Question 1 & 2

2025-11-23

Data

Just a brief description of the data used in this analysis. There are 4 files which I am going to import to this file later, two for Kenya, two for Bangladesh.

For Kenya, there are "Kenya_Wealth", "Kenya_Income", and in each of them, it contains the following indicators:

- Gini coefficient
- Share of income/wealth held by highest 1%
- Share of income/wealth held by highest 10%
- Share of income/wealth held by bottom 50%
- Share of income/wealth held by middle 40%

The same applies for Bangladesh, with files "Bangladesh_Wealth" and "Bangladesh_Income".

Note that the data for Bangladesh are imported in form of .xlsx files, as I found that it would be easier to import than the .csv file generated by the website as csv files generated are not in regular format. And I have changed the name for the files for convenience and clarity of the files.

```
# !!! DON"T FORGET TO CHANGE THE WORKING DIRECTORY TO YOUR OWN DIRECTORY !!!
setwd("~/R/BI_Group_Proj/Data")

# Importing Kenya Data
Ken_W_Ineq <- read_delim("Kenya_Wealth_Inequality.csv",
  delim = ";", escape_double = FALSE, col_names = FALSE,
  trim_ws = TRUE, skip = 1
) # This is why I would rather use xls file

Ken_I_Ineq <- read_delim("Kenya_Income_Inequality.csv",
  delim = ";", escape_double = FALSE, col_names = FALSE,
  trim_ws = TRUE, skip = 1
)

# Importing Bangladesh Data
Bang_W_Ineq <- read_excel("Bang_Wealth_Inequality.xlsx", col_names = FALSE)
Bang_I_Ineq <- read_excel("Bang_Income_Inequality.xlsx", col_names = FALSE)
```

```
# Make a function for cleaning data sets
clean_data_inequality <- function(x) {
  colnames(x) <- c("Country", "Indicator", "Percentile", "Year", "Value")
  # Columns of Inequality data sets are all in this order, check when use for others
  x <- x %>%
    pivot_wider(
      names_from = Percentile,
      values_from = Value
    ) %>%
```

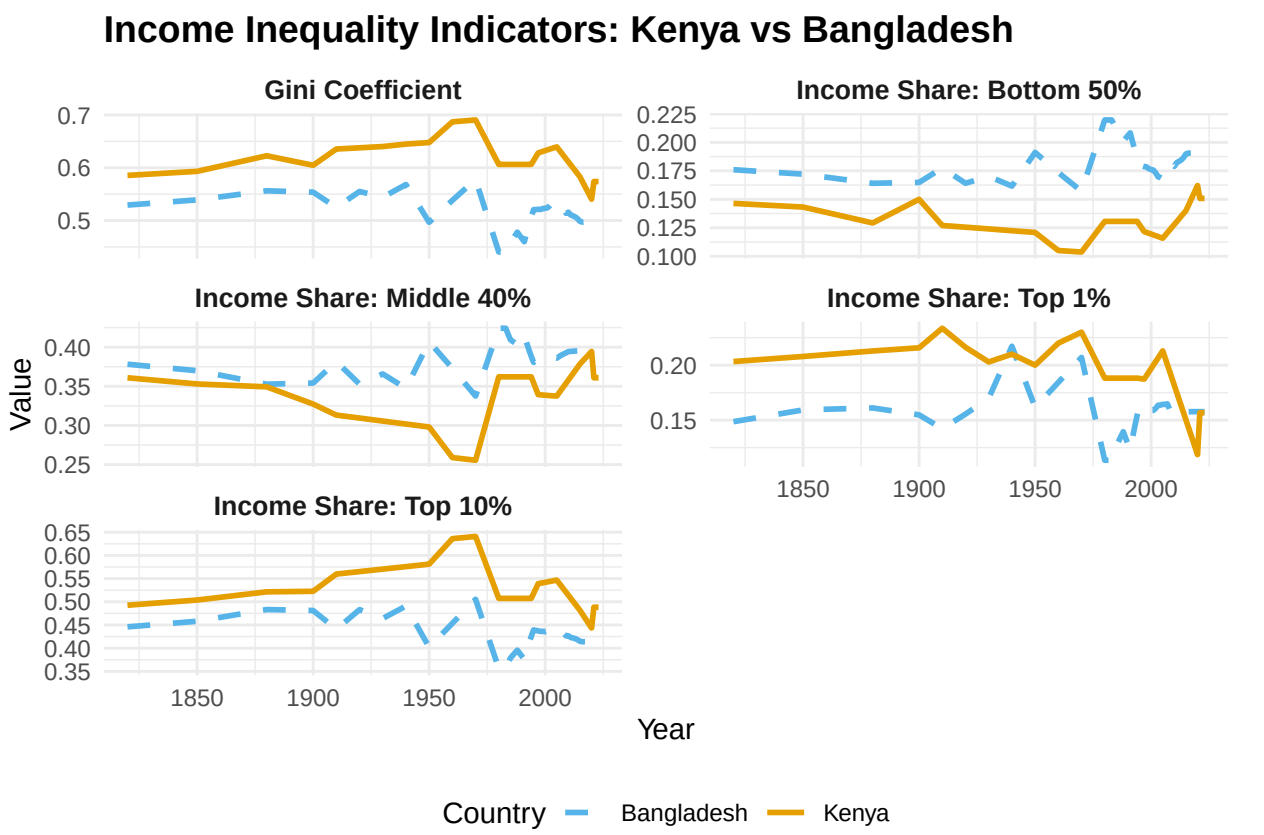
```
    filter(!if_all(c(pall, p0p50, p50p90, p90p100, p99p100), is.na)) %>%
    # filter out those rows where all the values are NA
    select(Country, Year, pall, p0p50, p50p90, p90p100, p99p100) %>%
    # To ensure the columns are in correct order and delete indicator column
    group_by(Country, Year) %>%
    summarise(
      across(
        c(pall, p0p50, p50p90, p90p100, p99p100),
        ~ first(na.omit(.))
      ),
      .groups = "drop"
    )
  # Note that previously we have 5 lines for a single year, and each
  # line only shows a single indicator. By doing this, we combine the data together.
  colnames(x) <- c(
    "Country", "Year", "Gini_Coeff", "Share_Bottom50",
    "Share_Middle40", "Share_Top10", "Share_Top1"
  )
  return(x)
}

Bang_I_Ineq_wider <- clean_data_inequality(Bang_I_Ineq)
Bang_W_Ineq_wider <- clean_data_inequality(Bang_W_Ineq)
Ken_I_Ineq_wider <- clean_data_inequality(Ken_I_Ineq)
Ken_W_Ineq_wider <- clean_data_inequality(Ken_W_Ineq)

longer_format <- function(x) {
  x %>% pivot_longer(
    cols = c(
      Gini_Coeff, Share_Bottom50, Share_Middle40,
      Share_Top10, Share_Top1
    ),
    names_to = "Indicator",
    values_to = "Value"
  )
}

Bang_I_Ineq_longer <- longer_format(Bang_I_Ineq_wider)
Bang_W_Ineq_longer <- longer_format(Bang_W_Ineq_wider)
Ken_I_Ineq_longer <- longer_format(Ken_I_Ineq_wider)
Ken_W_Ineq_longer <- longer_format(Ken_W_Ineq_wider)
```

Question 1

In this sector I will draw some line chart comparing inequality of income & wealth between Kenya and Bangladesh by means of Gini coefficient and share of income/wealth occupied by different social class.

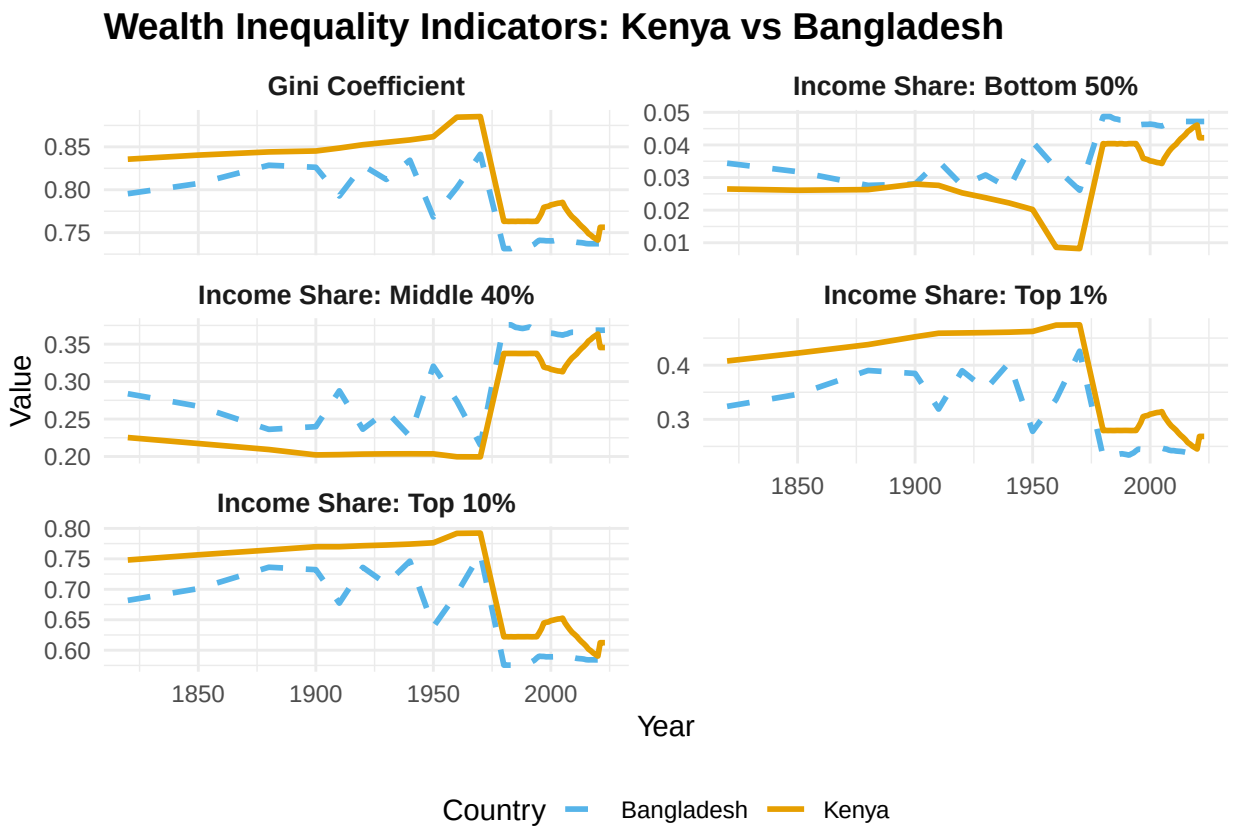
```
# -----Income Inequality-----
I_Inequality_K_and_B <- bind_rows(Ken_I_Ineq_longer, Bang_I_Ineq_longer)

indicator_labels <- c(
  "Gini_Coeff" = "Gini Coefficient",
  "Share_Bottom50" = "Income Share: Bottom 50%",
```

```
  "Share_Middle40" = "Income Share: Middle 40%",
  "Share_Top10" = "Income Share: Top 10%",
  "Share_Top1" = "Income Share: Top 1%"
)

I_Inequality_K_and_B %>% ggplot(aes(x = Year, y = Value, color = Country, linetype = Country)) +
  geom_line(linewidth = 1) +
  facet_wrap(~Indicator,
    scales = "free_y", ncol = 2,
    labeller = labeller(Indicator = indicator_labels)
  ) +
  scale_color_manual(values = c("Kenya" = "#E69F00", "Bangladesh" = "#56B4E9")) +
  scale_linetype_manual(values = c("Kenya" = "solid", "Bangladesh" = "dashed")) +
  labs(
    title = "Income Inequality Indicators: Kenya vs Bangladesh",
    x = "Year",
    y = "Value"
  ) +
  theme_minimal() +
  theme(
    legend.position = "bottom",
    plot.title = element_text(face = "bold", size = 14),
    strip.text = element_text(face = "bold", size = 10)
  )
```



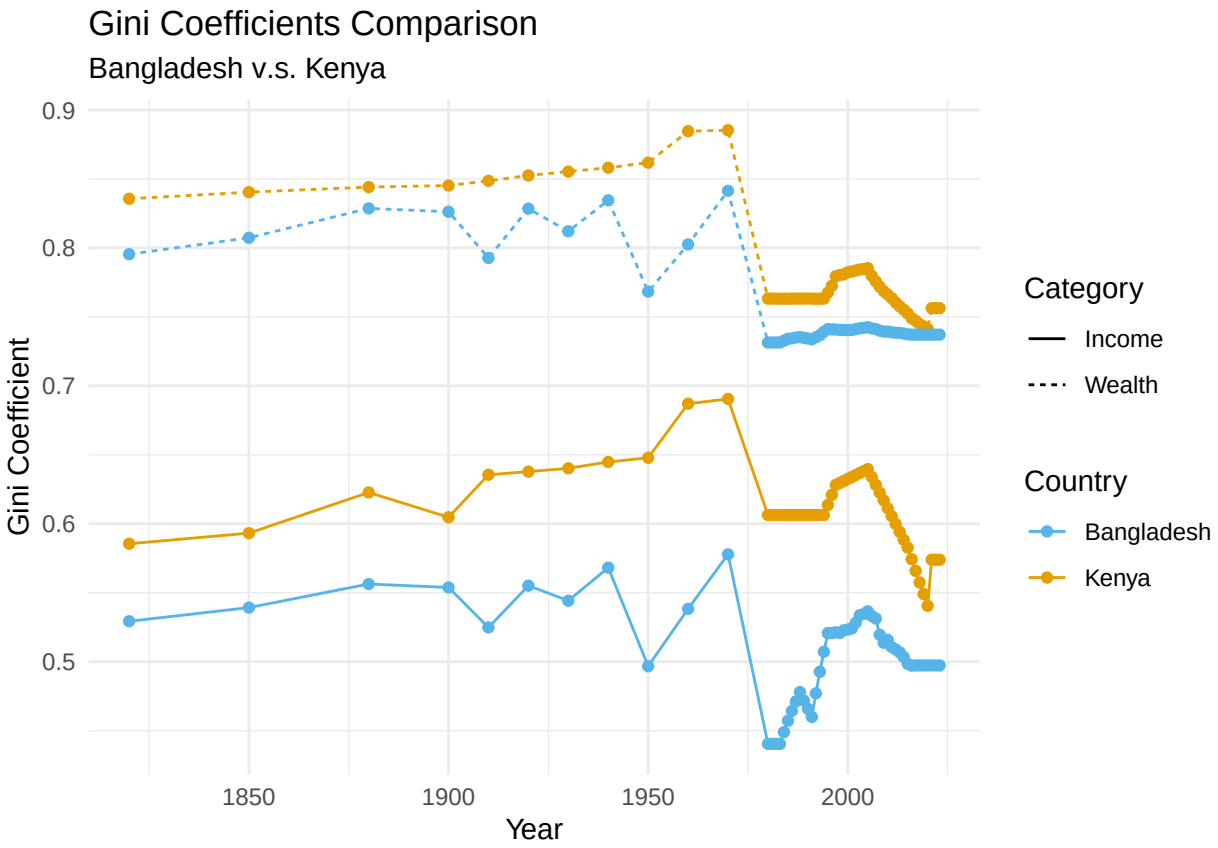

```
# -----Wealth Inequality-----
W_Inequality_K_and_B <- bind_rows(Ken_W_Ineq_longer, Bang_W_Ineq_longer)
```

```
W_Inequality_K_and_B %>% ggplot(aes(x = Year, y = Value, color = Country, linetype = Country)) +
  geom_line(linewidth = 1) +
  facet_wrap(~Indicator,
    scales = "free_y", ncol = 2,
    labeller = labeller(Indicator = indicator_labels)
  ) +
  scale_color_manual(values = c("Kenya" = "#E69F00", "Bangladesh" = "#56B4E9")) +
  scale_linetype_manual(values = c("Kenya" = "solid", "Bangladesh" = "dashed")) +
  labs(
    title = "Wealth Inequality Indicators: Kenya vs Bangladesh",
    x = "Year",
    y = "Value"
  ) +
  theme_minimal() +
  theme(
    legend.position = "bottom",
    plot.title = element_text(face = "bold", size = 14),
    strip.text = element_text(face = "bold", size = 10)
  )
```




```
W_I_Inequ_K_and_B <- bind_rows(
  Ken_W_Ineq_longer, Ken_I_Ineq_longer,
  Bang_W_Ineq_longer, Bang_I_Ineq_longer
) %>%
  filter(Indicator == "Gini_Coeff")

# Gini Coefficient Combined
```

```r
# See detailed explanation of the below function in question 2 part.
W_I_Combine <- function(df1, df2, df3, df4) {
  Keep_Gini_Only <- function(x, y) {
    {
      x %>%
        mutate(Category = ifelse(y == "I", "Income", "Wealth"))
    }
  }

  df1 <- Keep_Gini_Only(df1, "I")
  df2 <- Keep_Gini_Only(df2, "W")
  df3 <- Keep_Gini_Only(df3, "I")
  df4 <- Keep_Gini_Only(df4, "W")

  df <- bind_rows(df1, df2, df3, df4)
  return(df)
}

W_I_Inequ_K_and_B <- W_I_Combine(
  Ken_I_Ineq_wider, Ken_W_Ineq_wider,
  Bang_I_Ineq_wider, Bang_W_Ineq_wider
)

W_I_Inequ_K_and_B %>% ggplot(aes(
  x = Year, y = Gini_Coeff, colour = Country,
  linetype = Category
)) +
  geom_line() +
  geom_point() +
  labs(title = "Gini Coefficients Comparison",
       subtitle = "Bangladesh v.s. Kenya",
       x = "Year", y = "Gini Coefficient")+
  scale_colour_manual(
    values =
      c(
        "Kenya" = "#E69F00", "Bangladesh" = "#56B4E9"
      )
  ) +
  theme_minimal()
```

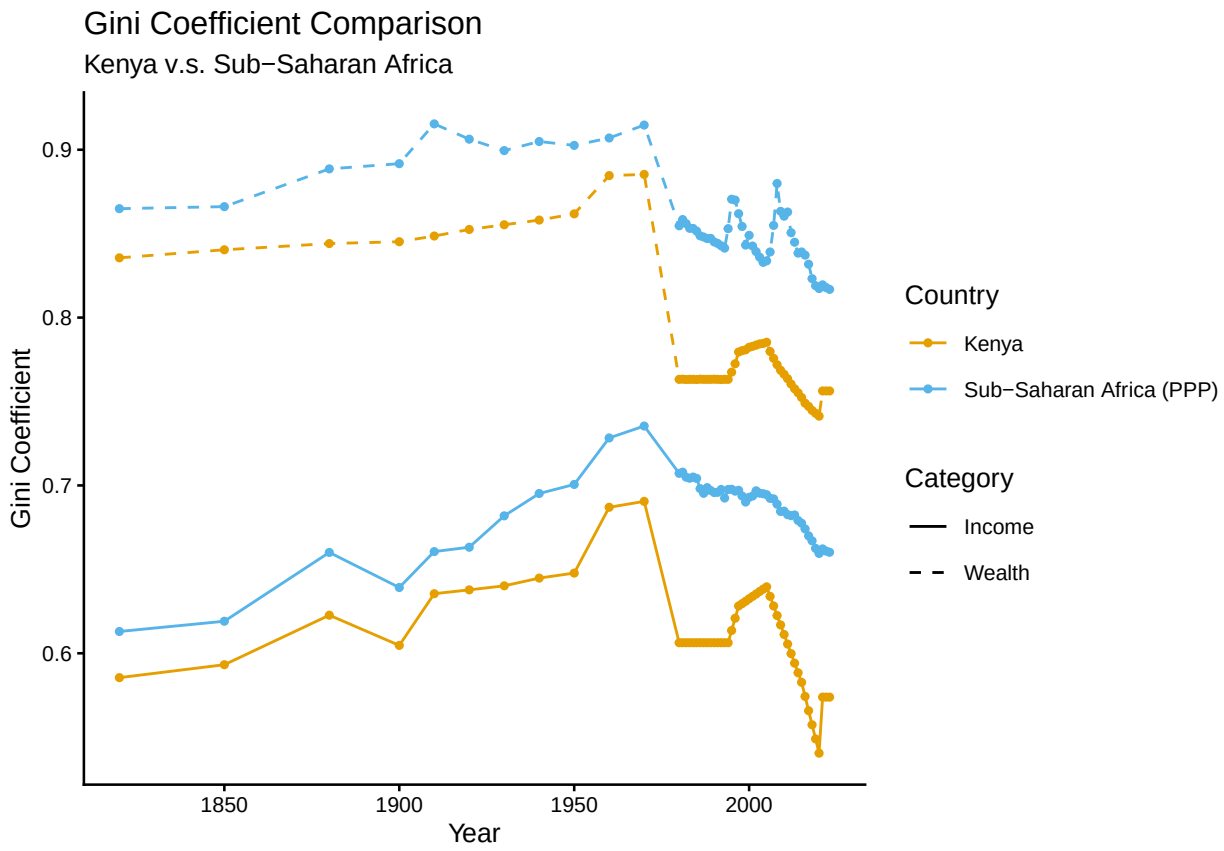


Question 2

```
# Import Data of wider region
SS_Africa_I_Ineq <- read_excel("Data/Sub_Sahara_Africa_Income_Inequality.xlsx",
  col_names = FALSE
)
SS_Africa_W_Ineq <- read_excel("Data/Sub_Sahara_Africa_Wealth_Inequality.xlsx",
  col_names = FALSE
)

SS_Asia_I_Ineq <- read_excel("Data/SAndSE_Asia_Income_Inequality.xls",
  col_names = FALSE
)
SS_Asia_W_Ineq <- read_excel("Data/SAndSE_Asia_Wealth_Inequality.xls",
  col_names = FALSE
)


# Clean data

SS_Africa_I_Ineq_wider <- clean_data_inequality(SS_Africa_I_Ineq)
SS_Africa_W_Ineq_wider <- clean_data_inequality(SS_Africa_W_Ineq)

SS_Asia_I_Ineq_wider <- clean_data_inequality(SS_Asia_I_Ineq)
SS_Asia_W_Ineq_wider <- clean_data_inequality(SS_Asia_W_Ineq)
```

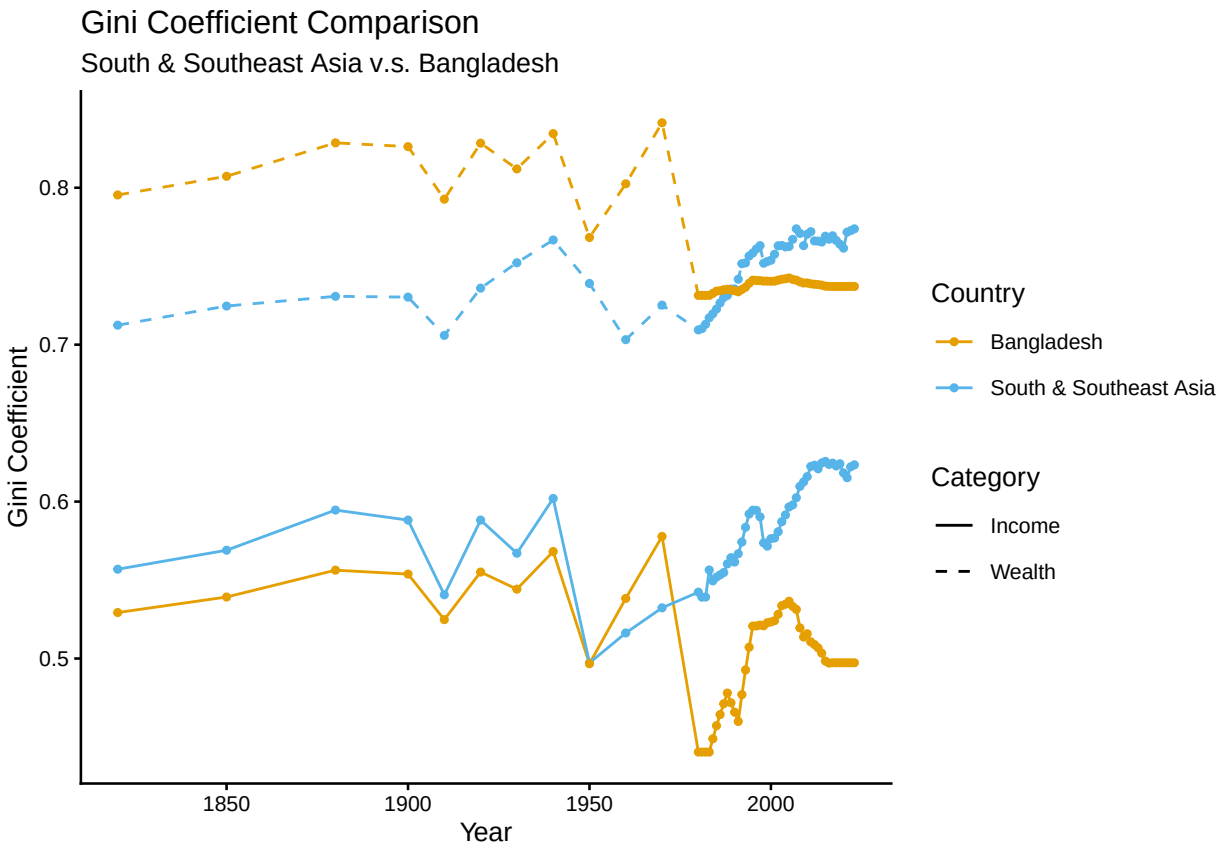
```r
# Pivot longer for plot
SS_Africa_I_Ineq_longer <- longer_format(SS_Africa_I_Ineq_wider)
SS_Africa_W_Ineq_longer <- longer_format(SS_Africa_W_Ineq_wider)

SS_Asia_I_Ineq_longer <- longer_format(SS_Asia_I_Ineq_wider)
SS_Asia_W_Ineq_longer <- longer_format(SS_Asia_W_Ineq_wider)


# Then we draw a line chart to compare the income and wealth distribution.

# We will draw two types of graphs, one only includes Gini coefficient, and the
# other one include all indicators
# Since the data between 1820 and 1980 is not recorded as frequent and without
# too much fluctuation, thus less important and valid comparing with one after.
# So one would ignore the part before 1950 to make room for more recent data.

# So we write a function first to combine the df's into one. (This function is moved to
# the first function as one found that it is useful there as well)

Africa_Inequality <- W_I_Combine(
  SS_Africa_I_Ineq_longer, SS_Africa_W_Ineq_longer,
  Ken_I_Ineq_longer, Ken_W_Ineq_longer
)

SS_Asia_Inequality <- W_I_Combine(
  SS_Asia_I_Ineq_longer, SS_Asia_W_Ineq_longer,
  Bang_I_Ineq_longer, Bang_W_Ineq_longer
)


# Compare Sub_Sahara Africa with Kenya

Africa_Inequality %>%
  filter(Indicator == "Gini_Coeff") %>%
  ggplot(aes(
    x = Year, y = Value,
    colour = Country, linetype = Category
  )) +
  geom_line(linewidth = 0.5) +
  geom_point(size= 1) +
  scale_colour_manual(
    values =
      c(
        "Kenya" = "#E69F00", "Sub-Saharan Africa (PPP)" = "#56B4E9",
        labels = c(
          "Sub-Saharan Africa (PPP)" = "Sub-Saharan Africa",
          "Kenya" = "Kenya"
        )
      )
  ) +
  scale_linetype_manual(
    values =
      c("Wealth" = "dashed", "Income" = "solid")
```

```
  ) +
  labs(
    title = "Gini Coefficient Comparison",
    subtitle = "Kenya v.s. Sub-Saharan Africa",
    x = "Year",
    y = "Gini Coefficient"
  ) +
  theme_classic(base_size = 10)
```

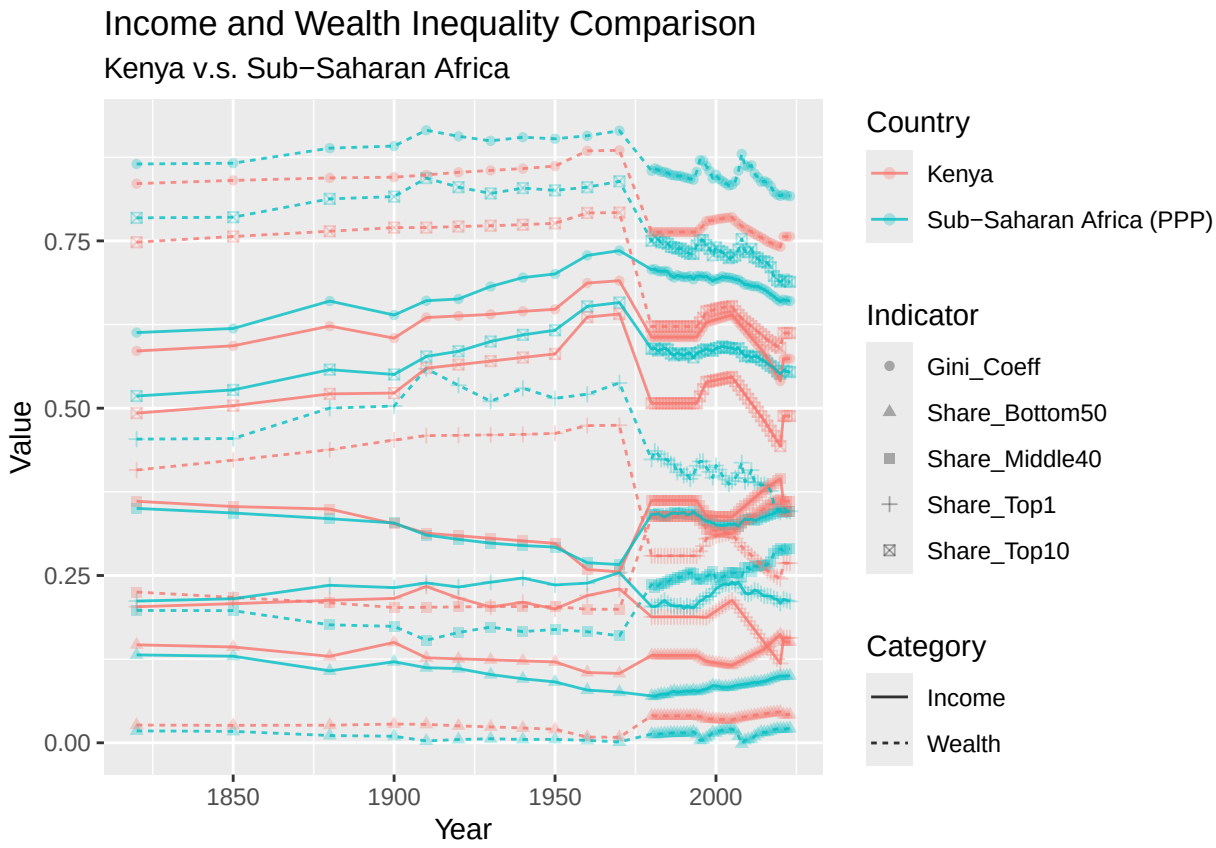



```
# Compare South and Southeast Asia with Bangladesh

SS_Asia_Inequality %>%
  filter(Indicator == "Gini_Coeff") %>%
  ggplot(aes(
    x = Year, y = Value,
    colour = Country, linetype = Category
  )) +
  geom_line(linewidth = 0.5) +
  geom_point(size = 1) +
  scale_color_manual(
    values = c("Bangladesh" = "#E69F00", "South & Southeast Asia (PPP)" = "#56b4e9"),
    labels = c(
      "Bangladesh" = "Bangladesh",
      "South & Southeast Asia (PPP)" = "South & Southeast Asia"
    )
  ) +
  scale_linetype_manual(
```

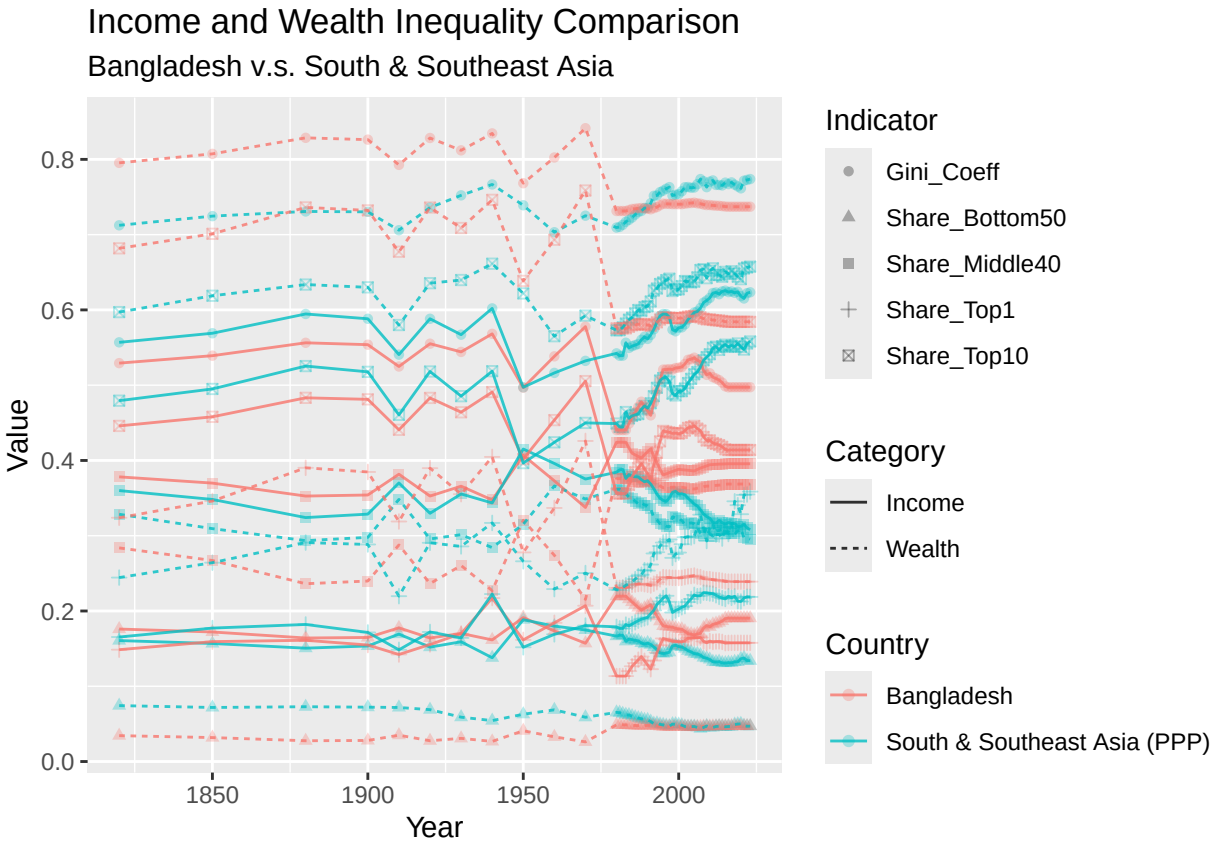
```
    values = c("Wealth" = "dashed", "Income" = "solid")
  ) +
  labs(
    title = "Gini Coefficient Comparison",
    subtitle = "South & Southeast Asia v.s. Bangladesh",
    x = "Year",
    y = "Gini Coefficient"
  ) +
  theme_classic(base_size = 10)
```




```
# Comparing All indices
## Sub-Saharan Africa and Kenya

Africa_Inequality %>% ggplot(aes(
  x = Year, y = Value,
  shape = Indicator, colour = Country,
  linetype = Category
)) +
  geom_point(alpha = 0.3) +
  geom_line(alpha = 0.8) +
  labs(
    title = "Income and Wealth Inequality Comparison",
    subtitle = "Kenya v.s. Sub-Saharan Africa"
  )
```




```
# South and Southeast Asia and Bangladesh
SS_Asia_Inequality %>% ggplot(aes(
  x = Year, y = Value,
  shape = Indicator, colour = Country,
  linetype = Category
)) +
  geom_point(alpha = 0.3) +
  geom_line(alpha = 0.8) +
  labs(
    title = "Income and Wealth Inequality Comparison",
    subtitle = "Bangladesh v.s. South & Southeast Asia"
  )
```




```
# Correlation between Gini Coefficient and other indicators

Corr_with_Gini <- bind_rows(Africa_Inequality, SS_Asia_Inequality) %>%
  pivot_wider(names_from = Indicator, values_from = Value) %>%
  group_by(Category) %>%
  summarise(across(
    c(Share_Bottom50, Share_Middle40, Share_Top10, Share_Top1),
    ~ cor(Gini_Coeff, .x)
  )) %>%
  pivot_longer(-Category, names_to = "Indicator", values_to = "Correlation")

kable(Corr_with_Gini,
  format = "markdown",
  caption = "Correlation between Gini and Other Indicators"
)
```

Table 1: Correlation between Gini and Other Indicators

Category	Indicator	Correlation
Income	Share_Bottom50	-0.9909142
Income	Share_Middle40	-0.8494054
Income	Share_Top10	0.9834682
Income	Share_Top1	0.8540337
Wealth	Share_Bottom50	-0.9499572
Wealth	Share_Middle40	-0.9415636
Wealth	Share_Top10	0.9804862
Wealth	Share_Top1	0.9740106

```
# From this table, we can see that there is a strong correlation between Gini and
# the other indicators of income and wealth distribution, so for simplicity and
# clarity, we may only concentrate on Gini alone, but one would leave the last
# two graphs for reference.
```

AI Usage

AI language models, such as ChatGPT and Claude, were used during the development of this project, particularly in the coding component. I will provide a detailed explanation of how these tools were used.

1. Coding Support

AI tools are generally used to help clarify the usage of certain functions, and advise on improvement in plotting. For instance, in the plot of question 2, where a graph comparing the income and wealth inequality were drawn, one would like to add a legend to side of the plot. Hence, one wrote the following prompt in Claude:

> I have drew a plot, year against Gini coefficient, and in that plot I compared Gini coefficient of two countries in terms of income and wealth respectively. I have used function scale_colour_manual() to assign each country a colour, how should I add a legend on the side and rename the country/region labels as they are not in the desired form. Also, give me a pair of contract colour in Unicode format.

2. Git and Version Control:

AI also played a significant role in supporting our group's use of Git. As we chose GitHub for code sharing and were initially unfamiliar with Git workflow, AI tools guided us through installing Git, connecting to a remote repository, resolving file-upload conflicts, etc. Claude was particularly helpful during a file conflict that nearly caused loss of data, offering step-by-step instruction to recover overwritten work. Example prompts include:

> Walk me through the process of pushing a file onto our GitHub repository.
>
> Remind me, how to push files to a new repository?
>
> What is the difference between rebase true/false and fast forward only?