign County 487   1954    Ohio      ohio  champaign county
## 13   Clermont County  59   1954    Ohio      ohio   clermont county
## 14    Clinton County 429   1954    Ohio      ohio    clinton county
## 15 Columbiana County 808   1954    Ohio      ohio columbiana county
## 16  Coshocton County 987   1954    Ohio      ohio  coshocton county
## 19      Darke County 441   1954    Ohio      ohio      darke county
## 21   Delaware County 577   1954    Ohio      ohio   delaware county
## 23  Fairfield County 823   1954    Ohio      ohio  fairfield county
## 24    Fayette County 339   1954    Ohio      ohio    fayette county
## 26     Fulton County 568   1954    Ohio      ohio     fulton county
## 27     Gallia County  41   1954    Ohio      ohio     gallia county
## 28     Geauga County 474   1954    Ohio      ohio     geauga county
## 29     Greene County 385   1954    Ohio      ohio     greene county
## 30   Guernsey County 394   1954    Ohio      ohio   guernsey county
## 32    Hancock County 727   1954    Ohio      ohio    hancock county
## 33     Hardin County 405   1954    Ohio      ohio     hardin county
## 34   Harrison County 284   1954    Ohio      ohio   harrison county
## 35      Henry County 364   1954    Ohio      ohio      henry county
## 36   Highland County 286   1954    Ohio      ohio   highland county
## 37    Hocking County 425   1954    Ohio      ohio    hocking county
## 38     Holmes County 298   1954    Ohio      ohio     holmes county
## 39      Huron County 658   1954    Ohio      ohio      huron county
## 40    Jackson County 361   1954    Ohio      ohio    jackson county
## 42       Knox County 818   1954    Ohio      ohio       knox county
## 46      Logan County 484   1954    Ohio      ohio      logan county
## 49    Madison County 136   1954    Ohio      ohio    madison county
## 51     Marion County 972   1954    Ohio      ohio     marion county
## 52     Medina County 738   1954    Ohio      ohio     medina county
## 53      Meigs County 104   1954    Ohio      ohio      meigs county
## 54     Mercer County 779   1954    Ohio      ohio     mercer county
```

```
## 56     Monroe County  16   1954    Ohio      ohio     monroe county
## 58     Morgan County 488   1954    Ohio      ohio     morgan county
## 59     Morrow County 555   1954    Ohio      ohio     morrow county
## 61      Noble County 219   1954    Ohio      ohio      noble county
## 62     Ottawa County 669   1954    Ohio      ohio     ottawa county
## 63   Paulding County 536   1954    Ohio      ohio   paulding county
## 64      Perry County 288   1954    Ohio      ohio      perry county
## 65       Pike County 746   1954    Ohio      ohio       pike county
## 66    Portage County 891   1954    Ohio      ohio    portage county
## 67     Preble County 149   1954    Ohio      ohio     preble county
## 68     Putnam County 873   1954    Ohio      ohio     putnam county
## 70       Ross County 586   1954    Ohio      ohio       ross county
## 72     Scioto County 554   1954    Ohio      ohio     scioto county
## 78 Tuscarawas County 839   1954    Ohio      ohio tuscarawas county
## 79      Union County 314   1954    Ohio      ohio      union county
## 80   Van Wert County 576   1954    Ohio      ohio   van wert county
## 81     Vinton County 277   1954    Ohio      ohio     vinton county
## 82     Warren County 265   1954    Ohio      ohio     warren county
## 83 Washington County 810   1954    Ohio      ohio washington county
## 85   Williams County 800   1954    Ohio      ohio   williams county
## 87    Wyandot County 306   1954    Ohio      ohio    wyandot county
##    colorID.y   color
## 1          1 #FF0000
## 3         14 #2A08FB
## 4         12 #5511F7
## 5          4 #D90C60
## 6         15 #1504FD
## 7          4 #D90C60
## 8          2 #F20420
## 10         9 #951DF1
## 11         8 #A61DE0
## 13         1 #FF0000
## 14         7 #B319C0
## 15        12 #5511F7
## 16        15 #1504FD
## 19         7 #B319C0
## 21         9 #951DF1
## 23        13 #3F0CF9
## 24         5 #CC1180
## 26         9 #951DF1
## 27         1 #FF0000
## 28         7 #B319C0
## 29         6 #BF15A0
## 30         6 #BF15A0
## 32        11 #6A15F5
## 33         6 #BF15A0
## 34         5 #CC1180
## 35         6 #BF15A0
## 36         5 #CC1180
## 37         7 #B319C0
## 38         5 #CC1180
## 39        10 #8019F3
## 40         6 #BF15A0
## 42        13 #3F0CF9
```

```
## 46          8 #A61DE0
## 49          2 #F20420
## 51         15 #1504FD
## 52         11 #6A15F5
## 53          2 #F20420
## 54         12 #5511F7
## 56          1 #FF0000
## 58          8 #A61DE0
## 59          9 #951DF1
## 61          4 #D90C60
## 62         10 #8019F3
## 63          8 #A61DE0
## 64          5 #CC1180
## 65         11 #6A15F5
## 66         14 #2A08FB
## 67          3 #E50840
## 68         13 #3F0CF9
## 70          9 #951DF1
## 72          9 #951DF1
## 78         13 #3F0CF9
## 79          5 #CC1180
## 80          9 #951DF1
## 81          5 #CC1180
## 82          4 #D90C60
## 83         12 #5511F7
## 85         12 #5511F7
## 87          5 #CC1180
```

Notice the lowest points going across the X-Axis(On Plot with line connecting outlier counties). These counties identified left-to-right are:

- Pike County
- Ross County
- Madison County
- Fayette County

The 2 Counties which are overlaying each other and can be seen to the right of the outlier line are

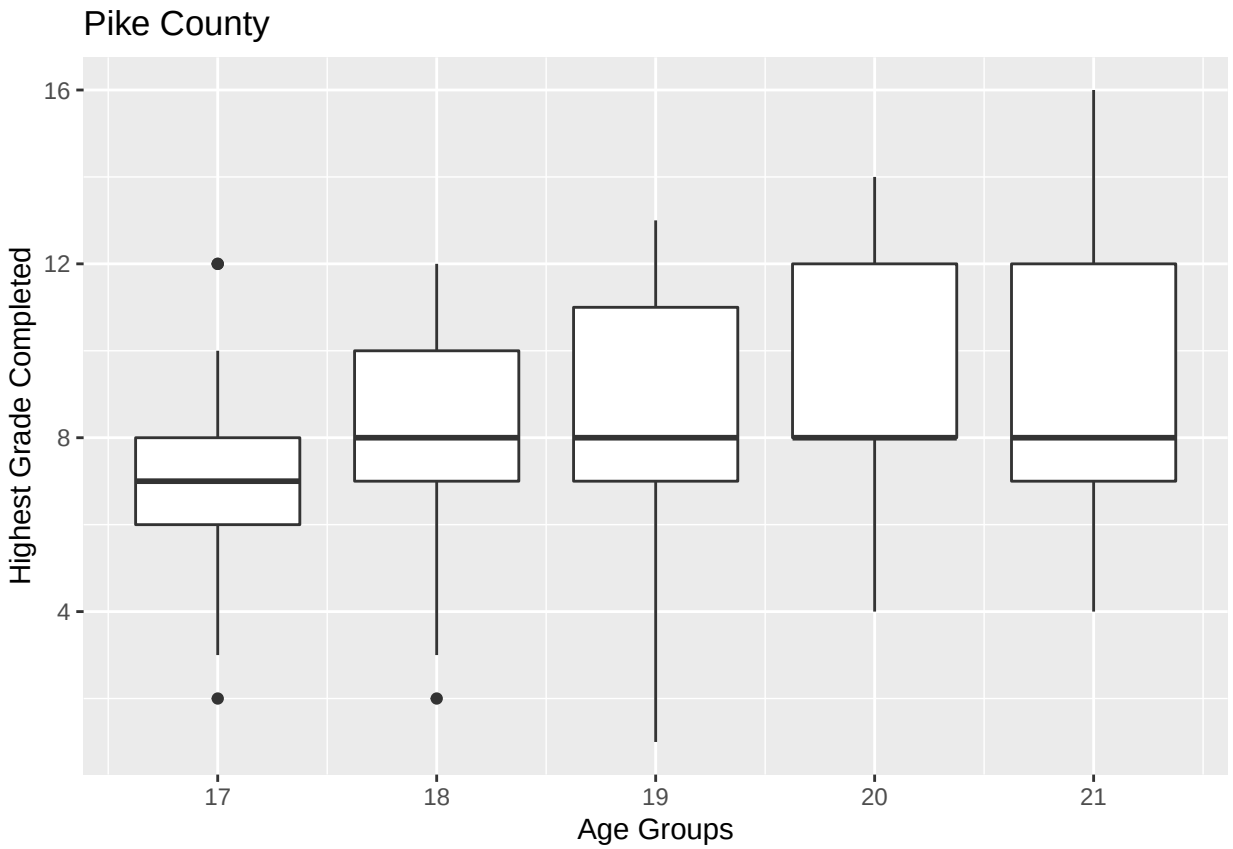
- Paulding County
- Henry County

The objective was to look at the difference in education from 1930 and 1940 and plot that against the % of Farms with Tractors in 1930. The problem I encountered was that the 1930's Education dataset has not features which indicate the highest grade completed for an individual.

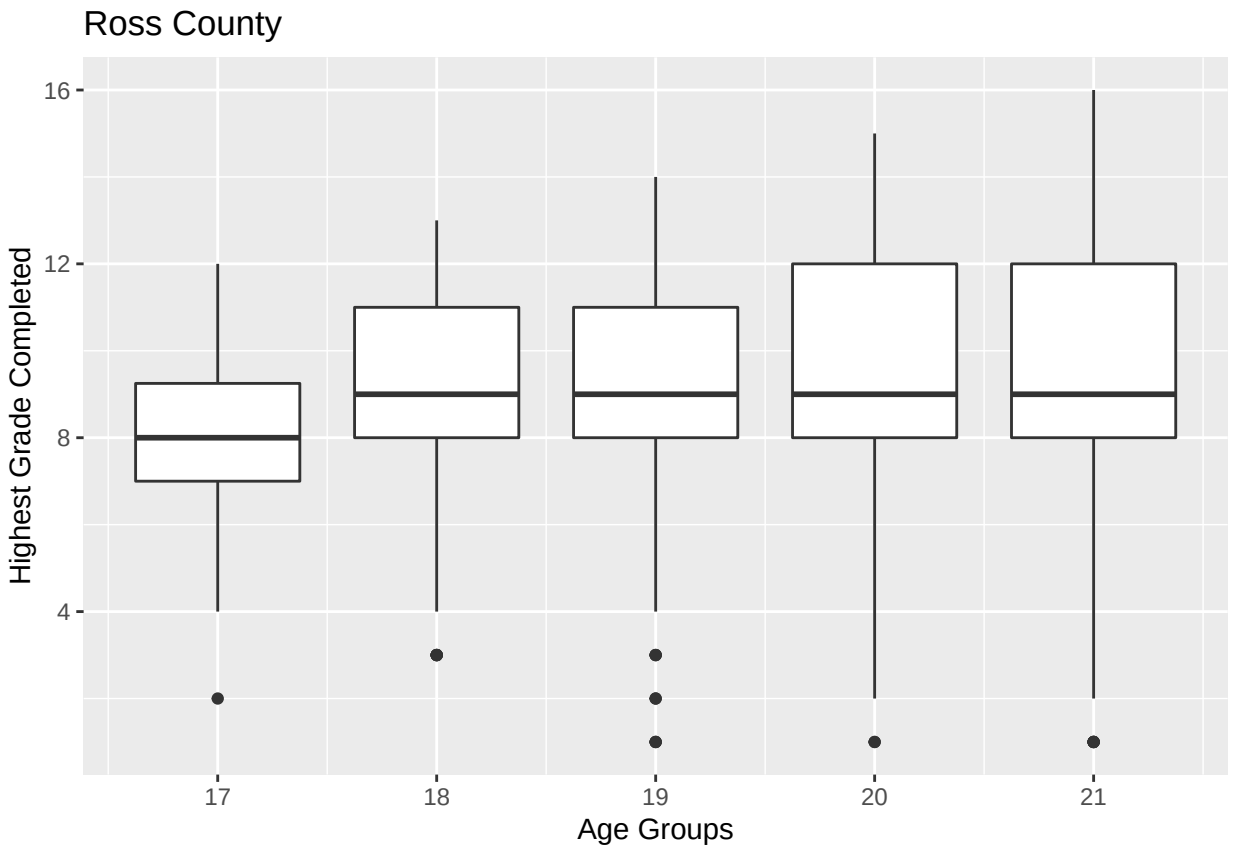
Taking a closer look at the outlier counties listed above(Pike, Ross, Madison, Fayette) but removing everyone who is currently in school, as they could continue their education and in that case the current represented value would not be accurate.

Highest Grade Completed by Age for the 4 outlier counties

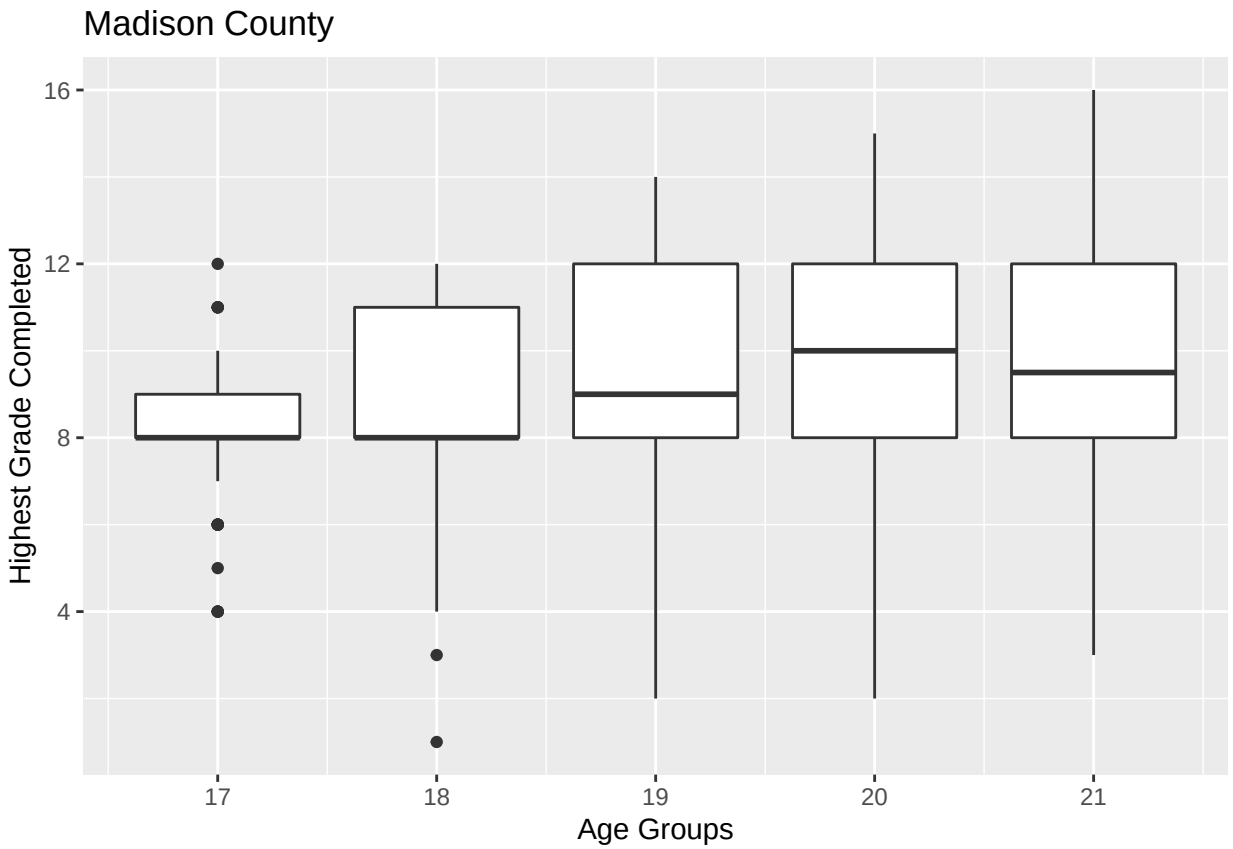
```
pike <- subset(pike, school == "No, not in school")
ggplot(pike, aes(x = age, y = higrade, group = age)) + geom_boxplot() + xlab("Age Groups") + ylab("High
```



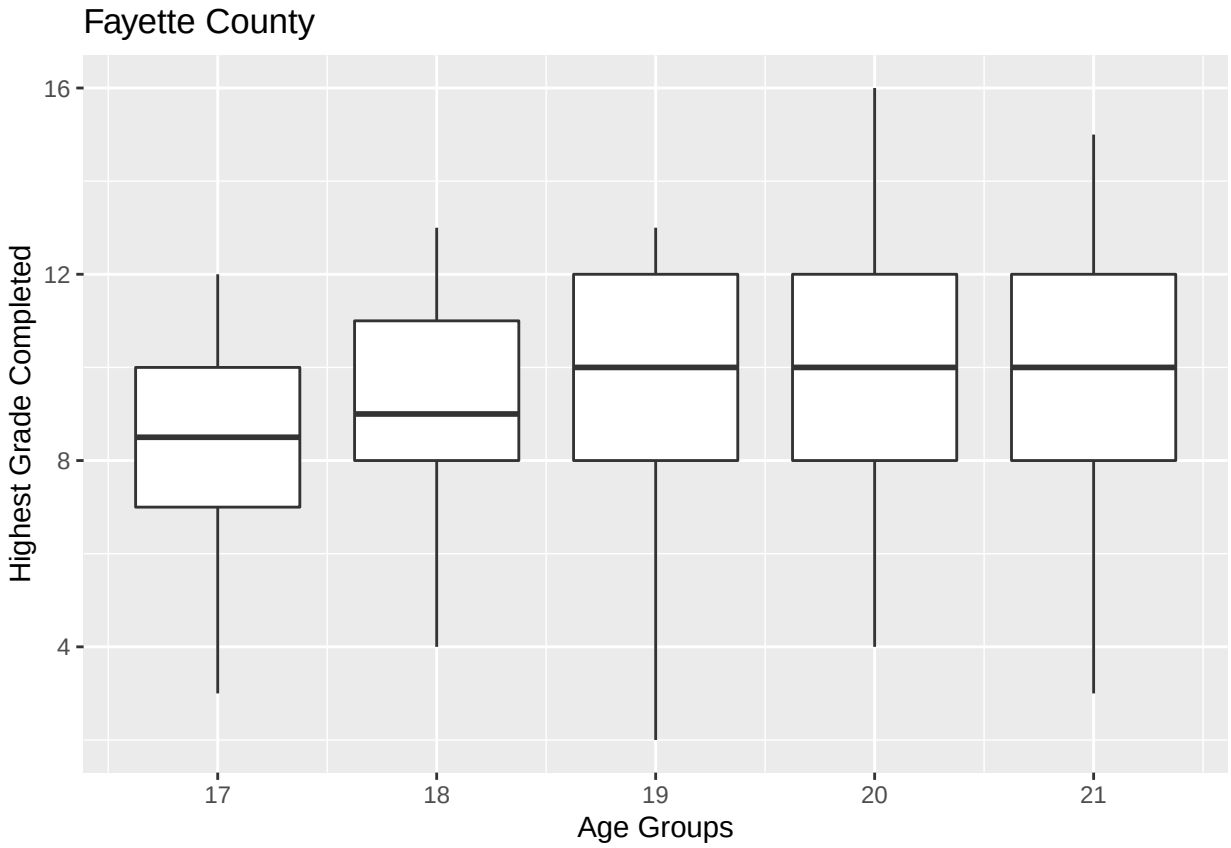

```
ross <- subset(ross, school == "No, not in school")
ggplot(ross, aes(x = age, y = higrade, group = age)) + geom_boxplot() + xlab("Age Groups") + ylab("High
```




```
madison <- subset(madison, school == "No, not in school")
ggplot(madison, aes(x = age, y = higrade, group = age)) + geom_boxplot() + xlab("Age Groups") + ylab("H
```




```
fayette <- subset(fayette, school == "No, not in school")
ggplot(fayette, aes(x = age, y = higrade, group = age)) + geom_boxplot() + xlab("Age Groups") + ylab("H
```


Fayette County
16
12
8
4
Highest Grade Completed
17
18
19
20
21
Age Groups