PISA2012_wenchit

Abstract

In this research, I want to explore the education resource distribution in Australia. For insatnce, comparing the education resources between remote and city areas and the discrepancies between private or public schools. Based on the PISA2012 mathematics literacy survey data. Also, I will break down the resource allocation within different states across Australia.

Introduction

- PISA2012: the term PISA stands for Programme for International Student Assessment is a survey that randomly select 15 year-old students as samples for assessment. In 2012, a total of 65 OECD countries and economics and about half a million 15 year-old students participated in the PISA assessment. Generally, the assessed reaults lies in 5 categories: Level 5 are high performers, whereas students who lies below the international standard baseline level 2 are cosidered low performers. In 2012, 775 Australian schools and 14,481 studnets participated in this assessment. To ensure the authenticity, an amount of indigenous students were also sampled.
- Mathematic Lieteracy: in the mathematic literacy domain, the assessment focused on students' ability to solve mathematic problems described in a real-life situation. In PISA2012 framework(OECD2012, p25), it defined mathematic literacy as follows: "Mathematic literacy is an individual's capacity to formulate, employ and interpret mathematics in a variety of contexts. It includes reasoning mathematically nd using mathematical concepts, procedures, facts and tools to describe, explain and predict phenomena. It assists individuals to recognise the role that Mathematics plays in the world and to make the well-founded judgments and decisions needed by constructive, engaged and reflective citizens." The assessment in math literacy is designed according three main components:

1. the context of a challenge or problem that arises in the real world
2. the nature of mathematical thought and action that can be used to solve the problem
3. the processes that the problem solver can use to construct a solution.

Overview of Australian Education System:

–Terms and definition It is defined in the handbook from PISA that, Village School or Rural Area: less than 3,000 people Small Town School: 3,000 to about 15,000 people Town School: 15,000 to about 100,000 people City School: 100,000 to about 1,000,000 people, for example, Hobart, Tasmania Large City School: ith over 1,000,000 people, for example, Sydney and Melbourne

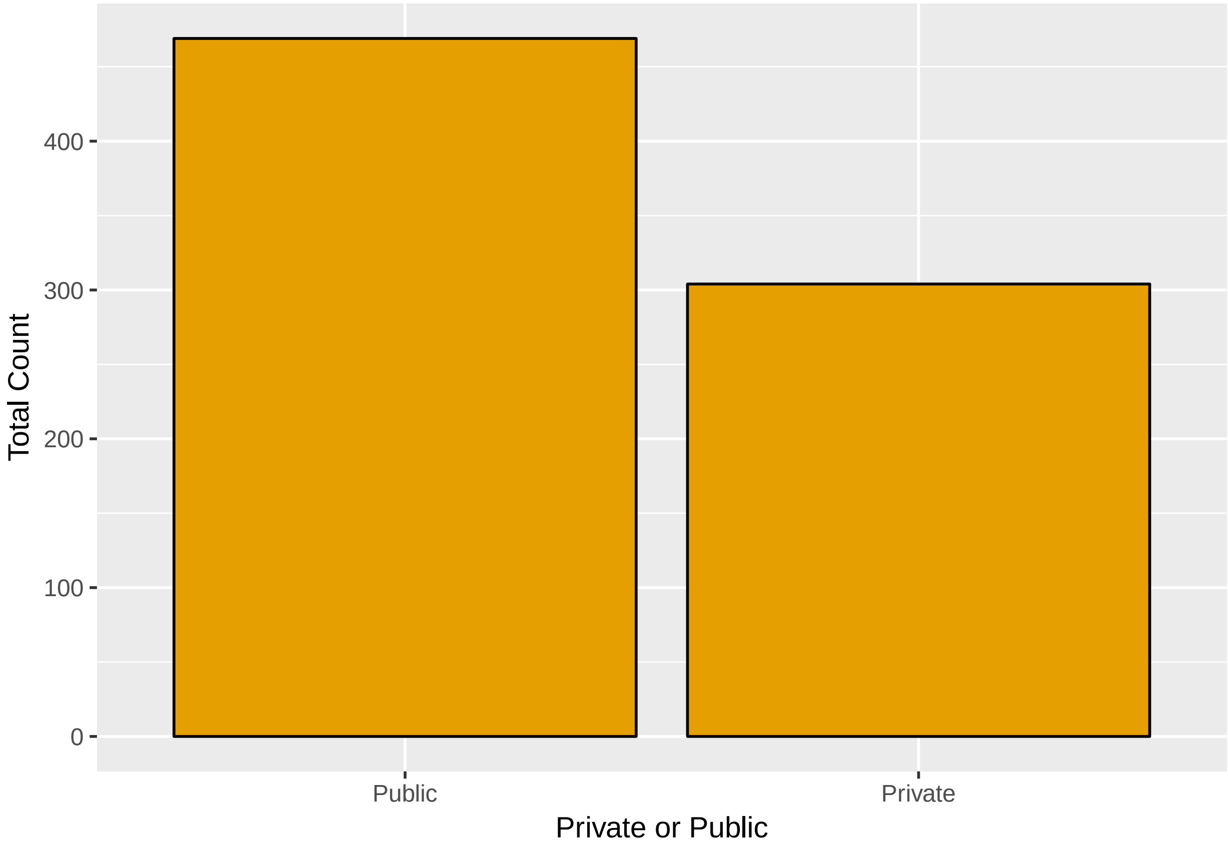
Methods Used

Linear Mixed Model: including linear regression model and ANOVA test:

Results

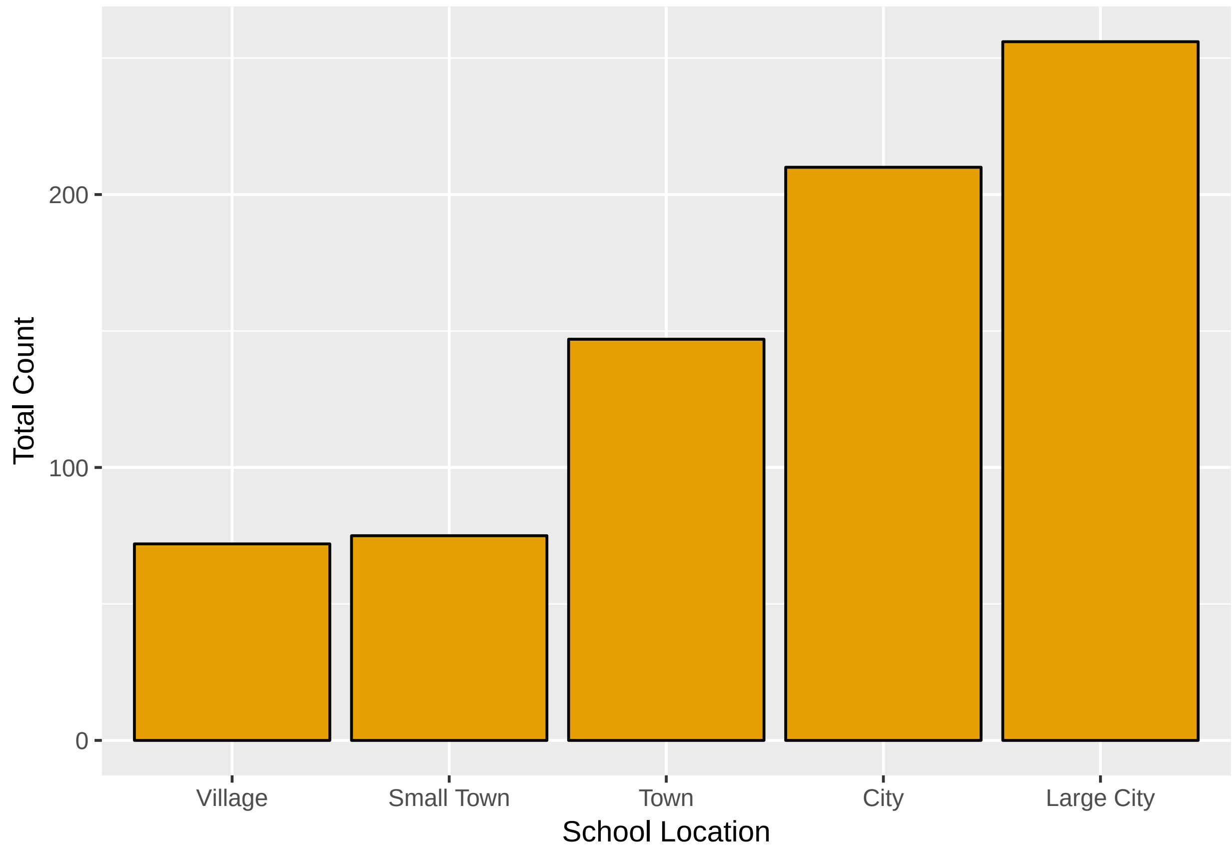
The following graph shows the amount of private and public schools in Australia that participated:

```r
library(data.table)
library(ggplot2)
library(PISA2012lite)
data("school2012")
setDT(school2012)

ggplot(school2012[NC == "Australia" & !is.na(SC01Q01)], aes(SC01Q01))+geom_bar(fill="#E69F00", colour="
```



The following is a graph about the distribution of schools in Australia that participated:

```r
library(data.table)
library(ggplot2)
library(PISA2012lite)
data("school2012")
setDT(school2012)

ggplot(school2012[NC == "Australia" & !is.na(SC03Q01)], aes(SC03Q01))+geom_bar(fill="#E69F00", colour="
```



The following is a calculation of math literacy scores by schools participated all across Australia and summarise by its house weight and to obtain coefficient in the null model:

```
library(data.table)
library(ggplot2)
library(PISA2012lite)
library(dplyr)
```

```
##
## Attaching package: 'dplyr'

## The following objects are masked from 'package:data.table':
##
##     between, first, last

## The following objects are masked from 'package:stats':
##
##     filter, lag

## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```
library(lme4)
```

```
## Loading required package: Matrix
```

```
data("computerStudent2012")
setDT(computerStudent2012)
```

```r
#calculate the weighted math literacy score, using the column W_FSTUWT
n <- nrow(computerStudent2012)
computerStudent2012$W_HOUSEWHT <- n * computerStudent2012$W_FSTUWT / sum(computerStudent2012$W_FSTUWT)

#calculate the weighted average of math literacy scores
computerStudent2012[NC == "Australia"] %>%
  group_by(SCHOOLID) %>%
  summarise(avg1 = weighted.mean(PV1MATH, w = W_HOUSEWHT))
```

```
## # A tibble: 775 x 2
##    SCHOOLID     avg1
##      <fctr>    <dbl>
## 1   0000001 562.9773
## 2   0000002 480.2559
## 3   0000003 566.4070
## 4   0000004 429.4231
## 5   0000005 464.8072
## 6   0000006 500.0640
## 7   0000007 484.0204
## 8   0000008 554.4547
## 9   0000009 431.5852
## 10  0000010 600.4370
## # ... with 765 more rows
```

```r
HLM0 <- lmer(PV1MATH ~ (1 | SCHOOLID), data = computerStudent2012[NC == "Australia"],
             weights = W_HOUSEWHT)
summary(HLM0)
```

```
## Linear mixed model fit by REML ['lmerMod']
## Formula: PV1MATH ~ (1 | SCHOOLID)
##    Data: computerStudent2012[NC == "Australia"]
## Weights: W_HOUSEWHT
##
## REML criterion at convergence: 174059.9
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -4.5983 -0.6028 -0.0587  0.5508  4.5737
##
## Random effects:
##  Groups   Name        Variance Std.Dev.
##  SCHOOLID (Intercept) 2598     50.97
##  Residual             1850     43.01
## Number of obs: 14481, groups:  SCHOOLID, 775
##
## Fixed effects:
##             Estimate Std. Error t value
## (Intercept)  498.342      2.019   246.8
```

The following cosidering the socio-economic state of the student

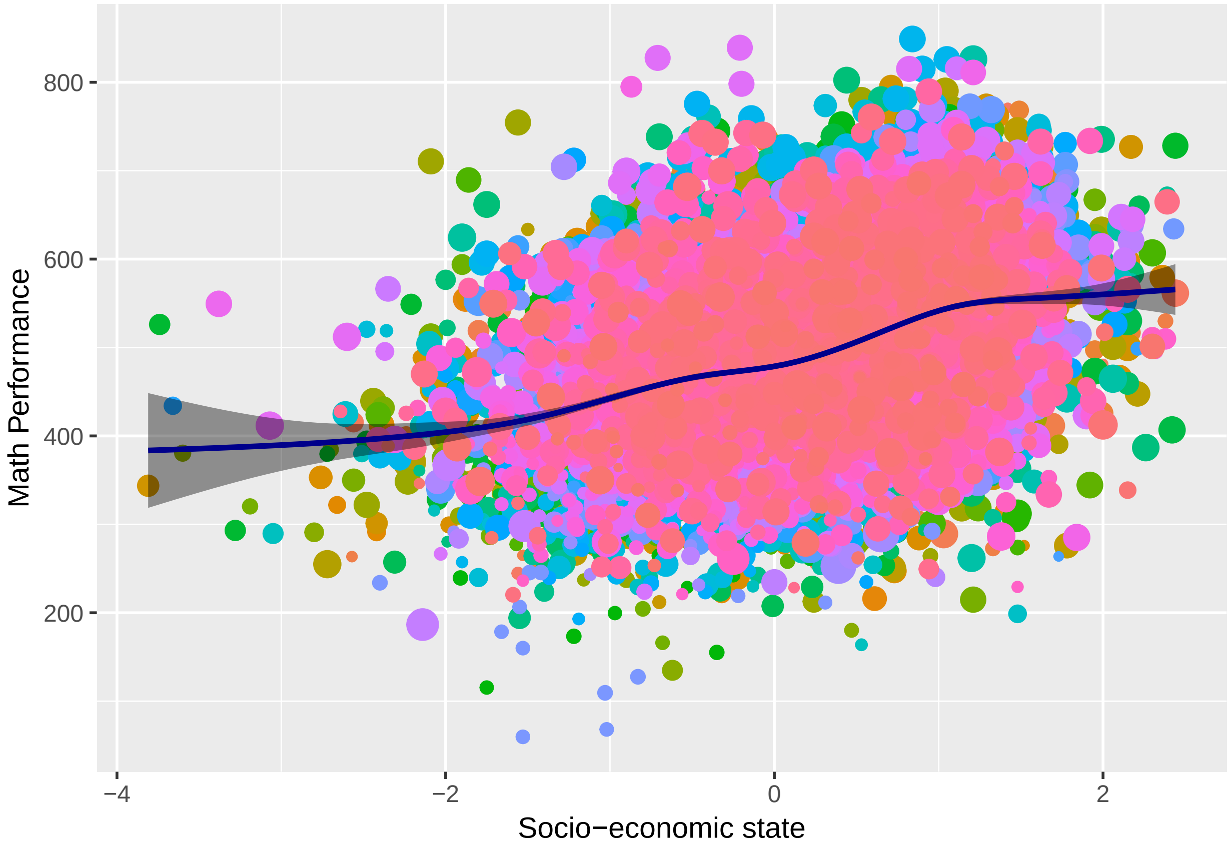
```r
library(data.table)
library(ggplot2)
library(PISA2012lite)
library(dplyr)
```

```r
library(lme4)
data("computerStudent2012")
setDT(computerStudent2012)

#calculate the weighted math literacy score, using the column W_FSTUWT
n <- nrow(computerStudent2012)
computerStudent2012$W_HOUSEWHT <- n * computerStudent2012$W_FSTUWT / sum(computerStudent2012$W_FSTUWT)

ggplot(data = computerStudent2012[NC == "Australia"], aes(x = ESCS, y = PV1MATH, size = W_HOUSEWHT)) +
  geom_point(aes(colour = SCHOOLID)) + geom_smooth(fill="black", colour="darkblue", size=1)+ theme(leger
```

```
## `geom_smooth()` using method = 'gam'
```

```
## Warning: Removed 371 rows containing non-finite values (stat_smooth).
```

```
## Warning: Removed 371 rows containing missing values (geom_point).
```

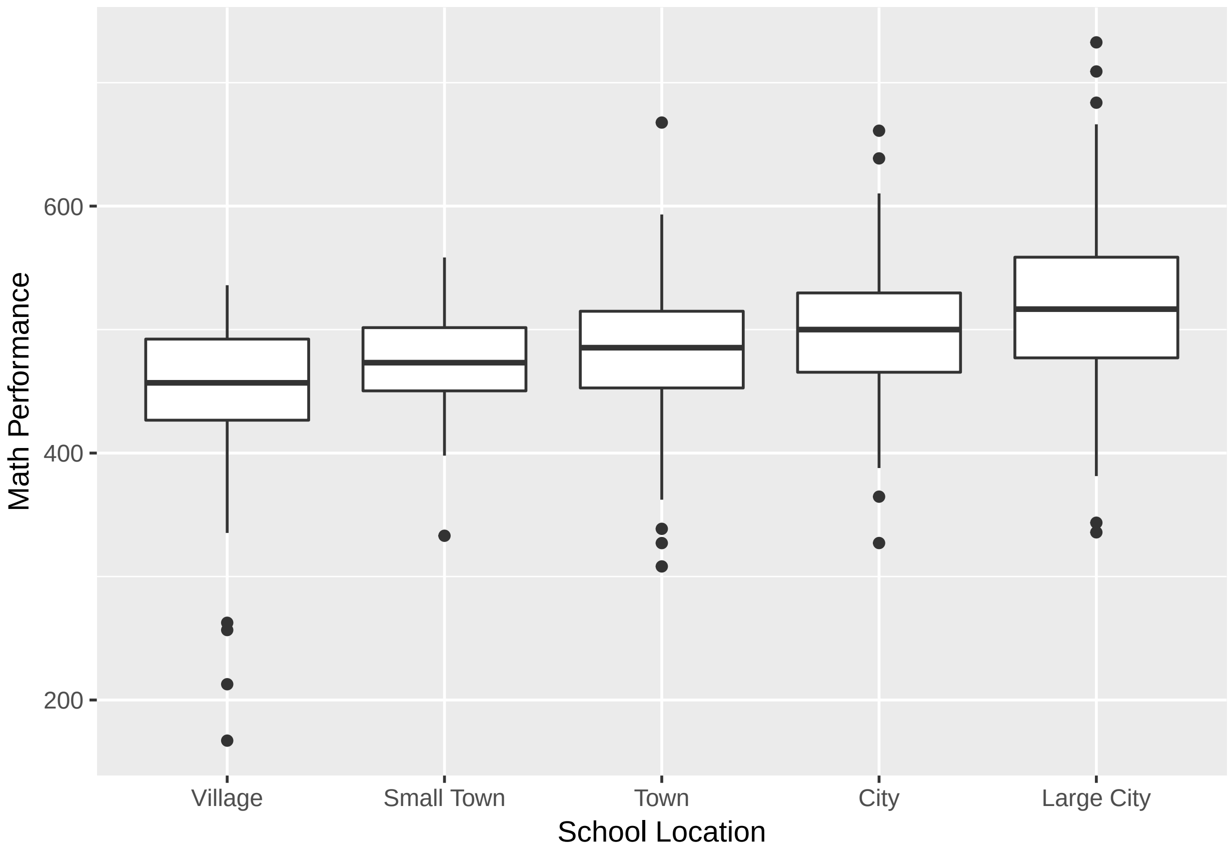


The graph shows the relationship between socio-economic state of a student and their math performance.

Now we want to look into the relationship between schools and math performances:

```r
library(data.table)
library(PISA2012lite)
library("dplyr")
data("computerStudent2012")
setDT(computerStudent2012)
data("school2012")
setDT(school2012)
```

```r
#filter data
school_view <- school2012[NC =="Australia" & !is.na(SC03Q01)]
school_plot_data <- select(school_view, SC03Q01, SCHOOLID)
#filter data
#calculate the weighted math literacy score, using the column W_FSTUWT
n <- nrow(computerStudent2012)
computerStudent2012$W_HOUSEWHT <- n * computerStudent2012$W_FSTUWT / sum(computerStudent2012$W_FSTUWT)
student_data <- computerStudent2012[NC == "Australia" & !is.na(PV1MATH), .(avg= weighted.mean(PV1MATH, w

#merge data
plot_data <- merge(student_data, school_plot_data, by="SCHOOLID")
ggplot(plot_data, aes(x=factor(SC03Q01), y=avg))+geom_boxplot()+labs(x="School Location", y="Math Perfor
```




```r
#run linear regression test
fit <- lm(avg~SC03Q01, data=plot_data)
summary(fit)
```

```
##
## Call:
## lm(formula = avg ~ SC03Q01, data = plot_data)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -279.715  -35.140    1.428   35.492  214.570
##
## Coefficients:
##                     Estimate Std. Error t value Pr(>|t|)
```

```
## (Intercept)        446.794      6.525  68.472  < 2e-16 ***
## SC03Q01Small Town   25.048      9.135   2.742  0.00625 **
## SC03Q01Town         37.020      7.965   4.648 3.95e-06 ***
## SC03Q01City         53.345      7.562   7.055 3.92e-12 ***
## SC03Q01Large City   71.274      7.386   9.650  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 55.37 on 755 degrees of freedom
## Multiple R-squared:  0.1371, Adjusted R-squared:  0.1325
## F-statistic: 29.98 on 4 and 755 DF,  p-value: < 2.2e-16
```

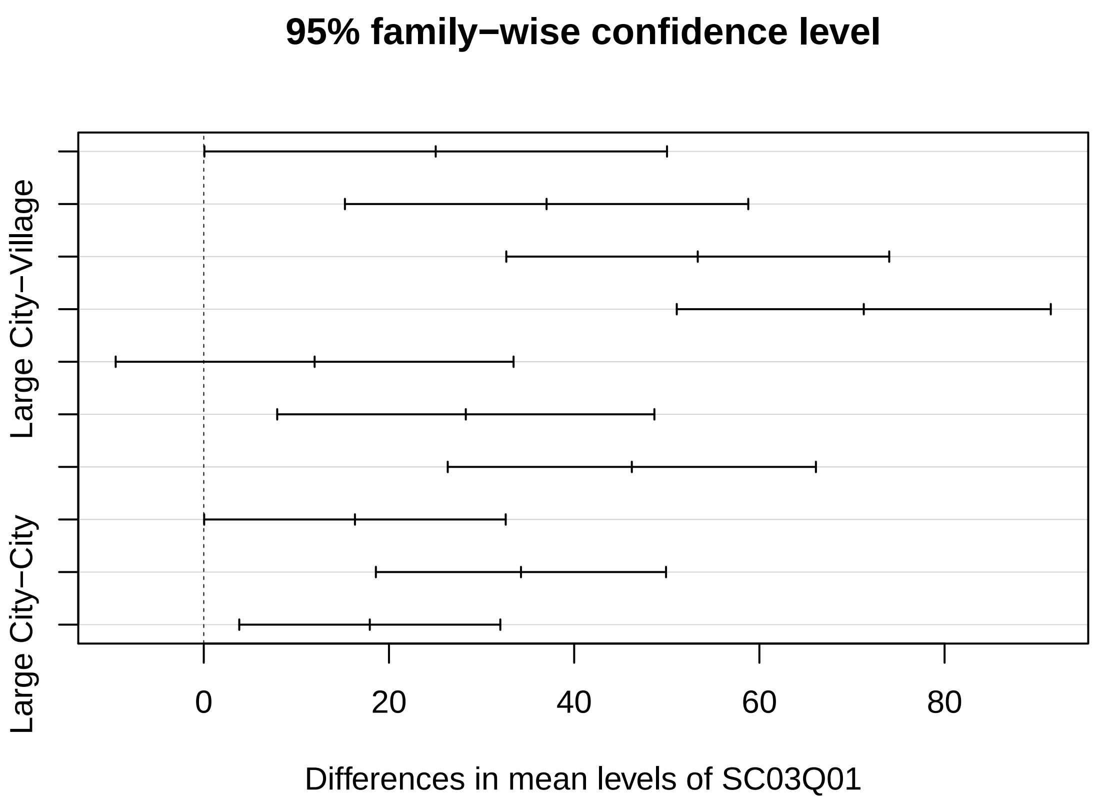
```r
#run ANOVA test
plot_anova <- aov(avg~SC03Q01, data = plot_data)
summary(plot_anova)
```

```
##              Df  Sum Sq Mean Sq F value Pr(>F)
## SC03Q01       4  367681   91920   29.98 <2e-16 ***
## Residuals   755 2314567    3066
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
#run Tukey test
tuk <- TukeyHSD(plot_anova)
tuk
```

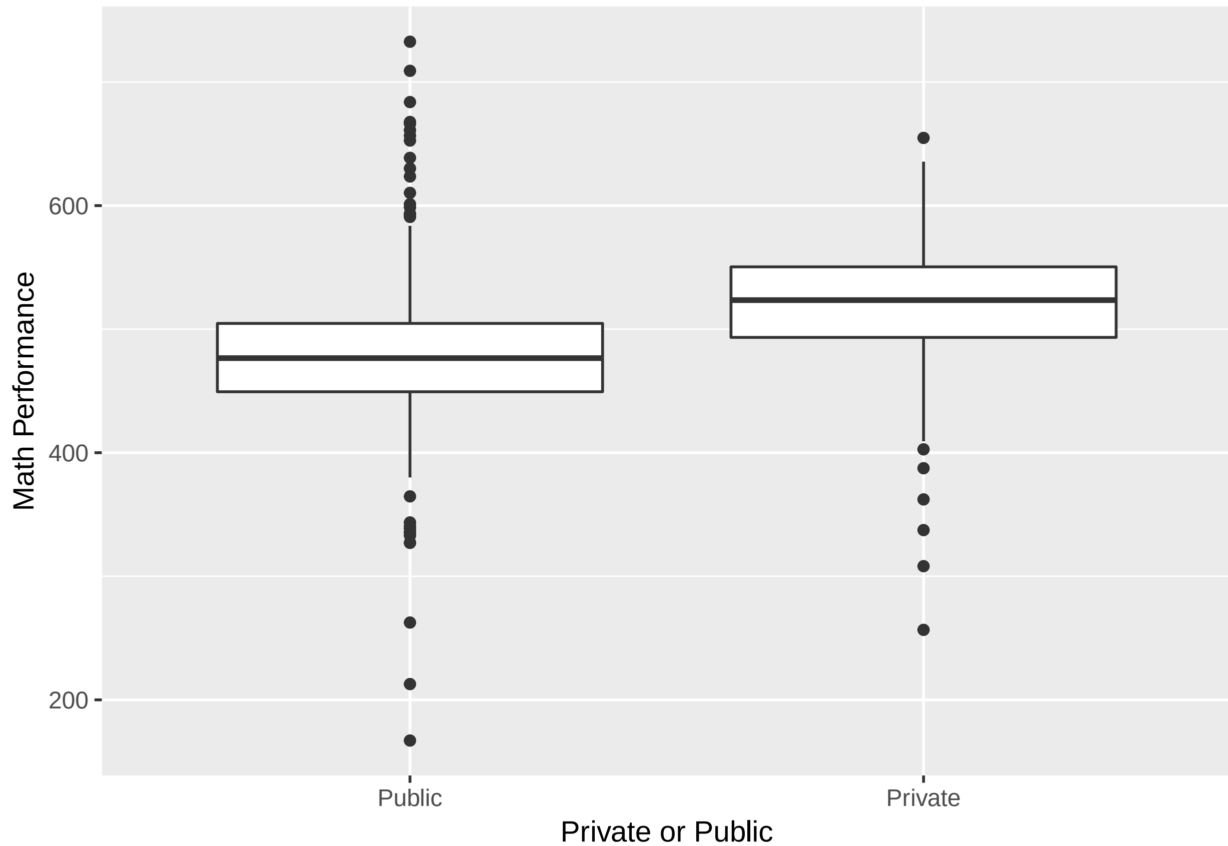
```
##   Tukey multiple comparisons of means
##     95% family-wise confidence level
##
## Fit: aov(formula = avg ~ SC03Q01, data = plot_data)
##
## $SC03Q01
##                            diff         lwr      upr     p adj
## Small Town-Village    25.04830  0.06888976 50.02771 0.0489816
## Town-Village          37.01961 15.24163169 58.79759 0.0000388
## City-Village          53.34472 32.66859799 74.02084 0.0000000
## Large City-Village    71.27421 51.07794520 91.47048 0.0000000
## Town-Small Town       11.97131 -9.51231913 33.45494 0.5473265
## City-Small Town       28.29642  7.93056627 48.66227 0.0014715
## Large City-Small Town 46.22591 26.34740180 66.10442 0.0000000
## City-Town             16.32511  0.04391673 32.60630 0.0490038
## Large City-Town       34.25460 18.58729741 49.92191 0.0000000
## Large City-City       17.92949  3.83388680 32.02510 0.0048371
```

```r
plot(tuk)
```



The boxplot shows there is a significant difference in the mean score of students from different region of Australia. The graph implies that students from large city in Australia, for example, Sydney and Melbourne normally scores higher than students from a village.

```
library(data.table)
library(PISA2012lite)
library("dplyr")
library(ggplot2)
data("computerStudent2012")
setDT(computerStudent2012)
data("school2012")
setDT(school2012)

#filter data
school_view <- school2012[NC =="Australia" & !is.na(SC01Q01)]
school_plot_data <- select(school_view, SC01Q01, SCHOOLID)
#filter data
#calculate the weighted math literacy score, using the column W_FSTUWT
n <- nrow(computerStudent2012)
computerStudent2012$W_HOUSEWHT <- n * computerStudent2012$W_FSTUWT / sum(computerStudent2012$W_FSTUWT)
student_data <- computerStudent2012[NC == "Australia" & !is.na(PV1MATH), .(avg= weighted.mean(PV1MATH, w

#merge data
plot_data <- merge(student_data, school_plot_data, by="SCHOOLID")
ggplot(plot_data, aes(x=factor(SC01Q01), y=avg))+geom_boxplot()+labs(x="Private or Public", y="Math Per
```




```r
#run linear regression test
fit <- lm(avg~SC01Q01, data=plot_data)
summary(fit)
```

```
##
## Call:
## lm(formula = avg ~ SC01Q01, data = plot_data)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -311.569  -29.259    0.429   27.836  253.990
##
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)     478.648      2.575  185.87   <2e-16 ***
## SC01Q01Private   41.856      4.106   10.19   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 55.77 on 771 degrees of freedom
## Multiple R-squared:  0.1188, Adjusted R-squared:  0.1176
## F-statistic: 103.9 on 1 and 771 DF,  p-value: < 2.2e-16
```

```r
#run ANOVA test
plot_anova <- aov(avg~SC01Q01, data = plot_data)
summary(plot_anova)
```

```
##              Df  Sum Sq Mean Sq F value Pr(>F)
```

```
## SC01Q01       1  323134  323134   103.9 <2e-16 ***
## Residuals   771 2397990    3110
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

A few results can be concluded accroding to the analysis result: 1. Students from private/independent schools significantly outperform public/government students. 2. Students from large city outperform students from other scetors of students. 3. Students from private schools have an average of ## scores whereas students from public schools have an average of ## scores in mathematic literacy. 4. Students with a higher socio-economic state also show a higher level of proficiency in math literacy 5. According to the regression model,

Discussion

As we can see from the analysis above, there is a positive relationship between the student's socio-economic background and their math performances. Big city students own more education resources than of villages students.

Reference

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