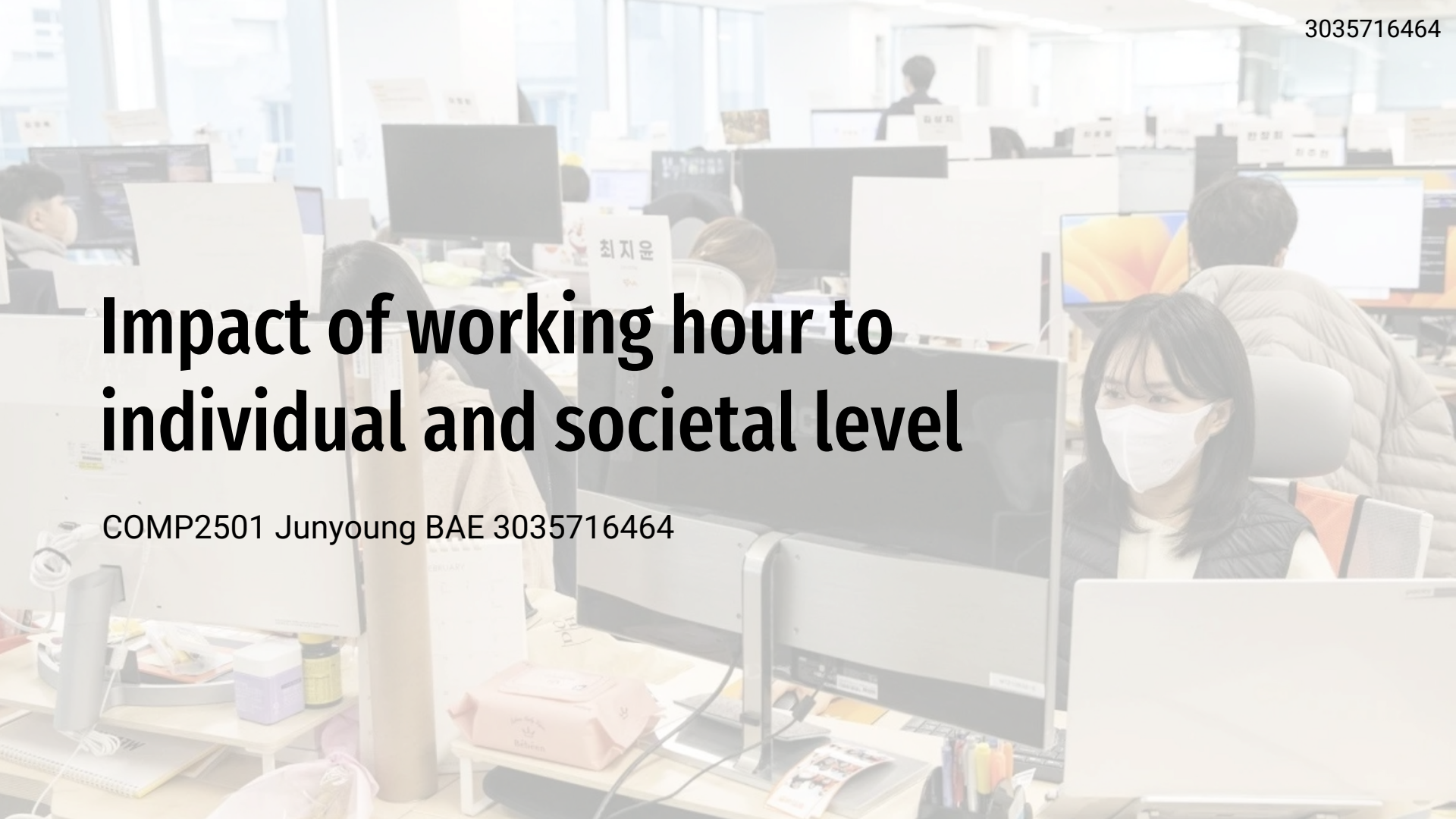


Impact of working hour to individual and societal level

COMP2501 Junyoung BAE 3035716464

Outline

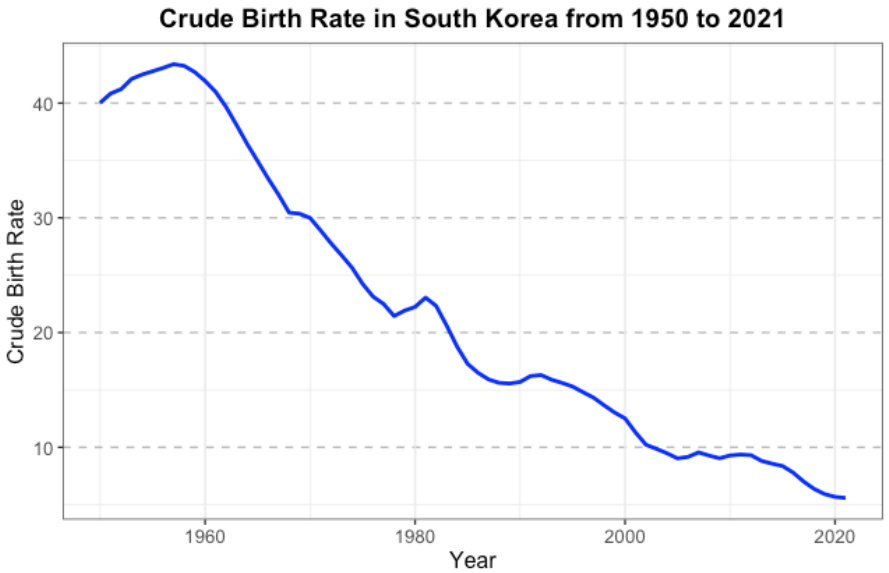
1. Background Information
2. Data Science Question
3. Methodology
4. Data collection and transformation
5. Findings
6. Conclusion
7. Limitation

Background Information

Current situation in South Korea

Using raw data from our worldindata.org

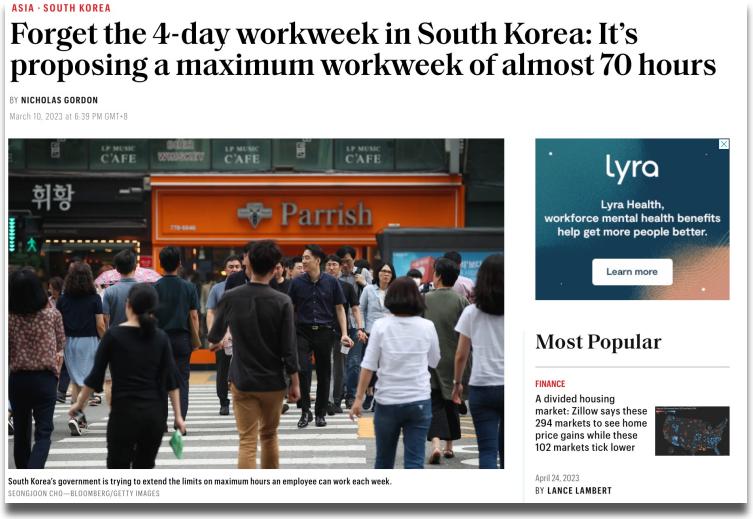
```
birth_rate <- read.csv(file = 'crude-birth-rate.csv')
Korea_brith_rate <- filter(birth_rate, Entity == "South Korea")
library(ggplot2)
plot <- ggplot(Korea_brith_rate, aes(x=Year, y=`Birth.rate...Sex..all...Age..all...Variant..estimates`, group=1)) +
  geom_line(color="blue", size=1) +

  xlab("Year") + ylab("Crude Birth Rate") +

  ggtitle("Crude Birth Rate in South Korea from 1950 to 2021") +

  theme_bw() +
  theme(axis.title.x = element_text(size=12),
        axis.title.y = element_text(size=12)) +
  theme(plot.title = element_text(size=14, face="bold", hjust=0.5)) +
  theme(axis.text.x = element_text(size=10),
        axis.text.y = element_text(size=10)) +
  theme(panel.grid.major.y = element_line(color="gray", linetype = "dashed"))
```



Although there were numerous policies by the South Korean government to increase the birth rate for nearly 20 years, birth rate kept fall reaching 0.84 births per woman in 2020.

Background Information

Government's attempt



ASIA · SOUTH KOREA

Forget the 4-day workweek in South Korea: It's proposing a maximum workweek of almost 70 hours

BY NICHOLAS GORDON

March 10, 2023 at 6:39 PM GMT+8

South Korea's government is trying to extend the limits on maximum hours an employee can work each week.

SEONGJOON CHO—BLOOMBERG/GETTY IMAGES

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April 24, 2023

BY LANCE LAMBERT

Increase working hour

52 hour per week

69 hour per week

As a solution to decreasing birth rate, the Korean government proposed increasing working hour as a solution

Background Information

Public's Reatction

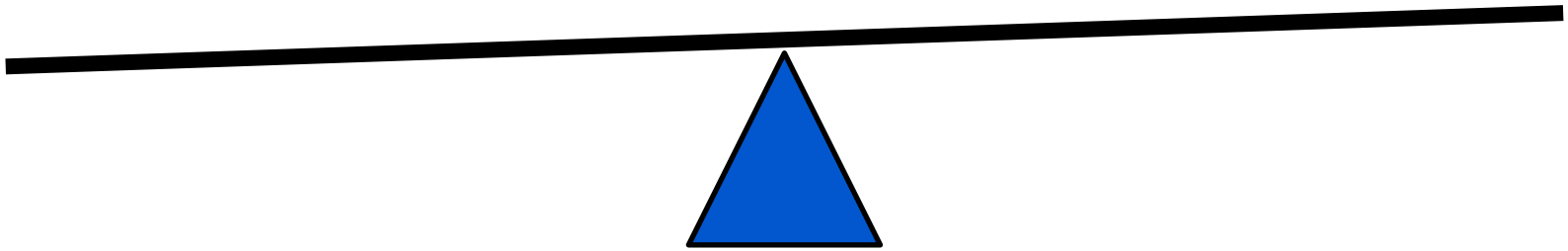
The public was opposed to this and the legislation did not pass.

Data science question

How much influence does changes in working hours have on an individual and societal perspective?

Individual perspective

Societal perspective



Methodolgoy

Independent variable:

Average working hour per year

Dependent variables:

Individual level
Suicide rates
Happiness
Societal level
GDP per capita
Income Inequality

Countries with high working hour:
Mexico, Hong Kong, Thailand, China, India
Country with low working hour
Germany, Norway, Netherlands, France, Denmark

Data collection and transformation

Data collection

Sources: Our World in Data, Stats OECD

CSV files that contain information about 263 countries

crude-birth-rate.csv
annual-working-hours-per-worker.csv
happiness-cantril-ladder.csv
suicide-rates-vs-prevalence-of-mental-and-substance-use-disorders.csv
economic-inequality-gini-index.csv
population-growth-the-annual-change-of-the-population.csv

Data transformation

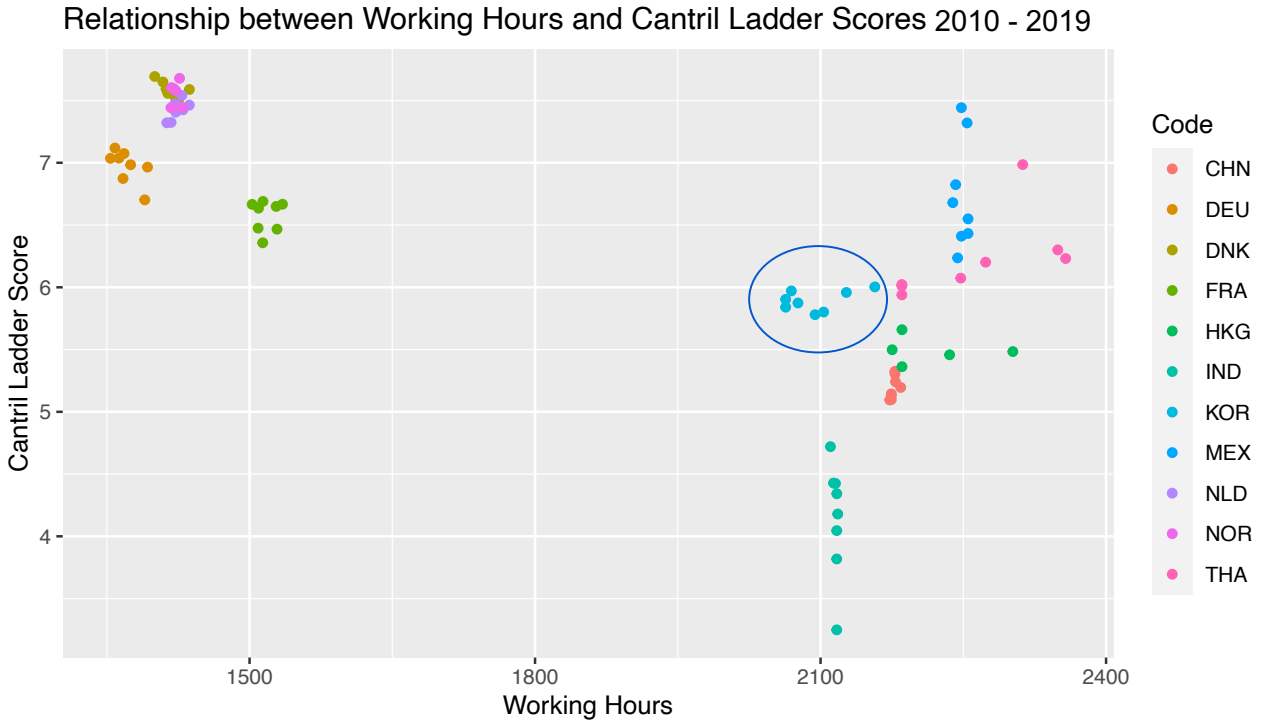
Functions to transform the data

filter: show only necessary data and remove countries with null data

rename: as the data are from different sources certain variables had to remain for instance rename time to year

merge: combine data frames together

Findings: Working Hour vs Happiness



Cantril Ladder Score

Self reported life satisfaction

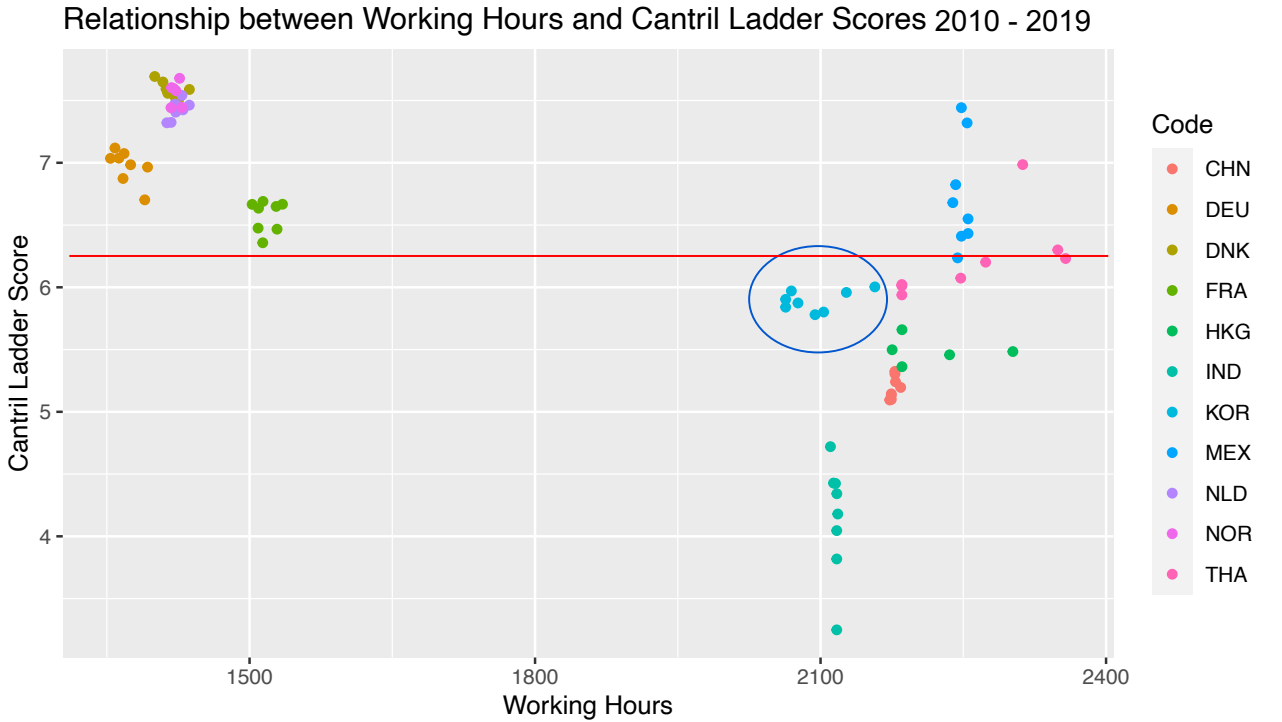
Scale of 0 - 10

Worst Possible Life

Best Possible Life

After using filter, select, rename for “stats-oecd-averageworkinghour perweek.csv” (independent) and “happiness-cantril-ladder.csv” (dependent)
ggplot(workinghour_happiness, aes(x = Working.hour, y = Cantril.ladder.score, color = Code)) + geom_point() + ggtitle("Relationship between Working Hours and Cantril Ladder Scores 2010 - 2019") + xlab("Working Hours") + ylab("Cantril Ladder Score")

Findings: Working Hour vs Happiness



Cantril Ladder Score

Self reported life satisfaction

Scale of 0 - 10

Worst Possible Life — **Best Possible Life**

After using filter, select, rename for “stats-oecd-averageworkinghour perweek.csv” (independent) and “happiness-cantril-ladder.csv” (dependent)
ggplot(workinghour_happiness, aes(x = Working.hour, y = Cantril.ladder.score, color = Code)) + geom_point() + ggtitle("Relationship between Working Hours and Cantril Ladder Scores 2010 - 2019") + xlab("Working Hours") + ylab("Cantril Ladder Score")

Findings: Working Hour vs Happiness

Insights

There is a **significant negative relationship** between independent variable annual working hour and dependent variable Cantril ladder score

Intercept coefficient: 9.933389

Slope coefficient for annual working hour: -0.001948

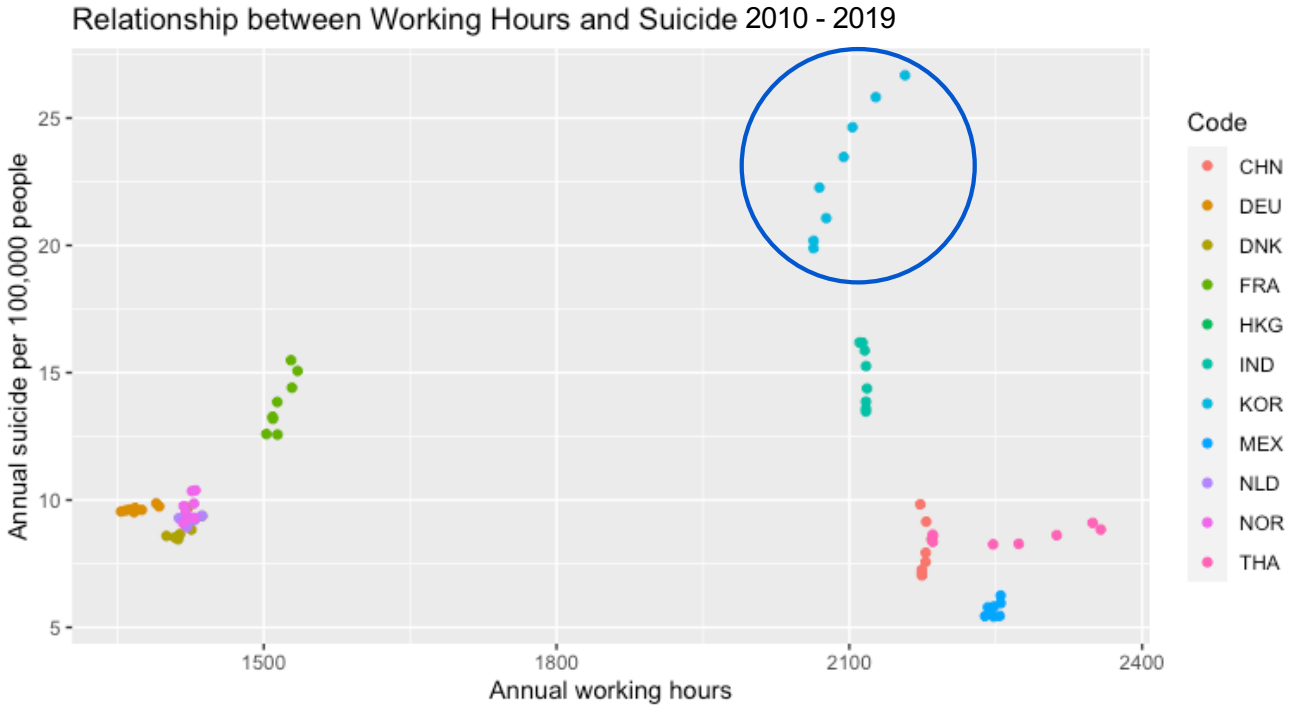
Adjusted R squared: 0.4804

Linear Regression Model

lm_model <- lm(Cantril.ladder.score ~ Working.hour, data = workinghour_happiness)

```
> summary(lm_model_workinghour_happiness)

Call:
lm(formula = Cantril.ladder.score ~ Annual.working.hour, data = workinghour_happiness)

Residuals:
    Min      1Q  Median      3Q     Max
-2.5598 -0.3590  0.0524  0.3966  1.8892

Coefficients:
                   Estimate Std. Error t value Pr(>|t|)
(Intercept)        9.933389   0.413925  23.998  < 2e-16 ***
Annual.working.hour -0.001948   0.000221  -8.818 1.66e-13 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.771 on 82 degrees of freedom
  (44 observations deleted due to missingness)
Multiple R-squared:  0.4867,    Adjusted R-squared:  0.4804
F-statistic: 77.75 on 1 and 82 DF,  p-value: 1.659e-13
```

Findings: Working Hour vs Suicide rate



After merging data from “stats-oecd-averageworkinghour perweek.csv” (independent) and “suicide-rates.csv” (dependent)
ggplot(workinghour_suicide, aes(x = Annual.working.hour, y = Deaths.by.suicide, color = Code)) + geom_point() + ggtitle("Relationship between Working Hours and Deaths by Suicide 2010 - 2019") + xlab("Working Hours") + ylab("Deaths by Suicide")

Findings: Working Hour vs Suicide rate

Insights

There is a **weak relationship and statistically insignificant** between independent variable Working hour and dependent variable suicide rate

Intercept coefficient: 662983

Slope coefficient for annual working hour: -0.001378

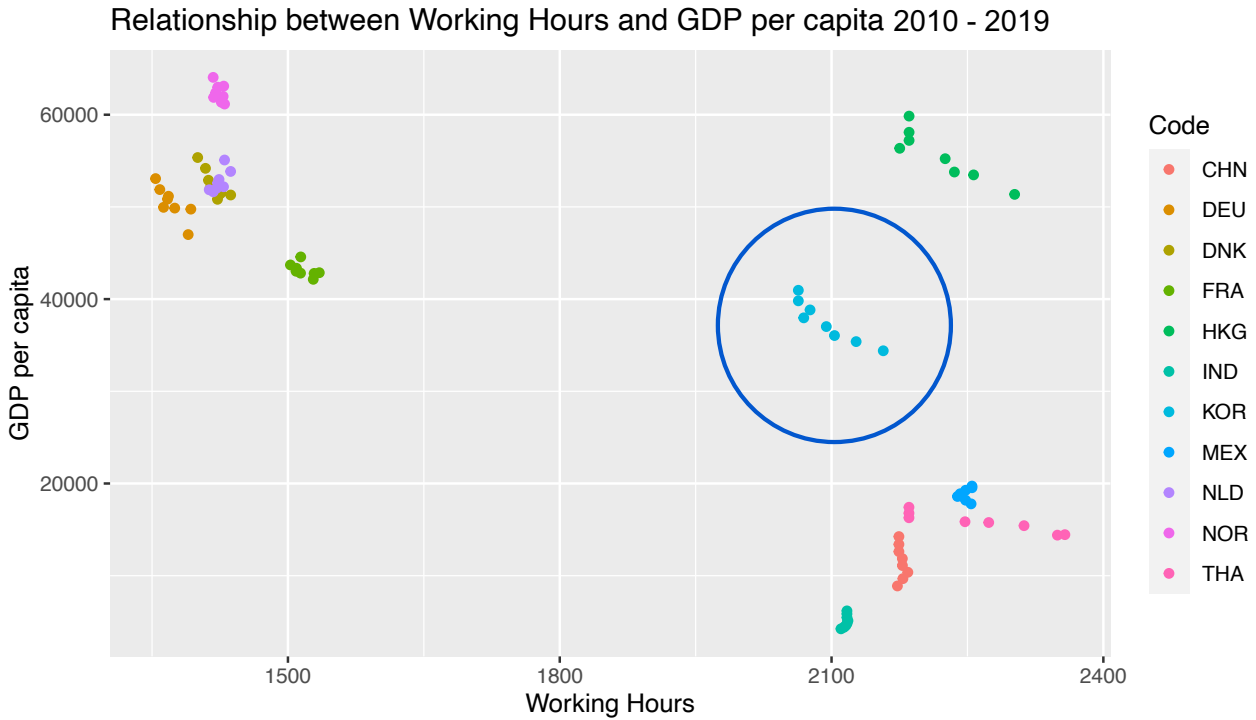
Adjusted R squared: -0.0007445

Linear Regression Model

lm_model_workinghour_suicide <- lm(Deaths.by.suicide ~ Annual.working.hour, data = workinghour_suicide)

```
> summary(lm_model_workinghour_suicide)

Call:
lm(formula = Deaths.by.suicide ~ Annual.working.hour, data = workinghour_suicide)

Residuals:
   Min     1Q Median     3Q    Max
-6.340 -3.043 -1.279  2.078 15.045

Coefficients:
                 Estimate Std. Error t value Pr(>|t|)
(Intercept)      8.662983   2.619813   3.307  0.00143 **
Annual.working.hour 0.001378   0.001420   0.970  0.33496
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 4.822 on 78 degrees of freedom
  (8 observations deleted due to missingness)
Multiple R-squared:  0.01192,   Adjusted R-squared:  -0.0007445
F-statistic: 0.9412 on 1 and 78 DF,  p-value: 0.335
```

Findings: Working Hour vs GDP per capita



After merging data from “stats-oecd-averageworkinghour perweek.csv” (independent) and “gdp-per-capita-worldbank.csv” (dependent)
ggplot(workinghour_gdppercapita, aes(x = Annual.working.hour, y = GDP.per.capita, color = Code)) + geom_point() + ggtitle("Relationship between Working Hours and GDP per capita 2010 - 2019") + xlab("Working Hours") + ylab("GDP per capita")

Findings: Working Hour vs GDP per capita

Insights

There is a **significant negative relationship** between independent variable Annual working hour and dependent variable GDP per capita

Intercept coefficient: 104546.995

Slope coefficient for annual working hour: -36.72

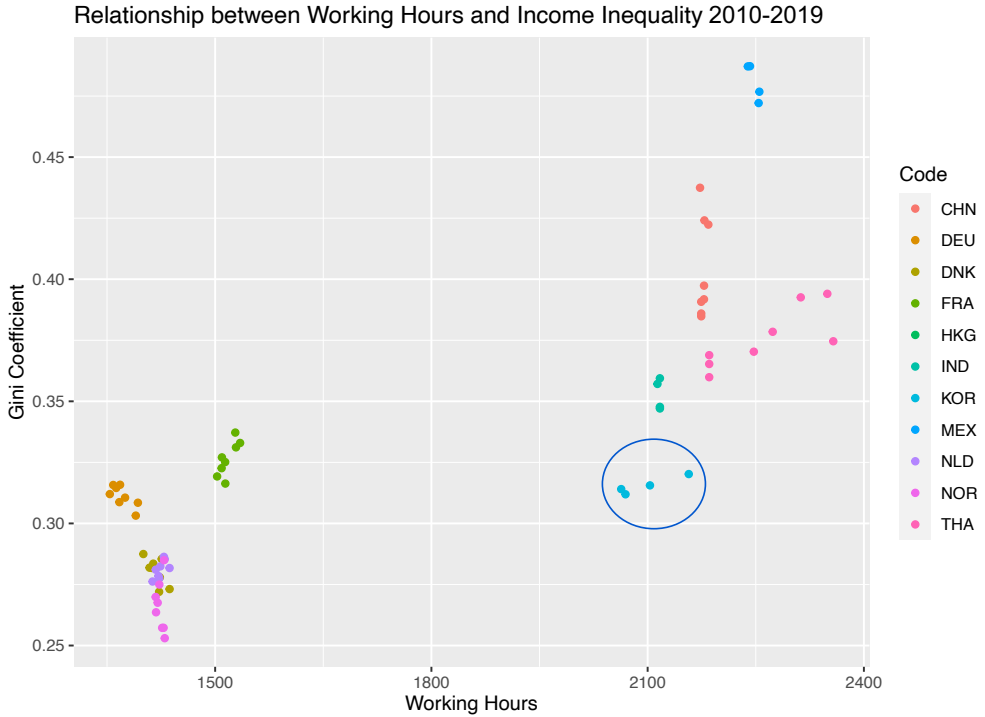
Adjusted R squared: 0.5114

Linear Regression Model

lm_model_workinghour_gdppercapita <- lm(GDP.per.capita ~ Annual.working.hour, data = workinghour_gdppercapita)

```
> summary(lm_model_workinghour_gdppercapita)

Call:
lm(formula = GDP.per.capita ~ Annual.working.hour, data = workinghour_gdppercapita)

Residuals:
   Min     1Q Median     3Q    Max
-22811  -6143  -2750   8984  35564

Coefficients:
                   Estimate Std. Error t value Pr(>|t|)
(Intercept)        104546.995   7202.456  14.515  < 2e-16 ***
Annual.working.hour   -36.723      3.827  -9.595 3.03e-15 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 13690 on 86 degrees of freedom
Multiple R-squared:  0.517,     Adjusted R-squared:  0.5114
F-statistic: 92.06 on 1 and 86 DF,  p-value: 3.027e-15
```

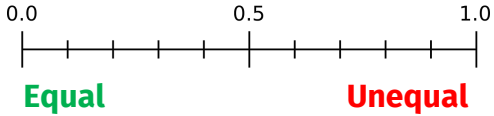
Findings: Working Hour vs Income Inequality



Gini Coefficient

Measure of income inequality within a population

Represented by value between 0 and 1



After merging data from “stats-oecd-averageworkinghour perweek.csv” (independent) and “economic-inequality-gini-index.csv” (dependent) ggplot(workinghour_gini, aes(x = Annual.working.hour, y = Gini.coefficient, color = Code)) + geom_point() + ggtitle("Relationship between Working Hours and Income Inequality 2010 - 2019") + xlab("Working Hours") + ylab("Gini Coefficient")

Findings: Working Hour vs Income Inequlaity

Insights

There is a **significant positive correlation** between independent variable Annual working hour and dependent variable Gini coefficient.

Intercept coefficient: 0.1087974

Slope coefficient for annual working hour: 0.0001278

Adjusted R squared: 0.675

Linear Regression Model

lm_model_workinghour_gini <- lm(Gini.coefficient ~ Annual.working.hour, data = workinghour_gini)

```
> summary(lm_model_workinghour_gini)

Call:
lm(formula = Gini.coefficient ~ Annual.working.hour, data = workinghour_gini)

Residuals:
      Min        1Q    Median        3Q       Max
-0.064281 -0.020295 -0.006758  0.023429  0.092170

Coefficients:
                    Estimate Std. Error t value Pr(>|t|)
(Intercept)        0.1087974  0.0192681   5.647 3.74e-07 ***
Annual.working.hour 0.0001278  0.0000108  11.839  < 2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.03375 on 66 degrees of freedom
  (20 observations deleted due to missingness)
Multiple R-squared:  0.6799,    Adjusted R-squared:  0.675
F-statistic: 140.2 on 1 and 66 DF,  p-value: < 2.2e-16
```

Findings Summary

How much influence does changes in working hours have on an individual and societal level?

Individual perspective

Happiness (Cantril Ladder Score)
Weekly negatively correlated

Suicide Rate
No correlation

Societal perspective

GDP per capita
Strongly negatively correlated

Income Inequality (Gini Coefficient)
Strongly positively correlated

Conclusion

South Korea compared to other countries with high average working hour

- Higher Suicide Rate
- Higher GDP per capita
- Lower Income Inequality

Although high working average working hours are **not the causation** to these factors
other qualitative and cultural factors that could have correlations

Limitations

Due to limited data it is not possible to do correlations of all countries.

Deaths by suicide could be better if it was suicide in the labor force

There are also other qualitative factors such as cultural, political factors behind this.

CORRELATION NOT CAUSATION

Works cited

Annual Working Hours per Worker. (n.d.). Our World in Data. Retrieved April 23, 2023, from https://ourworldindata.org/grapher/annual-working-hours-per-worker

Crude Birth Rate. (n.d.). Our World in Data. Retrieved April 23, 2023, from https://ourworldindata.org/grapher/crude-birth-rate

Economic Inequality (Gini Index). (n.d.). Our World in Data. Retrieved April 23, 2023, from https://ourworldindata.org/grapher/economic-inequality-gini-index

Happiness (Cantril Ladder). (n.d.). Our World in Data. Retrieved April 23, 2023, from https://ourworldindata.org/grapher/happiness-cantril-ladder

Population Growth - The Annual Change of the Population. (n.d.). Our World in Data. Retrieved April 23, 2023, from https://ourworldindata.org/grapher/population-growth-the-annual-change-of-the-population

Suicide Rates vs. Prevalence of Mental and Substance Use Disorders. (n.d.). Our World in Data. Retrieved April 23, 2023, from https://ourworldindata.org/grapher/suicide-rates-vs-prevalence-of-mental-and-substance-use-disorders

Wong, C. (2022, September 14). In the lens: South Korea's president faces backlash over 69-hour work week proposal. South China Morning Post. Retrieved April 23, 2023, from https://www.scmp.com/yp/discover/your-voice/opinion/article/3213860/lens-south-koreas-president-faces-backlash-69-hour-work-week-proposal