

# GDP Data Exploration

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*March 12, 2017*

## Introduction

Data sets are provided, and the source of the files are same as followings.

- <http://data.worldbank.org/data-catalog/GDP-ranking-table> (<http://data.worldbank.org/data-catalog/GDP-ranking-table>)
- <http://data.worldbank.org/data-catalog/ed-stats> (<http://data.worldbank.org/data-catalog/ed-stats>)

Two data sets are cleaned and merged together. Data is explored and paid speciall attention to the GDP and Income Group relations.

## R-Version and Packages

```
version
```

```
##  
## platform      _  
## arch          x86_64-w64-mingw32  
## os            mingw32  
## system        x86_64, mingw32  
## status  
## major         3  
## minor         3.2  
## year          2016  
## month         10  
## day           31  
## svn rev       71607  
## language      R  
## version.string R version 3.3.2 (2016-10-31)  
## nickname      Sincere Pumpkin Patch
```

```
packinfo <- installed.packages ()  
packinfo[,c("Package", "Version")]
```

| ##            | Package      | Version    |
|---------------|--------------|------------|
| ## assertthat | "assertthat" | "0.1"      |
| ## backports  | "backports"  | "1.0.5"    |
| ## base64enc  | "base64enc"  | "0.1-3"    |
| ## BH         | "BH"         | "1.62.0-1" |
| ## bitops     | "bitops"     | "1.0-6"    |
| ## caTools    | "caTools"    | "1.17.1"   |
| ## colorspace | "colorspace" | "1.3-2"    |
| ## crayon     | "crayon"     | "1.3.2"    |
| ## curl       | "curl"       | "2.3"      |
| ## data.table | "data.table" | "1.10.4"   |
| ## DBI        | "DBI"        | "0.5-1"    |
| ## devtools   | "devtools"   | "1.12.0"   |
| ## dichromat  | "dichromat"  | "2.0-0"    |
| ## digest     | "digest"     | "0.6.12"   |
| ## downloader | "downloader" | "0.4"      |
| ## dplyr      | "dplyr"      | "0.5.0"    |
| ## evaluate   | "evaluate"   | "0.10"     |
| ## fields     | "fields"     | "8.10"     |
| ## formatR    | "formatR"    | "1.4"      |
| ## gdata      | "gdata"      | "2.17.0"   |
| ## geosphere  | "geosphere"  | "1.5-5"    |
| ## ggmap      | "ggmap"      | "2.6.1"    |
| ## ggplot2    | "ggplot2"    | "2.2.1"    |
| ## git2r      | "git2r"      | "0.18.0"   |
| ## gtable     | "gtable"     | "0.2.0"    |
| ## gtools     | "gtools"     | "3.5.0"    |
| ## highr      | "highr"      | "0.6"      |
| ## htmltools  | "htmltools"  | "0.3.5"    |
| ## httr       | "httr"       | "1.2.1"    |
| ## jpeg       | "jpeg"       | "0.1-8"    |
| ## jsonlite   | "jsonlite"   | "1.3"      |
| ## knitr      | "knitr"      | "1.15.1"   |
| ## labeling   | "labeling"   | "0.3"      |
| ## lattice    | "lattice"    | "0.20-34"  |
| ## lazyeval   | "lazyeval"   | "0.2.0"    |
| ## magrittr   | "magrittr"   | "1.5"      |
| ## mapdata    | "mapdata"    | "2.2-6"    |
| ## mapproj    | "mapproj"    | "1.2-4"    |
| ## maps       | "maps"       | "3.1.1"    |
| ## maptools   | "maptools"   | "0.9-1"    |
| ## markdown   | "markdown"   | "0.7.7"    |
| ## memoise    | "memoise"    | "1.0.0"    |
| ## mime       | "mime"       | "0.5"      |
| ## munsell    | "munsell"    | "0.4.3"    |
| ## openssl    | "openssl"    | "0.9.6"    |
| ## packrat    | "packrat"    | "0.4.8-1"  |
| ## PKI        | "PKI"        | "0.1-3"    |
| ## plyr       | "plyr"       | "1.8.4"    |
| ## png        | "png"        | "0.1-7"    |
| ## praise     | "praise"     | "1.0.0"    |
| ## proto      | "proto"      | "1.0.0"    |
| ## R.cache    | "R.cache"    | "0.12.0"   |

|                 |                |            |
|-----------------|----------------|------------|
| ## R.methodsS3  | "R.methodsS3"  | "1.7.1"    |
| ## R.oo         | "R.oo"         | "1.21.0"   |
| ## R.utils      | "R.utils"      | "2.5.0"    |
| ## R6           | "R6"           | "2.2.0"    |
| ## RColorBrewer | "RColorBrewer" | "1.1-2"    |
| ## Rcpp         | "Rcpp"         | "0.12.9"   |
| ## RCurl        | "RCurl"        | "1.95-4.8" |
| ## repmis       | "repmis"       | "0.5"      |
| ## reshape      | "reshape"      | "0.8.6"    |
| ## reshape2     | "reshape2"     | "1.4.2"    |
| ## RgoogleMaps  | "RgoogleMaps"  | "1.4.1"    |
| ## rjson        | "rjson"        | "0.2.15"   |
| ## RJSONIO      | "RJSONIO"      | "1.3-0"    |
| ## rmarkdown    | "rmarkdown"    | "1.3"      |
| ## rprojroot    | "rprojroot"    | "1.2"      |
| ## rsconnect    | "rsconnect"    | "0.7"      |
| ## rstudioapi   | "rstudioapi"   | "0.6"      |
| ## rworldmap    | "rworldmap"    | "1.3-6"    |
| ## scales       | "scales"       | "0.4.1"    |
| ## sp           | "sp"           | "1.2-4"    |
| ## spam         | "spam"         | "1.4-0"    |
| ## stringi      | "stringi"      | "1.1.2"    |
| ## stringr      | "stringr"      | "1.2.0"    |
| ## swirl        | "swirl"        | "2.4.3"    |
| ## testthat     | "testthat"     | "1.0.2"    |
| ## tibble       | "tibble"       | "1.2"      |
| ## tidyr        | "tidyr"        | "0.6.1"    |
| ## whisker      | "whisker"      | "0.3-2"    |
| ## withr        | "withr"        | "1.0.2"    |
| ## yaml         | "yaml"         | "2.1.14"   |
| ## base         | "base"         | "3.3.2"    |
| ## boot         | "boot"         | "1.3-18"   |
| ## class        | "class"        | "7.3-14"   |
| ## cluster      | "cluster"      | "2.0.5"    |
| ## codetools    | "codetools"    | "0.2-15"   |
| ## compiler     | "compiler"     | "3.3.2"    |
| ## datasets     | "datasets"     | "3.3.2"    |
| ## foreign      | "foreign"      | "0.8-67"   |
| ## graphics     | "graphics"     | "3.3.2"    |
| ## grDevices    | "grDevices"    | "3.3.2"    |
| ## grid         | "grid"         | "3.3.2"    |
| ## KernSmooth   | "KernSmooth"   | "2.23-15"  |
| ## lattice      | "lattice"      | "0.20-34"  |
| ## MASS         | "MASS"         | "7.3-45"   |
| ## Matrix       | "Matrix"       | "1.2-7.1"  |
| ## methods      | "methods"      | "3.3.2"    |
| ## mgcv         | "mgcv"         | "1.8-15"   |
| ## nlme         | "nlme"         | "3.1-128"  |
| ## nnet         | "nnet"         | "7.3-12"   |
| ## parallel     | "parallel"     | "3.3.2"    |
| ## rpart        | "rpart"        | "4.1-10"   |
| ## spatial      | "spatial"      | "7.3-11"   |
| ## splines      | "splines"      | "3.3.2"    |
| ## stats        | "stats"        | "3.3.2"    |

```
## stats4      "stats4"      "3.3.2"
## survival    "survival"    "2.39-5"
## tcltk       "tcltk"      "3.3.2"
## tools       "tools"      "3.3.2"
## translations "translations" "3.3.2"
## utils       "utils"      "3.3.2"
```

## Library Loading

A separate library list file is generated for better reproducibility.

```
source("Analysis/Data/LibraryList.R")
```

```
## Loading required package: maps
```

## Library List includes:

- library(downloader)
- library(tidyr)
- library(ggplot2)
- library(mapdata)
- library(ggmap)
- library(RgoogleMaps)

## Data Importing

Two files are downloaded using a 'download' function.

```
source("Analysis/Data/GDP_Importing.R")
```

## Data Importing Code (for grader)

```
### GDP Case Study 1
### Data Importing
### Mooyoung Lee 3/11/2017

## Downloading GDP and Country detail information from an online source, which is given for this
## Case Study.

download("https://d396qusza40orc.cloudfront.net/getdata%2Fdata%2FGDP.csv", destfile = "gdp.csv")
# Download GDP data
download("https://d396qusza40orc.cloudfront.net/getdata%2Fdata%2FEDSTATS_Country.csv", destfile
= "stat.csv") # Download country stats

gdp = read.csv("gdp.csv", sep = ",", stringsAsFactors = FALSE, header = FALSE) # Open GDP file
stat = read.csv("stat.csv", sep = ",", stringsAsFactors = FALSE, header = TRUE) # Open country s
tat file
```

# Data Cleaning

Two sets of data files are cleaned and merged. Some data types are changed.

```
source("Analysis/Data/GDP_Cleaning.R")
```

## Data Cleaning Code (for grader)

```
### GDP Case Study 1
### Data Cleaning
### Mooyoung Lee 3/11/2017

## Cleaning GDP table
gdpClean = gdp[, colSums(is.na(gdp)) != nrow(gdp)]           # Delete columns
  with NA values only
colnames(gdpClean) = c("CountryCode", gdpClean[4,2:3], "GDPMilDollar", "Note") # Assign column
  names
gdpNote = gdpClean[239:241,2]                               # Save the origi
  nal NOTE on the bottom of the table in case
gdpClean = gdpClean[nchar(gdpClean[,1])>0,]                 # Delete all emp
  lty rows
gdpClean$GDPMilDollar = as.numeric(gsub(",", "", gdpClean$GDPMilDollar)) # Save GDP value
  s as numeric
gdpClean$Ranking = as.numeric(gdpClean$Ranking)             # Save Ranking v
  alues as numeric

## Merging data tables
gdpStat = merge(gdpClean, stat, by = intersect("CountryCode", "CountryCode"), all = TRUE) # Merg
  e by contury code and sorting
gdpStatSort = gdpStat[order(gdpStat$GDPMilDollar),]          # Sort
  gdpStat table by GDP

## Manipulating tables in order to answer questions #3-#6
gdpStatSpread = spread(gdpStatSort, Income.Group, GDPMilDollar) # Spread GPD val
  ue into multiple Income group columns
gdpIncomeGather = gather(subset(gdpStatSpread, select = c(35:39)),
  "Income.Group", "GDPMilDollar", na.rm=TRUE)                # Gathering only
  useful Income Group data
gdpRankIncome = gdpStatSort[,c("Economy", "Ranking", "Income.Group")] # Subset Ranking
  and Income group
gdpRankIncome = gdpRankIncome[!is.na(gdpRankIncome$Ranking),] # Select NA valu
  es from Ranking column
gdpRankIncome = gdpRankIncome[order(gdpRankIncome$Ranking),] # Sort ascending
  order
```

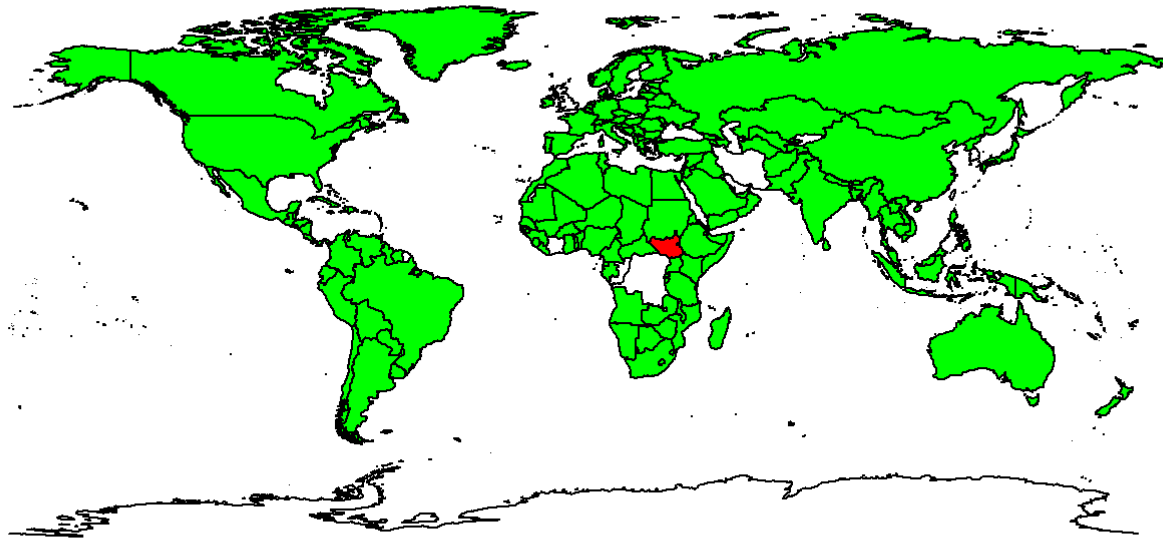
## Data Analysis

Explored the data by checking summary stats and distribution plots. Mapping tools are used to check the countries visually.

```
source("Analysis/GDP_Analysis.R")
```

```
## [1] "ID Matching from Data Merging: 224"
```

```
## Countries that is matching(green) and not matching(red) from merging process (Figure below)
```

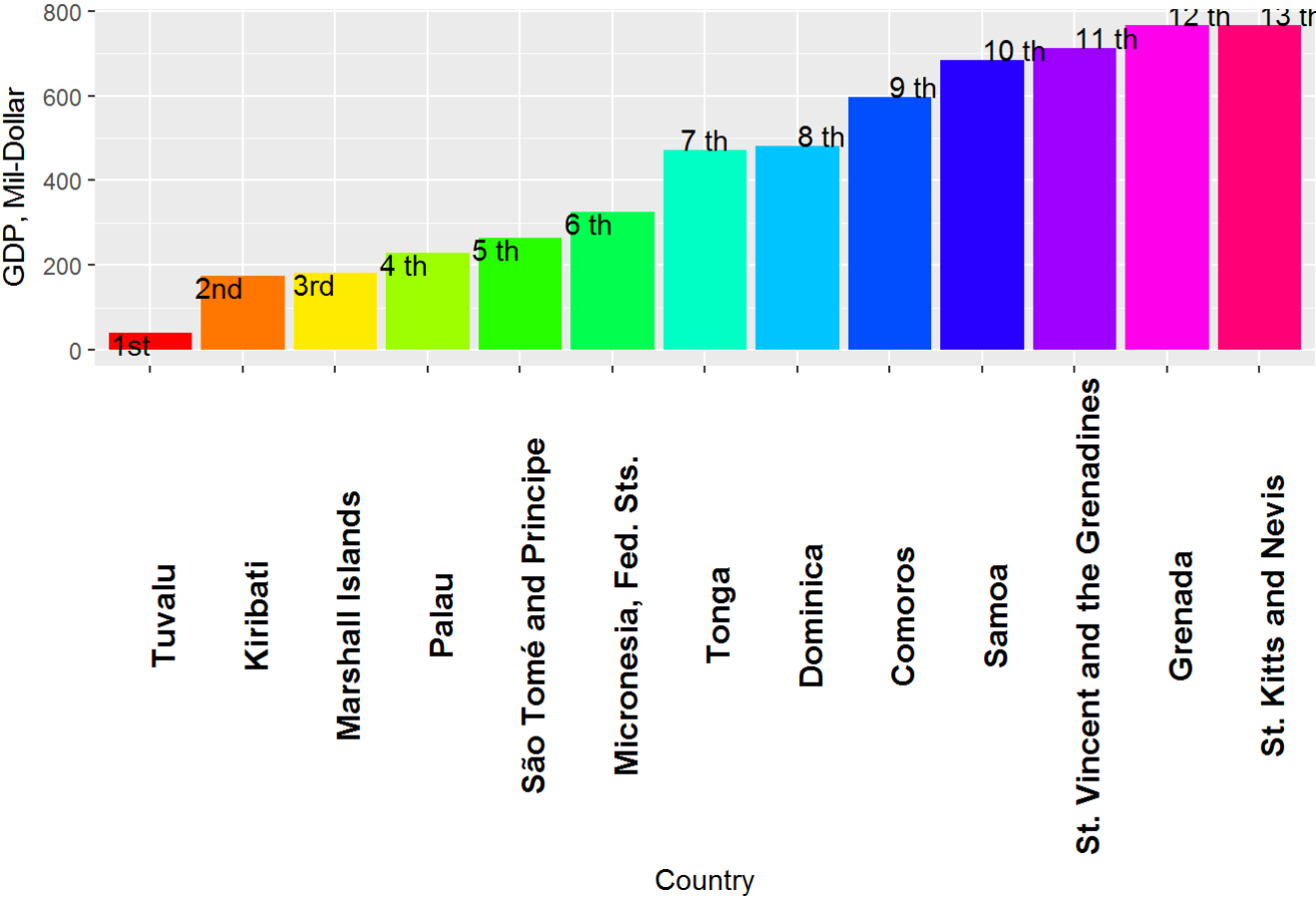


```
## [1] "13th Lowest GDP Country: Grenada"
```

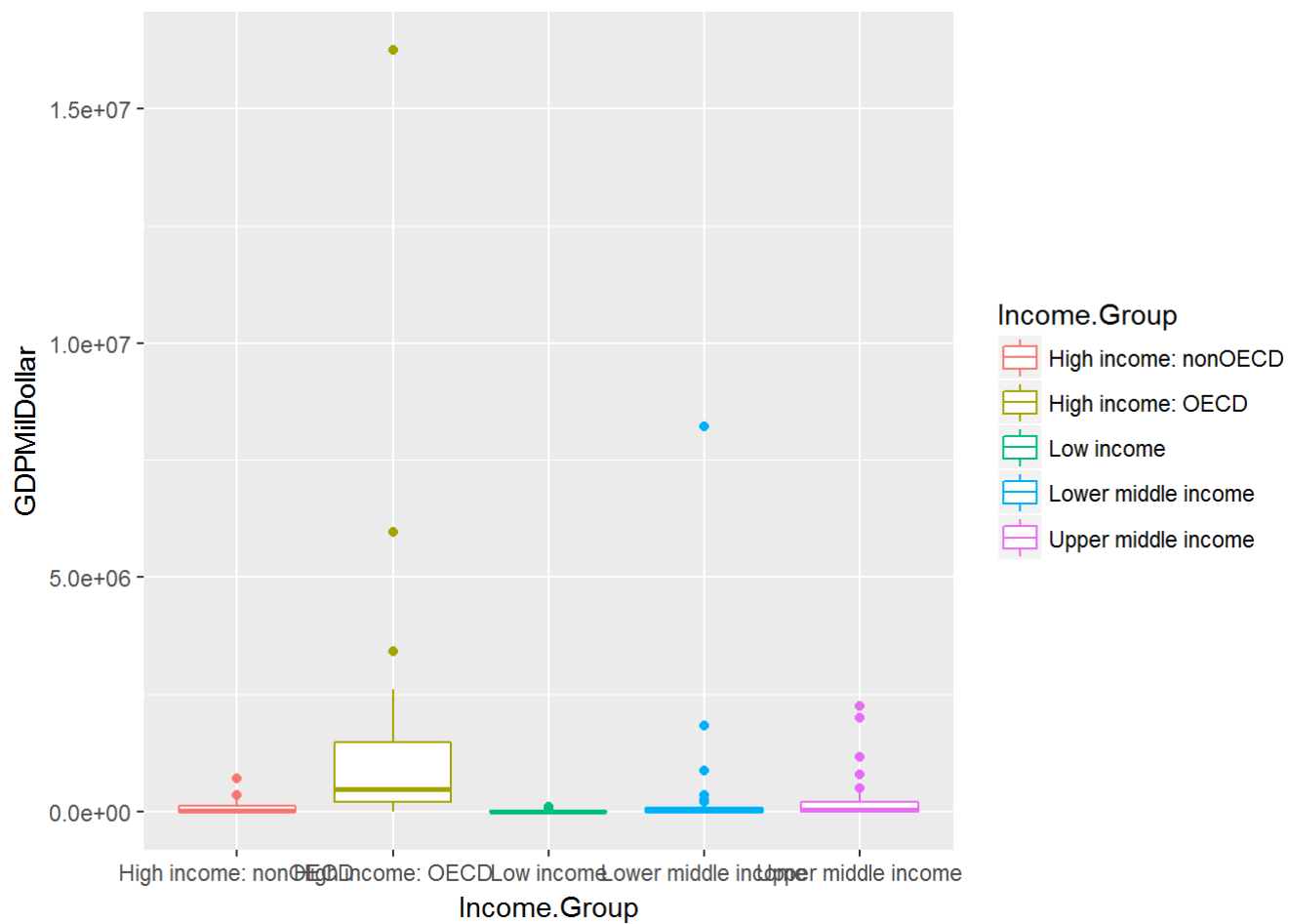
```
## [2] "13th Lowest GDP Country: St. Kitts and Nevis"
```

```
## Countries within the 13th lowest GDP Ranking (Below Plot)
```

GDP: Lowest 13 Countries

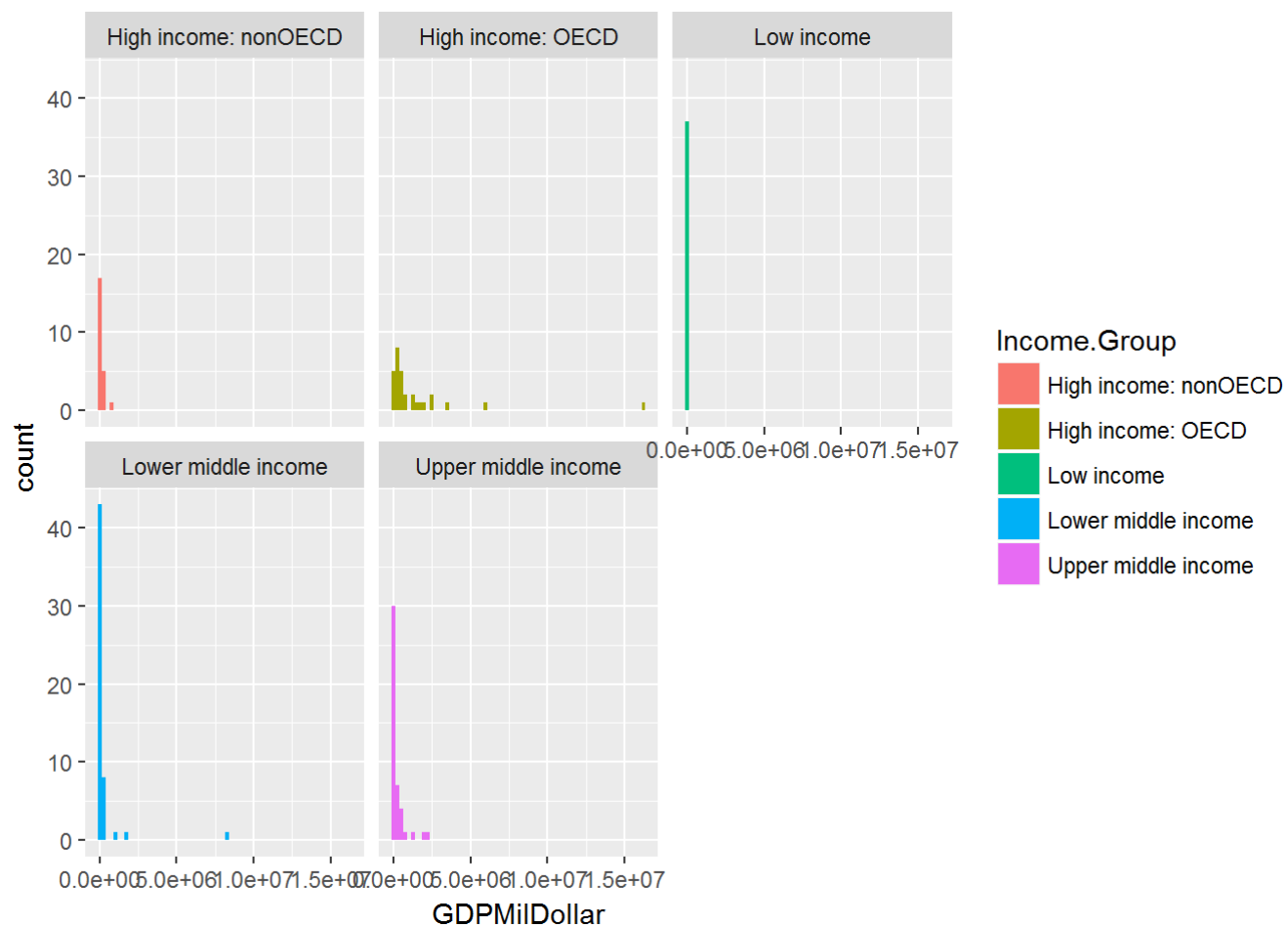


## Box Plot: GDP by Income Group



## Histogram: GDP by Income Group



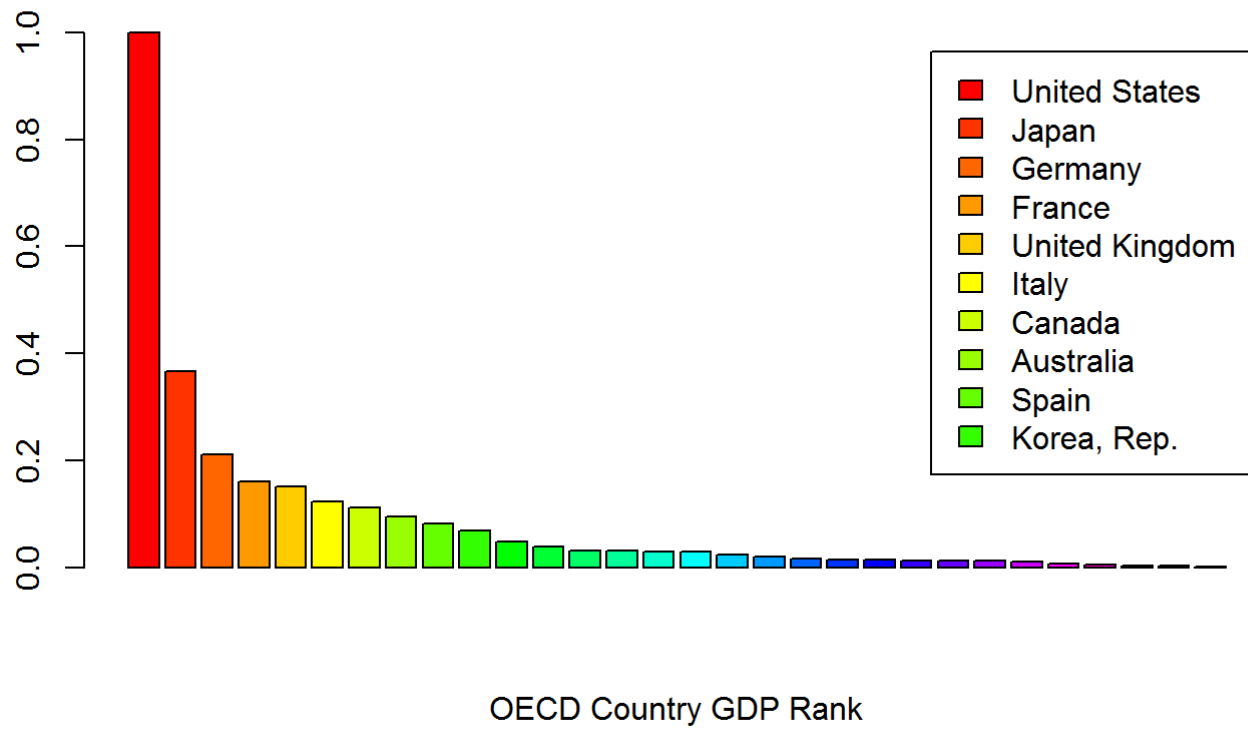


```

## *****
## GDP Summary Table
## *****
## High income: nonOECD High income: OECD Low income
## Min. : 2584 Min. : 13579 Min. : 596
## 1st Qu.: 12838 1st Qu.: 211147 1st Qu.: 3814
## Median : 28373 Median : 486528 Median : 7843
## Mean :104350 Mean : 1483917 Mean : 14411
## 3rd Qu.:131205 3rd Qu.: 1480047 3rd Qu.: 17204
## Max. :711050 Max. :16244600 Max. :116355
## NA's :215 NA's :208 NA's :201
## Lower middle income Upper middle income
## Min. : 40 Min. : 228
## 1st Qu.: 2549 1st Qu.: 9613
## Median : 24272 Median : 42945
## Mean : 256663 Mean : 231848
## 3rd Qu.: 81448 3rd Qu.: 205789
## Max. :8227103 Max. :2252664
## NA's :184 NA's :193
## Total GDP by Income.Group
## High income: nonOECD High income: OECD Low income
## 2400046 44517514 533199
## Lower middle income Upper middle income
## 13859828 10433153
## Total GDP by Income.Group (RATIO)
## High income: nonOECD High income: OECD Low income
## 0.033453037 0.620507294 0.007431993
## Lower middle income Upper middle income
## 0.193185189 0.145422486
## GDP Ratio: U.S. vs. Rest OECD Countries

```

## OECD Country GDP Ratio to U.S. GDP



```

## GDP RAtio: U.S. GDP vs. All other OECD Country Total
## [1] 1.00000 1.74045
## GDP RAtio: U.S. GDP vs. All other Nations
## [1] 1.000000 3.416467
## Total Country Number by Income Group
## High income: nonOECD      High income: OECD          Low income
##                23                30                37
## Lower middle income Upper middle income
##                54                45
## *****
## GDP Ranking: 5 Quantile Groups
## *****
## GDP Ranking Q1:
##                Economy High income: nonOECD High income: OECD
## 1                Argentina                NA                NA
## 2                Australia                NA                12
## 3                Austria                NA                27
## 4                Belgium                NA                25
## 5                Brazil                NA                NA
## 6                Canada                NA                11
## 7                Chile                NA                NA
## 8                China                NA                NA
## 9                Colombia                NA                NA
## 10               Denmark                NA                33
## 11               Egypt, Arab Rep.        NA                NA
## 12               France                NA                5
## 13               Germany                NA                4
## 14 Hong Kong SAR, China                37                NA
## 15               India                NA                NA
## 16               Indonesia                NA                NA
## 17               Iran, Islamic Rep.        NA                NA
## 18               Italy                NA                9
## 19               Japan                NA                3
## 20               Korea, Rep.                NA                15
## 21               Malaysia                NA                NA
## 22               Mexico                NA                NA
## 23               Netherlands                NA                18
## 24               Norway                NA                23
## 25               Poland                NA                24
## 26               Russian Federation        NA                NA
## 27               Saudi Arabia                19                NA
## 28               Singapore                35                NA
## 29               South Africa                NA                NA
## 30               Spain                NA                13
## 31               Sweden                NA                21
## 32               Switzerland                NA                20
## 33               Thailand                NA                NA
## 34               Turkey                NA                NA
## 35 United Arab Emirates                32                NA
## 36               United Kingdom                NA                6
## 37               United States                NA                1
## 38               Venezuela, RB                NA                NA
## Lower middle income Upper middle income

```

|       |    |    |
|-------|----|----|
| ## 1  | NA | 26 |
| ## 2  | NA | NA |
| ## 3  | NA | NA |
| ## 4  | NA | NA |
| ## 5  | NA | 7  |
| ## 6  | NA | NA |
| ## 7  | NA | 36 |
| ## 8  | 2  | NA |
| ## 9  | NA | 30 |
| ## 10 | NA | NA |
| ## 11 | 38 | NA |
| ## 12 | NA | NA |
| ## 13 | NA | NA |
| ## 14 | NA | NA |
| ## 15 | 10 | NA |
| ## 16 | 16 | NA |
| ## 17 | NA | 22 |
| ## 18 | NA | NA |
| ## 19 | NA | NA |
| ## 20 | NA | NA |
| ## 21 | NA | 34 |
| ## 22 | NA | 14 |
| ## 23 | NA | NA |
| ## 24 | NA | NA |
| ## 25 | NA | NA |
| ## 26 | NA | 8  |
| ## 27 | NA | NA |
| ## 28 | NA | NA |
| ## 29 | NA | 28 |
| ## 30 | NA | NA |
| ## 31 | NA | NA |
| ## 32 | NA | NA |
| ## 33 | 31 | NA |
| ## 34 | NA | 17 |
| ## 35 | NA | NA |
| ## 36 | NA | NA |
| ## 37 | NA | NA |
| ## 38 | NA | 29 |

# ## GDP Ranking Q2:

| ##    | Economy            | High income: nonOECD | High income: OECD | Low income |
|-------|--------------------|----------------------|-------------------|------------|
| ## 1  | Algeria            | NA                   | NA                | NA         |
| ## 2  | Angola             | NA                   | NA                | NA         |
| ## 3  | Azerbaijan         | NA                   | NA                | NA         |
| ## 4  | Bangladesh         | NA                   | NA                | 59         |
| ## 5  | Belarus            | NA                   | NA                | NA         |
| ## 6  | Bulgaria           | NA                   | NA                | NA         |
| ## 7  | Croatia            | 71                   | NA                | NA         |
| ## 8  | Cuba               | NA                   | NA                | NA         |
| ## 9  | Czech Republic     | NA                   | 51                | NA         |
| ## 10 | Dominican Republic | NA                   | NA                | NA         |
| ## 11 | Ecuador            | NA                   | NA                | NA         |
| ## 12 | Finland            | NA                   | 43                | NA         |
| ## 13 | Greece             | NA                   | 42                | NA         |
| ## 14 | Hungary            | NA                   | 58                | NA         |

|       |                      |                     |    |    |
|-------|----------------------|---------------------|----|----|
| ## 15 | Iraq                 | NA                  | NA | NA |
| ## 16 | Ireland              | NA                  | 46 | NA |
| ## 17 | Israel               | NA                  | 40 | NA |
| ## 18 | Kazakhstan           | NA                  | NA | NA |
| ## 19 | Kuwait               | 56                  | NA | NA |
| ## 20 | Luxembourg           | NA                  | 74 | NA |
| ## 21 | Morocco              | NA                  | NA | NA |
| ## 22 | New Zealand          | NA                  | 55 | NA |
| ## 23 | Nigeria              | NA                  | NA | NA |
| ## 24 | Oman                 | 66                  | NA | NA |
| ## 25 | Pakistan             | NA                  | NA | NA |
| ## 26 | Peru                 | NA                  | NA | NA |
| ## 27 | Philippines          | NA                  | NA | NA |
| ## 28 | Portugal             | NA                  | 45 | NA |
| ## 29 | Puerto Rico          | 61                  | NA | NA |
| ## 30 | Qatar                | 54                  | NA | NA |
| ## 31 | Romania              | NA                  | NA | NA |
| ## 32 | Slovak Republic      | NA                  | 63 | NA |
| ## 33 | Sri Lanka            | NA                  | NA | NA |
| ## 34 | Sudan                | NA                  | NA | NA |
| ## 35 | Syrian Arab Republic | NA                  | NA | NA |
| ## 36 | Ukraine              | NA                  | NA | NA |
| ## 37 | Uzbekistan           | NA                  | NA | NA |
| ## 38 | Vietnam              | NA                  | NA | NA |
| ##    | Lower middle income  | Upper middle income |    |    |
| ## 1  | NA                   | 48                  |    |    |
| ## 2  | 60                   | NA                  |    |    |
| ## 3  | NA                   | 68                  |    |    |
| ## 4  | NA                   | NA                  |    |    |
| ## 5  | NA                   | 69                  |    |    |
| ## 6  | NA                   | 76                  |    |    |
| ## 7  | NA                   | NA                  |    |    |
| ## 8  | NA                   | 67                  |    |    |
| ## 9  | NA                   | NA                  |    |    |
| ## 10 | NA                   | 72                  |    |    |
| ## 11 | 64                   | NA                  |    |    |
| ## 12 | NA                   | NA                  |    |    |
| ## 13 | NA                   | NA                  |    |    |
| ## 14 | NA                   | NA                  |    |    |
| ## 15 | 47                   | NA                  |    |    |
| ## 16 | NA                   | NA                  |    |    |
| ## 17 | NA                   | NA                  |    |    |
| ## 18 | NA                   | 50                  |    |    |
| ## 19 | NA                   | NA                  |    |    |
| ## 20 | NA                   | NA                  |    |    |
| ## 21 | 62                   | NA                  |    |    |
| ## 22 | NA                   | NA                  |    |    |
| ## 23 | 39                   | NA                  |    |    |
| ## 24 | NA                   | NA                  |    |    |
| ## 25 | 44                   | NA                  |    |    |
| ## 26 | NA                   | 49                  |    |    |
| ## 27 | 41                   | NA                  |    |    |
| ## 28 | NA                   | NA                  |    |    |
| ## 29 | NA                   | NA                  |    |    |

|                    |  |     |     |
|--------------------|--|-----|-----|
| ## 30              | NA   | NA  |     |
| ## 31              | NA   | 52  |     |
| ## 32              | NA   | NA  |     |
| ## 33              | 70   | NA  |     |
| ## 34              | 73   | NA  |     |
| ## 35              | 65   | NA  |     |
| ## 36              | 53   | NA  |     |
| ## 37              | 75   | NA  |     |
| ## 38              | 57   | NA  |     |
| ## GDP Ranking Q3: |  |     |     |
| ##                 | Economy High income: nonOECD High income: OECD     |     |     |
| ## 1               | Afghanistan  | NA  | NA  |
| ## 2               | Bahrain  | 93  | NA  |
| ## 3               | Bolivia  | NA  | NA  |
| ## 4               | Bosnia and Herzegovina                             | NA  | NA  |
| ## 5               | Brunei Darussalam                                  | 113 | NA  |
| ## 6               | Cameroon   | NA  | NA  |
| ## 7               | Congo, Dem. Rep.                                   | NA  | NA  |
| ## 8               | Costa Rica   | NA  | NA  |
| ## 9               | Côte d'Ivoire                                      | NA  | NA  |
| ## 10              | Cyprus   | 102 | NA  |
| ## 11              | El Salvador  | NA  | NA  |
| ## 12              | Equatorial Guinea                                  | 110 | NA  |
| ## 13              | Estonia  | 103 | NA  |
| ## 14              | Ethiopia   | NA  | NA  |
| ## 15              | Gabon  | NA  | NA  |
| ## 16              | Georgia  | NA  | NA  |
| ## 17              | Ghana  | NA  | NA  |
| ## 18              | Guatemala  | NA  | NA  |
| ## 19              | Honduras   | NA  | NA  |
| ## 20              | Jordan   | NA  | NA  |
| ## 21              | Kenya  | NA  | NA  |
| ## 22              | Latvia   | 94  | NA  |
| ## 23              | Lebanon  | NA  | NA  |
| ## 24              | Lithuania  | NA  | NA  |
| ## 25              | Macao SAR, China                                   | 82  | NA  |
| ## 26              | Nepal  | NA  | NA  |
| ## 27              | Panama   | NA  | NA  |
| ## 28              | Paraguay   | NA  | NA  |
| ## 29              | Serbia   | NA  | NA  |
| ## 30              | Slovenia   | NA  | 80  |
| ## 31              | Tanzania   | NA  | NA  |
| ## 32              | Trinidad and Tobago                                | 101 | NA  |
| ## 33              | Tunisia  | NA  | NA  |
| ## 34              | Turkmenistan                                       | NA  | NA  |
| ## 35              | Uganda   | NA  | NA  |
| ## 36              | Uruguay  | NA  | NA  |
| ## 37              | Yemen, Rep.  | NA  | NA  |
| ## 38              | Zambia   | NA  | NA  |
| ##                 | Low income Lower middle income Upper middle income |     |     |
| ## 1               | 105  | NA  | NA  |
| ## 2               | NA   | NA  | NA  |
| ## 3               | NA   | 96  | NA  |
| ## 4               | NA   | NA  | 111 |

|       |     |     |     |
|-------|-----|-----|-----|
| ## 5  | NA  | NA  | NA  |
| ## 6  | NA  | 98  | NA  |
| ## 7  | 112 | NA  | NA  |
| ## 8  | NA  | NA  | 81  |
| ## 9  | NA  | 99  | NA  |
| ## 10 | NA  | NA  | NA  |
| ## 11 | NA  | 100 | NA  |
| ## 12 | NA  | NA  | NA  |
| ## 13 | NA  | NA  | NA  |
| ## 14 | 85  | NA  | NA  |
| ## 15 | NA  | NA  | 109 |
| ## 16 | NA  | 114 | NA  |
| ## 17 | 86  | NA  | NA  |
| ## 18 | NA  | 77  | NA  |
| ## 19 | NA  | 108 | NA  |
| ## 20 | NA  | 92  | NA  |
| ## 21 | 87  | NA  | NA  |
| ## 22 | NA  | NA  | NA  |
| ## 23 | NA  | NA  | 83  |
| ## 24 | NA  | NA  | 84  |
| ## 25 | NA  | NA  | NA  |
| ## 26 | 107 | NA  | NA  |
| ## 27 | NA  | NA  | 89  |
| ## 28 | NA  | 97  | NA  |
| ## 29 | NA  | NA  | 88  |
| ## 30 | NA  | NA  | NA  |
| ## 31 | 95  | NA  | NA  |
| ## 32 | NA  | NA  | NA  |
| ## 33 | NA  | 79  | NA  |
| ## 34 | NA  | 91  | NA  |
| ## 35 | 106 | NA  | NA  |
| ## 36 | NA  | NA  | 78  |
| ## 37 | NA  | 90  | NA  |
| ## 38 | 104 | NA  | NA  |

#### ## GDP Ranking Q4:

| ##    | Economy         | High income: nonOECD | High income: OECD | Low income |
|-------|-----------------|----------------------|-------------------|------------|
| ## 1  | Albania         | NA                   | NA                | NA         |
| ## 2  | Armenia         | NA                   | NA                | NA         |
| ## 3  | Bahamas, The    | 138                  | NA                | NA         |
| ## 4  | Benin           | NA                   | NA                | 140        |
| ## 5  | Bermuda         | 149                  | NA                | NA         |
| ## 6  | Botswana        | NA                   | NA                | NA         |
| ## 7  | Burkina Faso    | NA                   | NA                | 128        |
| ## 8  | Cambodia        | NA                   | NA                | 120        |
| ## 9  | Chad            | NA                   | NA                | 124        |
| ## 10 | Congo, Rep.     | NA                   | NA                | NA         |
| ## 11 | Guinea          | NA                   | NA                | 148        |
| ## 12 | Haiti           | NA                   | NA                | 139        |
| ## 13 | Iceland         | NA                   | 122               | NA         |
| ## 14 | Jamaica         | NA                   | NA                | NA         |
| ## 15 | Kosovo          | NA                   | NA                | NA         |
| ## 16 | Kyrgyz Republic | NA                   | NA                | 145        |
| ## 17 | Lao PDR         | NA                   | NA                | 136        |
| ## 18 | Macedonia, FYR  | NA                   | NA                | NA         |



|       |                     |                     |      |     |
|-------|---------------------|---------------------|------|-----|
| ## 19 | Madagascar          | NA                  | NA   | 132 |
| ## 20 | Malawi              | NA                  | NA   | 152 |
| ## 21 | Mali                | NA                  | NA   | 129 |
| ## 22 | Malta               | 137                 | NA   | NA  |
| ## 23 | Mauritius           | NA                  | NA   | NA  |
| ## 24 | Moldova             | NA                  | NA   | NA  |
| ## 25 | Monaco              | 147                 | NA   | NA  |
| ## 26 | Mongolia            | NA                  | NA   | NA  |
| ## 27 | Montenegro          | NA                  | NA   | NA  |
| ## 28 | Mozambique          | NA                  | NA   | 118 |
| ## 29 | Namibia             | NA                  | NA   | NA  |
| ## 30 | Nicaragua           | NA                  | NA   | NA  |
| ## 31 | Niger               | NA                  | NA   | 144 |
| ## 32 | Papua New Guinea    | NA                  | NA   | NA  |
| ## 33 | Rwanda              | NA                  | NA   | 142 |
| ## 34 | Senegal             | NA                  | NA   | NA  |
| ## 35 | South Sudan         | NA                  | NA   | NA  |
| ## 36 | Suriname            | NA                  | NA   | NA  |
| ## 37 | Tajikistan          | NA                  | NA   | 143 |
| ## 38 | Zimbabwe            | NA                  | NA   | 134 |
| ##    | Lower middle income | Upper middle income | <NA> |     |
| ## 1  | NA                  | 125                 | NA   |     |
| ## 2  | 133                 | NA                  | NA   |     |
| ## 3  | NA                  | NA                  | NA   |     |
| ## 4  | NA                  | NA                  | NA   |     |
| ## 5  | NA                  | NA                  | NA   |     |
| ## 6  | NA                  | 117                 | NA   |     |
| ## 7  | NA                  | NA                  | NA   |     |
| ## 8  | NA                  | NA                  | NA   |     |
| ## 9  | NA                  | NA                  | NA   |     |
| ## 10 | 121                 | NA                  | NA   |     |
| ## 11 | NA                  | NA                  | NA   |     |
| ## 12 | NA                  | NA                  | NA   |     |
| ## 13 | NA                  | NA                  | NA   |     |
| ## 14 | NA                  | 116                 | NA   |     |
| ## 15 | 146                 | NA                  | NA   |     |
| ## 16 | NA                  | NA                  | NA   |     |
| ## 17 | NA                  | NA                  | NA   |     |
| ## 18 | NA                  | 135                 | NA   |     |
| ## 19 | NA                  | NA                  | NA   |     |
| ## 20 | NA                  | NA                  | NA   |     |
| ## 21 | NA                  | NA                  | NA   |     |
| ## 22 | NA                  | NA                  | NA   |     |
| ## 23 | NA                  | 127                 | NA   |     |
| ## 24 | 141                 | NA                  | NA   |     |
| ## 25 | NA                  | NA                  | NA   |     |
| ## 26 | 130                 | NA                  | NA   |     |
| ## 27 | NA                  | 151                 | NA   |     |
| ## 28 | NA                  | NA                  | NA   |     |
| ## 29 | NA                  | 123                 | NA   |     |
| ## 30 | 126                 | NA                  | NA   |     |
| ## 31 | NA                  | NA                  | NA   |     |
| ## 32 | 115                 | NA                  | NA   |     |
| ## 33 | NA                  | NA                  | NA   |     |

|                    |                                |                      |            |
|--------------------|--------------------------------|----------------------|------------|
| ## 34              | 119                            | NA                   | NA         |
| ## 35              | NA                             | NA                   | 131        |
| ## 36              | NA                             | 150                  | NA         |
| ## 37              | NA                             | NA                   | NA         |
| ## 38              | NA                             | NA                   | NA         |
| ## GDP Ranking Q5: |                                |                      |            |
| ##                 | Economy                        | High income: nonOECD | Low income |
| ## 1               | Antigua and Barbuda            | NA                   | NA         |
| ## 2               | Aruba                          | 161                  | NA         |
| ## 3               | Barbados                       | 153                  | NA         |
| ## 4               | Belize                         | NA                   | NA         |
| ## 5               | Bhutan                         | NA                   | NA         |
| ## 6               | Burundi                        | NA                   | 162        |
| ## 7               | Cape Verde                     | NA                   | NA         |
| ## 8               | Central African Republic       | NA                   | 165        |
| ## 9               | Comoros                        | NA                   | 182        |
| ## 10              | Dominica                       | NA                   | NA         |
| ## 11              | Eritrea                        | NA                   | 159        |
| ## 12              | Fiji                           | NA                   | NA         |
| ## 13              | Gambia, The                    | NA                   | 175        |
| ## 14              | Grenada                        | NA                   | NA         |
| ## 15              | Guinea-Bissau                  | NA                   | 176        |
| ## 16              | Guyana                         | NA                   | NA         |
| ## 17              | Kiribati                       | NA                   | NA         |
| ## 18              | Lesotho                        | NA                   | NA         |
| ## 19              | Liberia                        | NA                   | 168        |
| ## 20              | Maldives                       | NA                   | NA         |
| ## 21              | Marshall Islands               | NA                   | NA         |
| ## 22              | Mauritania                     | NA                   | 154        |
| ## 23              | Micronesia, Fed. Sts.          | NA                   | NA         |
| ## 24              | Palau                          | NA                   | NA         |
| ## 25              | Samoa                          | NA                   | NA         |
| ## 26              | São Tomé and Príncipe          | NA                   | NA         |
| ## 27              | Seychelles                     | NA                   | NA         |
| ## 28              | Sierra Leone                   | NA                   | 157        |
| ## 29              | Solomon Islands                | NA                   | 174        |
| ## 30              | St. Kitts and Nevis            | NA                   | NA         |
| ## 31              | St. Lucia                      | NA                   | NA         |
| ## 32              | St. Vincent and the Grenadines | NA                   | NA         |
| ## 33              | Swaziland                      | NA                   | NA         |
| ## 34              | Timor-Leste                    | NA                   | NA         |
| ## 35              | Togo                           | NA                   | 156        |
| ## 36              | Tonga                          | NA                   | NA         |
| ## 37              | Tuvalu                         | NA                   | NA         |
| ## 38              | Vanuatu                        | NA                   | NA         |
| ##                 | Lower middle income            | Upper middle income  |            |
| ## 1               | NA                             | 172                  |            |
| ## 2               | NA                             | NA                   |            |
| ## 3               | NA                             | NA                   |            |
| ## 4               | 169                            | NA                   |            |
| ## 5               | 167                            | NA                   |            |
| ## 6               | NA                             | NA                   |            |
| ## 7               | 166                            | NA                   |            |
| ## 8               | NA                             | NA                   |            |

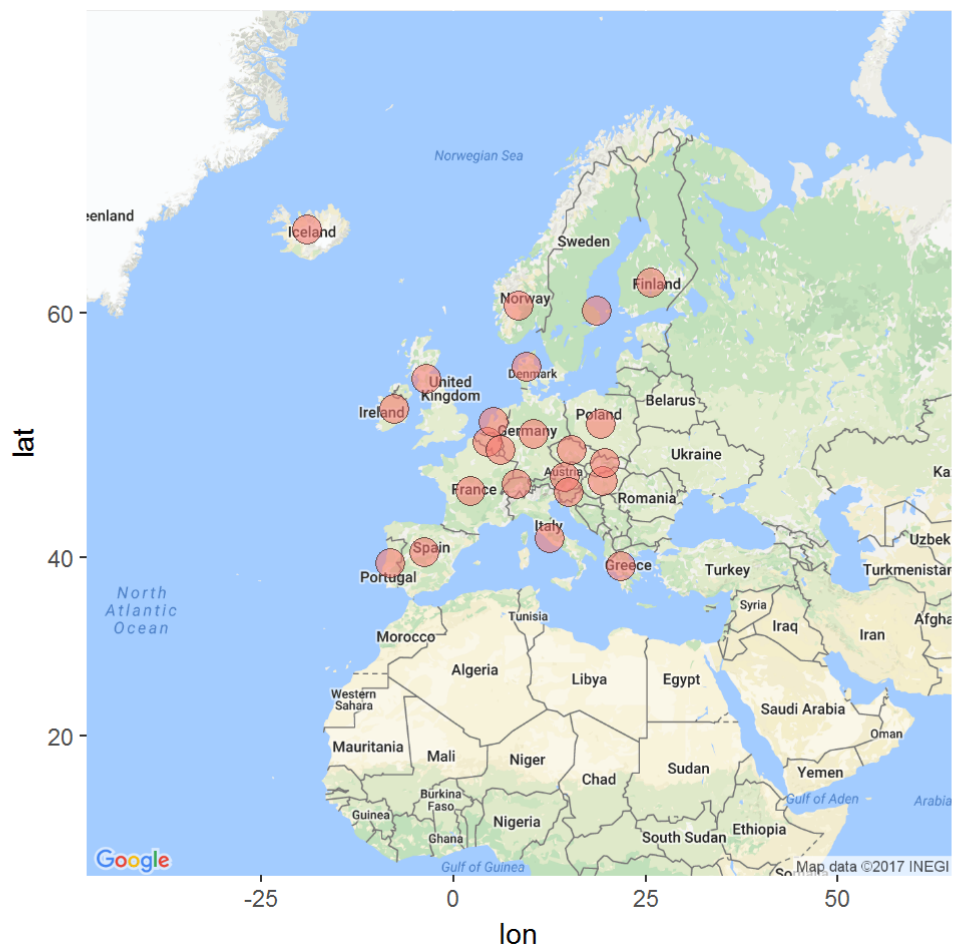
|       |     |     |
|-------|-----|-----|
| ## 9  | NA  | NA  |
| ## 10 | NA  | 183 |
| ## 11 | NA  | NA  |
| ## 12 | NA  | 155 |
| ## 13 | NA  | NA  |
| ## 14 | NA  | 178 |
| ## 15 | NA  | NA  |
| ## 16 | 160 | NA  |
| ## 17 | 189 | NA  |
| ## 18 | 163 | NA  |
| ## 19 | NA  | NA  |
| ## 20 | 164 | NA  |
| ## 21 | 188 | NA  |
| ## 22 | NA  | NA  |
| ## 23 | 185 | NA  |
| ## 24 | NA  | 187 |
| ## 25 | 181 | NA  |
| ## 26 | 186 | NA  |
| ## 27 | NA  | 173 |
| ## 28 | NA  | NA  |
| ## 29 | NA  | NA  |
| ## 30 | NA  | 178 |
| ## 31 | NA  | 171 |
| ## 32 | NA  | 180 |
| ## 33 | 158 | NA  |
| ## 34 | 170 | NA  |
| ## 35 | NA  | NA  |
| ## 36 | 184 | NA  |
| ## 37 | 190 | NA  |
| ## 38 | 177 | NA  |

## GDP Summary for the First Quantile group

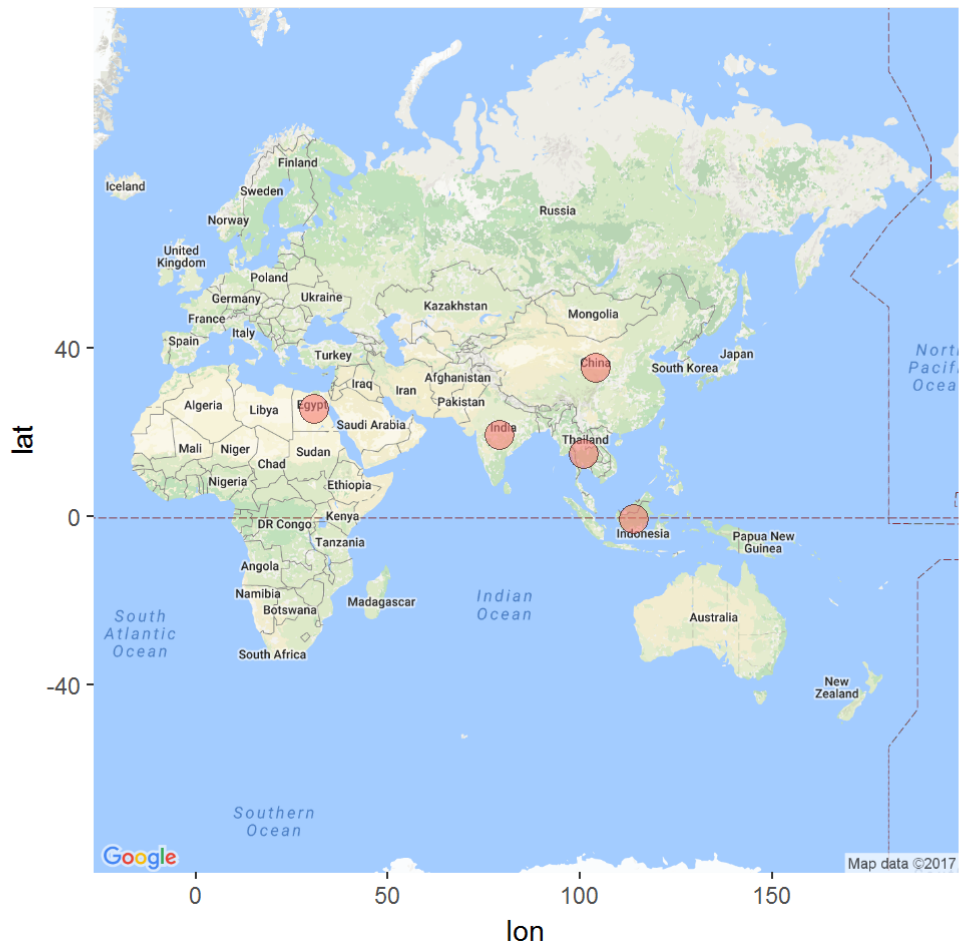
| ## Economy          | High income: nonOECD | High income: OECD |
|---------------------|----------------------|-------------------|
| ## Length:38        | Min. :19.00          | Min. : 1.00       |
| ## Class :character | 1st Qu.:28.75        | 1st Qu.: 6.75     |
| ## Mode :character  | Median :33.50        | Median :14.00     |
| ##                  | Mean :30.75          | Mean :15.00       |
| ##                  | 3rd Qu.:35.50        | 3rd Qu.:22.50     |
| ##                  | Max. :37.00          | Max. :33.00       |
| ##                  | NA's :34             | NA's :20          |

| ## Lower middle income | Upper middle income |
|------------------------|---------------------|
| ## Min. : 2.0          | Min. : 7.00         |
| ## 1st Qu.:10.0        | 1st Qu.:15.50       |
| ## Median :16.0        | Median :26.00       |
| ## Mean :19.4          | Mean :22.82         |
| ## 3rd Qu.:31.0        | 3rd Qu.:29.50       |
| ## Max. :38.0          | Max. :36.00         |
| ## NA's :33            | NA's :27            |

## OECD countries in Europe (Figure Below)



```
## Number of Countries in Lower middle income group and GDP Rank within 38th
## [1] 5
## Countries are in Lower middle income group and GDP Rank within 38th (Figure Below)
```



Data Analysis Code (for grader)

### GDP Case Study 1

### Data Analysis

### Mooyoung Lee 3/11/2017

## Question 1: How many of the IDs match?

```
q1_noIdMatch = sum(!is.na(match(gdpClean$CountryCode, stat$CountryCode)))      # Number of ID m
atching
```

```
print(paste("ID Matching from Data Merging: ", q1_noIdMatch))
```

# Country List that exist from both data files

```
CountryMatching = gdpClean[match(gdpClean$CountryCode, stat$CountryCode)>0,c("CountryCode","Econ
omy")]
```

```
CountryMatching = na.omit(CountryMatching)
```

# Country List that are existing only on GDP data file

```
CountryNotMatchingGDP = gdpClean[is.na(match(gdpClean$CountryCode, stat$CountryCode)), c("Countr
yCode","Economy")]
```

# Country List that are existing only on STAT data file

```
CountryNotMatchingSTAT = stat[is.na(match(stat$CountryCode, gdpClean$CountryCode)), c("CountryCo
de","Long.Name")]
```

# Showing countries that is matching(green) and not matching(red) from merging process

```
cat("Countries that is matching(green) and not matching(red) from merging process (Figure below)
\n")
```

```
map(resolution = 0)
```

```
map('world', regions=CountryMatching[,1], fill=TRUE, col='green', add = TRUE)
```

```
map('world', regions=CountryMatching[,2], fill=TRUE, col='green', add = TRUE)
```

```
# map('world', regions=CountryNotMatchingGDP[,1], fill=TRUE, col='red', add = TRUE)
```

```
map('world', regions=CountryNotMatchingGDP[,2], fill=TRUE, col='red', add = TRUE)
```

```
# map('world', regions=CountryNotMatchingSTAT[,1], fill=TRUE, col='orange', add = TRUE)
```

```
# map('world', regions=CountryNotMatchingSTAT[,2], fill=TRUE, col='orange', add = TRUE)
```

## Question 2: What is the 13th country in the resulting data frame?

```
gdpRank = rank(gdpStatSort$Ranking, ties.method = c("average"))
```

```
# Rank the Ranking value
```

```
q2_13thLowGdp = gdpStatSort$Long.Name[gdpRank==gdpRank[13]]
```

```
# the 13th Lowest GDP country; considered tie rank
```

```
print(paste("13th Lowest GDP Country: ", q2_13thLowGdp))
```

# Plotting the 13 Lowest GDP countries

```
gdpStatSort2 = gdpStatSort[1:13,c("Economy", "GDPMilDollar")]
```

```
ggbar_13LowGDP = ggplot(gdpStatSort2, aes(x = factor(Economy,
```

```
levels=unique(as.character(Economy))),
```

```
      y = GDPMilDollar))+
```

```
      geom_bar(stat = 'identity', fill = rainbow(13))+
```

```
      xlab("Country")+
```

```
      ylab("GDP, Mil-Dollar")+
```

```
      theme(axis.text.x = element_text(face="bold", color="black",size=12, angle=9
```

```
0))+
```

```
      ggtitle("GDP: Lowest 13 Countries")+
```

```
      geom_text(aes(label = c("1st","2nd","3rd", paste(c(4:13),"th")), vjust = "ou
```

```
tward", hjust = "outward"))
```

```
cat("Countries within the 13th lowest GDP Ranking (Below Plot)")
```

```

print(ggbar_13LowGDP)

## Question 3: Avg GDP rankings of "High income: OECD" and "High income: nonOECD" groups?
q3_avgRank.HiOecd = mean(gdpStatSpread$Ranking[gdpStatSpread$`High income: OECD`>0], na.rm=TRUE)
                        # Avg GDP ranking of "High income: OECD"
q3_avgRank.HiNonOecd =mean(gdpStatSpread$Ranking[gdpStatSpread$`High income: nonOECD`>0],
na.rm=TRUE)                # Avg GDP ranking of "High income: OECD"
q3_avgRank = c(q3_avgRank.HiOecd, q3_avgRank.HiNonOecd)
                        # Group two answers together

## Question 4: Show distribution of GDP by income group
q4_box = ggplot(data = gdpIncomeGather, mapping = aes(x = Income.Group, y = GDPMilDollar, color
=Income.Group ))+geom_boxplot() # GDP Boxplot by Income Group

# q4_HistDodge = ggplot(data = gdpIncomeGather)+
#                 geom_histogram(mapping = aes(x = GDPMilDollar, fill = Income.Group),
#                 binwidth = 100000, position = "dodge") # GDP Hi
#                 stogram by Income Group

q4_HistIndiv = ggplot(data = gdpIncomeGather)+
                geom_histogram(mapping = aes(x = GDPMilDollar, fill = Income.Group),
                binwidth = 250000, position = "dodge") +
                facet_wrap(~ Income.Group, nrow = 2)
                # GDP Histogram by Income Group individually plotted

cat("Box Plot: GDP by Income Group\n")
print(q4_box)
cat("Histogram: GDP by Income Group\n")
print(q4_HistIndiv)

## Question 5: Summary Stats of GDP by income groups
q5_gdpSummary = summary(gdpStatSpread[,35:39]) # Summary Stat o
f GDP by income Groups
cat("*****\n")
cat("GDP Summary Table\n")
cat("*****\n")
print(q5_gdpSummary)

cat("Total GDP by Income.Group\n")
gdpTotal = colSums(gdpStatSpread[,35:39], na.rm = TRUE)
print(gdpTotal)
cat("Total GDP by Income.Group (RATIO)\n")
gdpTotalRatio = colSums(gdpStatSpread[,35:39], na.rm = TRUE)/sum(gdpStatSpread[,35:39], na.rm =
TRUE)
print(gdpTotalRatio)
cat("GDP Ratio: U.S. vs. Rest OECD Countries\n")
countryOECD = na.omit(gdpStatSpread[,c("Economy","High income: OECD")])
countryOECD = countryOECD[order(countryOECD$`High income: OECD`, decreasing = TRUE),]
gdpOECDoverUS = countryOECD$`High income: OECD`/countryOECD[1,2]
barplot(gdpOECDoverUS, main = "OECD Country GDP Ratio to U.S. GDP",
        xlab = "OECD Country GDP Rank",
        col = rainbow(nrow(countryOECD)),
        legend = countryOECD$Economy[1:10])
cat("GDP RAtio: U.S. GDP vs. All other OECD Country Total\n")

```

```

print(c(1,sum(gdpOECDoverUS)-1))
cat("GDP RAtio: U.S. GDP vs. All other Nations\n")
print(c(countryOECD[1,2],sum(gdpStatSpread[,35:39], na.rm = TRUE)-
countryOECD[1,2])/countryOECD[1,2])
noCountryGroup = colSums(!is.na(gdpStatSpread[,35:39]))
cat("Total Country Number by Income Group\n")
print(noCountryGroup)

## Question 6a: Spread GDP Ranking values into 5 quantile groups. Make a table versus Income.Gro
up.
RIVector = c(1:nrow(gdpRankIncome)) # A vector has a
same length as GDP table w/o NAs
RowSplit = split(RIVector, cut(RIVector, quantile(RIVector, probs = seq(0, 1, by = 0.2)),
include.lowest=TRUE)) # Cut row number
s into 5 groups

for (i in 1:5){
    assign(paste("RankQ",i, sep = ""),
spread(gdpRankIncome[unlist(RowSplit[i]),],Income.Group, Ranking))
} # Assign 5 quant
ile tables into RankQ1~5 tables.
# Copying Ranking values into corresponding Income groups;neat spreading

cat("*****\n")
cat("GDP Ranking: 5 Quantile Groups\n")
cat("*****\n")
cat("GDP Ranking Q1:\n")
print(RankQ1)
cat("GDP Ranking Q2:\n")
print(RankQ2)
cat("GDP Ranking Q3:\n")
print(RankQ3)
cat("GDP Ranking Q4:\n")
print(RankQ4)
cat("GDP Ranking Q5:\n")
print(RankQ5)

cat("GDP Summary for the First Quantile group\n")
q1Stat = summary(RankQ1)
print(q1Stat)

# High income: OECD Countries from each continent
oecdRegion = gdpStat[gdpStat$Income.Group=="High income: OECD", c("CountryCode","Economy","Regio
n")]
oecdRegion = na.omit(oecdRegion)

## Selecting OECD countries in Europe and Plotting
oecdEurope = spread(oecdRegion, Region, CountryCode)
oecdEurope = na.omit(oecdEurope[,c(1,3)])

# getting the map

```



```

oecdEuropeCoord = geocode(oecdEurope[,1]) # Get coordinate
s of each country
df = oecdEuropeCoord # define data frame
ame

map_oecdEurope <- get_map(location = c(lon = mean(df$lon), lat = mean(df$lat)), zoom = 3,
                           maptype = "roadmap", scale = 2)

# plotting the map with some points on it
MapEuropeOECD = ggmap(map_oecdEurope) +
  geom_point(data = df, aes(x = lon, y = lat, fill = "red", alpha = 0.8), size
    = 5, shape = 21) +
  guides(fill=FALSE, alpha=FALSE, size=FALSE)

cat("OECD countries in Europe (Figure Below)\n")
print(MapEuropeOECD)

## Question 6b: How many countries are in Lower middle income group but among the top 38 GDP nations?
q6_LMIRankAmong38 = sum(gdpStatSort$Ranking <= 38 & gdpStatSort$Income.Group == "Lower middle income", na.rm = TRUE) # Number of countries among top 38 ranking
cat("Number of Countries in Lower middle income group and GDP Rank within 38th\n")
print(q6_LMIRankAmong38)

## Identifying the five countries from the above question
LowMidHigh38 = na.omit(gdpStat$Long.Name[gdpStat$Income.Group=="Lower middle income" & gdpStat$Ranking <=38])
# getting the map
df = geocode(LowMidHigh38) # Get coordinate
s of each country
map_LowMidGdpWithin38 = get_map(location = c(lon = mean(df$lon), lat = mean(df$lat)), zoom = 2,
                                maptype = "roadmap", scale = 2)

# plotting the map with some points on it
Map5countryQ6 = ggmap(map_LowMidGdpWithin38) +
  geom_point(data = df, aes(x = lon, y = lat, fill = "red", alpha = 0.8), size
    = 5, shape = 21) +
  guides(fill=FALSE, alpha=FALSE, size=FALSE)

cat("Countries are in Lower middle income group and GDP Rank within 38th (Figure Below)\n")
print(Map5countryQ6)

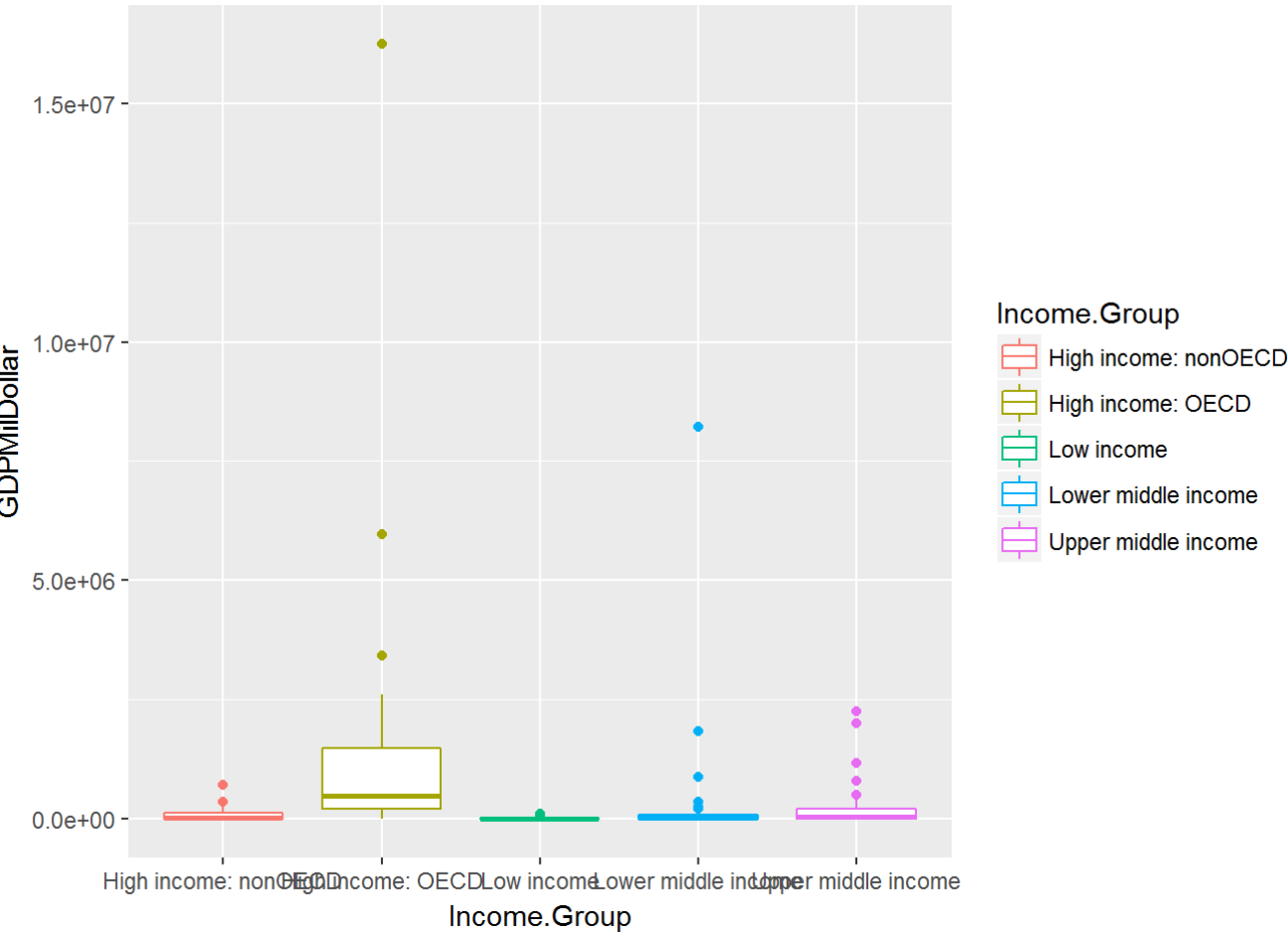
```

## Case Study Answers

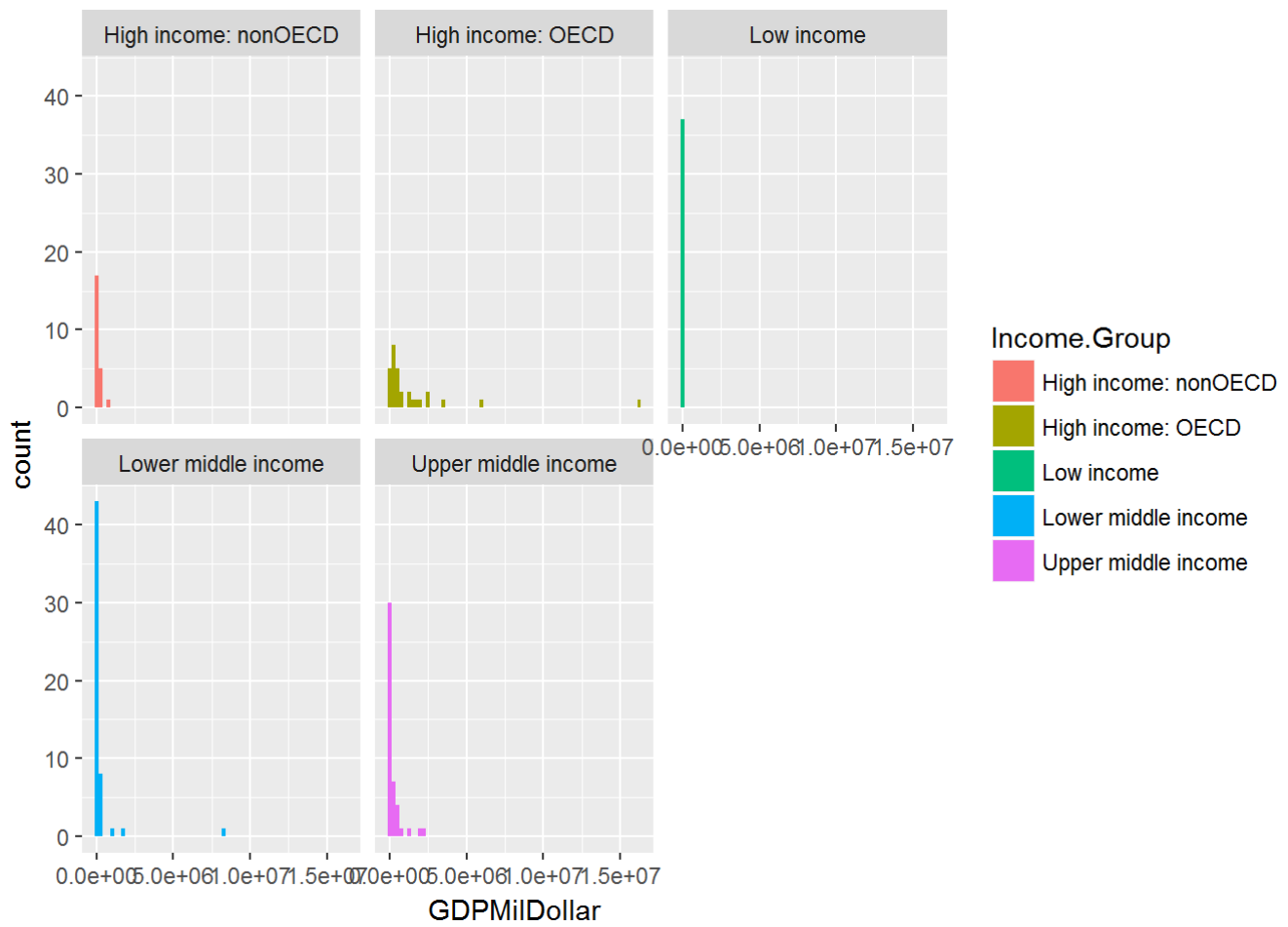
Case study answers are grouped here.

```
source("Analysis/Data/GDP_Answers.R")
```

```
## [1] "ID Matching: 224"
## [1] "13th Country: Grenada"
## [2] "13th Country: St. Kitts and Nevis"
## [1] "AVG Ranking (High OECD, High nonOECD) : 32.97 , 91.91"
## Box Plot: GDP by Income Group
```



```
## Histogram: GDP by Income Group
```



```

## *****
## GDP Summary Table
## *****
## High income: nonOECD High income: OECD Low income
## Min. : 2584 Min. : 13579 Min. : 596
## 1st Qu.: 12838 1st Qu.: 211147 1st Qu.: 3814
## Median : 28373 Median : 486528 Median : 7843
## Mean :104350 Mean : 1483917 Mean : 14411
## 3rd Qu.:131205 3rd Qu.: 1480047 3rd Qu.: 17204
## Max. :711050 Max. :16244600 Max. :116355
## NA's :215 NA's :208 NA's :201
## Lower middle income Upper middle income
## Min. : 40 Min. : 228
## 1st Qu.: 2549 1st Qu.: 9613
## Median : 24272 Median : 42945
## Mean : 256663 Mean : 231848
## 3rd Qu.: 81448 3rd Qu.: 205789
## Max. :8227103 Max. :2252664
## NA's :184 NA's :193
## *****
## GDP Ranking: 5 Quantile Groups
## *****
## GDP Ranking Q1:
## Economy High income: nonOECD High income: OECD
## 1 Argentina NA NA
## 2 Australia NA 12
## 3 Austria NA 27
## 4 Belgium NA 25
## 5 Brazil NA NA
## 6 Canada NA 11
## 7 Chile NA NA
## 8 China NA NA
## 9 Colombia NA NA
## 10 Denmark NA 33
## 11 Egypt, Arab Rep. NA NA
## 12 France NA 5
## 13 Germany NA 4
## 14 Hong Kong SAR, China 37 NA
## 15 India NA NA
## 16 Indonesia NA NA
## 17 Iran, Islamic Rep. NA NA
## 18 Italy NA 9
## 19 Japan NA 3
## 20 Korea, Rep. NA 15
## 21 Malaysia NA NA
## 22 Mexico NA NA
## 23 Netherlands NA 18
## 24 Norway NA 23
## 25 Poland NA 24
## 26 Russian Federation NA NA
## 27 Saudi Arabia 19 NA
## 28 Singapore 35 NA
## 29 South Africa NA NA

```

|       |                      |    |    |
|-------|----------------------|----|----|
| ## 30 | Spain                | NA | 13 |
| ## 31 | Sweden               | NA | 21 |
| ## 32 | Switzerland          | NA | 20 |
| ## 33 | Thailand             | NA | NA |
| ## 34 | Turkey               | NA | NA |
| ## 35 | United Arab Emirates | 32 | NA |
| ## 36 | United Kingdom       | NA | 6  |
| ## 37 | United States        | NA | 1  |
| ## 38 | Venezuela, RB        | NA | NA |

## Lower middle income Upper middle income

|       |    |    |
|-------|----|----|
| ## 1  | NA | 26 |
| ## 2  | NA | NA |
| ## 3  | NA | NA |
| ## 4  | NA | NA |
| ## 5  | NA | 7  |
| ## 6  | NA | NA |
| ## 7  | NA | 36 |
| ## 8  | 2  | NA |
| ## 9  | NA | 30 |
| ## 10 | NA | NA |
| ## 11 | 38 | NA |
| ## 12 | NA | NA |
| ## 13 | NA | NA |
| ## 14 | NA | NA |
| ## 15 | 10 | NA |
| ## 16 | 16 | NA |
| ## 17 | NA | 22 |
| ## 18 | NA | NA |
| ## 19 | NA | NA |
| ## 20 | NA | NA |
| ## 21 | NA | 34 |
| ## 22 | NA | 14 |
| ## 23 | NA | NA |
| ## 24 | NA | NA |
| ## 25 | NA | NA |
| ## 26 | NA | 8  |
| ## 27 | NA | NA |
| ## 28 | NA | NA |
| ## 29 | NA | 28 |
| ## 30 | NA | NA |
| ## 31 | NA | NA |
| ## 32 | NA | NA |
| ## 33 | 31 | NA |
| ## 34 | NA | 17 |
| ## 35 | NA | NA |
| ## 36 | NA | NA |
| ## 37 | NA | NA |
| ## 38 | NA | 29 |

## GDP Ranking Q2:

|      |            |                      |                   |            |
|------|------------|----------------------|-------------------|------------|
| ##   | Economy    | High income: nonOECD | High income: OECD | Low income |
| ## 1 | Algeria    | NA                   | NA                | NA         |
| ## 2 | Angola     | NA                   | NA                | NA         |
| ## 3 | Azerbaijan | NA                   | NA                | NA         |
| ## 4 | Bangladesh | NA                   | NA                | 59         |

|       |                      |                     |    |    |
|-------|----------------------|---------------------|----|----|
| ## 5  | Belarus              | NA                  | NA | NA |
| ## 6  | Bulgaria             | NA                  | NA | NA |
| ## 7  | Croatia              | 71                  | NA | NA |
| ## 8  | Cuba                 | NA                  | NA | NA |
| ## 9  | Czech Republic       | NA                  | 51 | NA |
| ## 10 | Dominican Republic   | NA                  | NA | NA |
| ## 11 | Ecuador              | NA                  | NA | NA |
| ## 12 | Finland              | NA                  | 43 | NA |
| ## 13 | Greece               | NA                  | 42 | NA |
| ## 14 | Hungary              | NA                  | 58 | NA |
| ## 15 | Iraq                 | NA                  | NA | NA |
| ## 16 | Ireland              | NA                  | 46 | NA |
| ## 17 | Israel               | NA                  | 40 | NA |
| ## 18 | Kazakhstan           | NA                  | NA | NA |
| ## 19 | Kuwait               | 56                  | NA | NA |
| ## 20 | Luxembourg           | NA                  | 74 | NA |
| ## 21 | Morocco              | NA                  | NA | NA |
| ## 22 | New Zealand          | NA                  | 55 | NA |
| ## 23 | Nigeria              | NA                  | NA | NA |
| ## 24 | Oman                 | 66                  | NA | NA |
| ## 25 | Pakistan             | NA                  | NA | NA |
| ## 26 | Peru                 | NA                  | NA | NA |
| ## 27 | Philippines          | NA                  | NA | NA |
| ## 28 | Portugal             | NA                  | 45 | NA |
| ## 29 | Puerto Rico          | 61                  | NA | NA |
| ## 30 | Qatar                | 54                  | NA | NA |
| ## 31 | Romania              | NA                  | NA | NA |
| ## 32 | Slovak Republic      | NA                  | 63 | NA |
| ## 33 | Sri Lanka            | NA                  | NA | NA |
| ## 34 | Sudan                | NA                  | NA | NA |
| ## 35 | Syrian Arab Republic | NA                  | NA | NA |
| ## 36 | Ukraine              | NA                  | NA | NA |
| ## 37 | Uzbekistan           | NA                  | NA | NA |
| ## 38 | Vietnam              | NA                  | NA | NA |
| ##    | Lower middle income  | Upper middle income |    |    |
| ## 1  | NA                   | 48                  |    |    |
| ## 2  | 60                   | NA                  |    |    |
| ## 3  | NA                   | 68                  |    |    |
| ## 4  | NA                   | NA                  |    |    |
| ## 5  | NA                   | 69                  |    |    |
| ## 6  | NA                   | 76                  |    |    |
| ## 7  | NA                   | NA                  |    |    |
| ## 8  | NA                   | 67                  |    |    |
| ## 9  | NA                   | NA                  |    |    |
| ## 10 | NA                   | 72                  |    |    |
| ## 11 | 64                   | NA                  |    |    |
| ## 12 | NA                   | NA                  |    |    |
| ## 13 | NA                   | NA                  |    |    |
| ## 14 | NA                   | NA                  |    |    |
| ## 15 | 47                   | NA                  |    |    |
| ## 16 | NA                   | NA                  |    |    |
| ## 17 | NA                   | NA                  |    |    |
| ## 18 | NA                   | 50                  |    |    |
| ## 19 | NA                   | NA                  |    |    |

|       |    |    |
|-------|----|----|
| ## 20 | NA | NA |
| ## 21 | 62 | NA |
| ## 22 | NA | NA |
| ## 23 | 39 | NA |
| ## 24 | NA | NA |
| ## 25 | 44 | NA |
| ## 26 | NA | 49 |
| ## 27 | 41 | NA |
| ## 28 | NA | NA |
| ## 29 | NA | NA |
| ## 30 | NA | NA |
| ## 31 | NA | 52 |
| ## 32 | NA | NA |
| ## 33 | 70 | NA |
| ## 34 | 73 | NA |
| ## 35 | 65 | NA |
| ## 36 | 53 | NA |
| ## 37 | 75 | NA |
| ## 38 | 57 | NA |

# ## GDP Ranking Q3:

| ##    | Economy                | High income: nonOECD | High income: OECD |
|-------|------------------------|----------------------|-------------------|
| ## 1  | Afghanistan            | NA                   | NA                |
| ## 2  | Bahrain                | 93                   | NA                |
| ## 3  | Bolivia                | NA                   | NA                |
| ## 4  | Bosnia and Herzegovina | NA                   | NA                |
| ## 5  | Brunei Darussalam      | 113                  | NA                |
| ## 6  | Cameroon               | NA                   | NA                |
| ## 7  | Congo, Dem. Rep.       | NA                   | NA                |
| ## 8  | Costa Rica             | NA                   | NA                |
| ## 9  | Côte d'Ivoire          | NA                   | NA                |
| ## 10 | Cyprus                 | 102                  | NA                |
| ## 11 | El Salvador            | NA                   | NA                |
| ## 12 | Equatorial Guinea      | 110                  | NA                |
| ## 13 | Estonia                | 103                  | NA                |
| ## 14 | Ethiopia               | NA                   | NA                |
| ## 15 | Gabon                  | NA                   | NA                |
| ## 16 | Georgia                | NA                   | NA                |
| ## 17 | Ghana                  | NA                   | NA                |
| ## 18 | Guatemala              | NA                   | NA                |
| ## 19 | Honduras               | NA                   | NA                |
| ## 20 | Jordan                 | NA                   | NA                |
| ## 21 | Kenya                  | NA                   | NA                |
| ## 22 | Latvia                 | 94                   | NA                |
| ## 23 | Lebanon                | NA                   | NA                |
| ## 24 | Lithuania              | NA                   | NA                |
| ## 25 | Macao SAR, China       | 82                   | NA                |
| ## 26 | Nepal                  | NA                   | NA                |
| ## 27 | Panama                 | NA                   | NA                |
| ## 28 | Paraguay               | NA                   | NA                |
| ## 29 | Serbia                 | NA                   | NA                |
| ## 30 | Slovenia               | NA                   | 80                |
| ## 31 | Tanzania               | NA                   | NA                |
| ## 32 | Trinidad and Tobago    | 101                  | NA                |
| ## 33 | Tunisia                | NA                   | NA                |

|       |              |    |    |
|-------|--------------|----|----|
| ## 34 | Turkmenistan | NA | NA |
| ## 35 | Uganda       | NA | NA |
| ## 36 | Uruguay      | NA | NA |
| ## 37 | Yemen, Rep.  | NA | NA |
| ## 38 | Zambia       | NA | NA |

|    |            |                     |                     |
|----|------------|---------------------|---------------------|
| ## | Low income | Lower middle income | Upper middle income |
|----|------------|---------------------|---------------------|

|       |     |     |     |
|-------|-----|-----|-----|
| ## 1  | 105 | NA  | NA  |
| ## 2  | NA  | NA  | NA  |
| ## 3  | NA  | 96  | NA  |
| ## 4  | NA  | NA  | 111 |
| ## 5  | NA  | NA  | NA  |
| ## 6  | NA  | 98  | NA  |
| ## 7  | 112 | NA  | NA  |
| ## 8  | NA  | NA  | 81  |
| ## 9  | NA  | 99  | NA  |
| ## 10 | NA  | NA  | NA  |
| ## 11 | NA  | 100 | NA  |
| ## 12 | NA  | NA  | NA  |
| ## 13 | NA  | NA  | NA  |
| ## 14 | 85  | NA  | NA  |
| ## 15 | NA  | NA  | 109 |
| ## 16 | NA  | 114 | NA  |
| ## 17 | 86  | NA  | NA  |
| ## 18 | NA  | 77  | NA  |
| ## 19 | NA  | 108 | NA  |
| ## 20 | NA  | 92  | NA  |
| ## 21 | 87  | NA  | NA  |
| ## 22 | NA  | NA  | NA  |
| ## 23 | NA  | NA  | 83  |
| ## 24 | NA  | NA  | 84  |
| ## 25 | NA  | NA  | NA  |
| ## 26 | 107 | NA  | NA  |
| ## 27 | NA  | NA  | 89  |
| ## 28 | NA  | 97  | NA  |
| ## 29 | NA  | NA  | 88  |
| ## 30 | NA  | NA  | NA  |
| ## 31 | 95  | NA  | NA  |
| ## 32 | NA  | NA  | NA  |
| ## 33 | NA  | 79  | NA  |
| ## 34 | NA  | 91  | NA  |
| ## 35 | 106 | NA  | NA  |
| ## 36 | NA  | NA  | 78  |
| ## 37 | NA  | 90  | NA  |
| ## 38 | 104 | NA  | NA  |

## GDP Ranking Q4:

|      |              |                      |                   |            |
|------|--------------|----------------------|-------------------|------------|
| ##   | Economy      | High income: nonOECD | High income: OECD | Low income |
| ## 1 | Albania      | NA                   | NA                | NA         |
| ## 2 | Armenia      | NA                   | NA                | NA         |
| ## 3 | Bahamas, The | 138                  | NA                | NA         |
| ## 4 | Benin        | NA                   | NA                | 140        |
| ## 5 | Bermuda      | 149                  | NA                | NA         |
| ## 6 | Botswana     | NA                   | NA                | NA         |
| ## 7 | Burkina Faso | NA                   | NA                | 128        |
| ## 8 | Cambodia     | NA                   | NA                | 120        |



|       |                  |     |     |     |
|-------|------------------|-----|-----|-----|
| ## 9  | Chad             | NA  | NA  | 124 |
| ## 10 | Congo, Rep.      | NA  | NA  | NA  |
| ## 11 | Guinea           | NA  | NA  | 148 |
| ## 12 | Haiti            | NA  | NA  | 139 |
| ## 13 | Iceland          | NA  | 122 | NA  |
| ## 14 | Jamaica          | NA  | NA  | NA  |
| ## 15 | Kosovo           | NA  | NA  | NA  |
| ## 16 | Kyrgyz Republic  | NA  | NA  | 145 |
| ## 17 | Lao PDR          | NA  | NA  | 136 |
| ## 18 | Macedonia, FYR   | NA  | NA  | NA  |
| ## 19 | Madagascar       | NA  | NA  | 132 |
| ## 20 | Malawi           | NA  | NA  | 152 |
| ## 21 | Mali             | NA  | NA  | 129 |
| ## 22 | Malta            | 137 | NA  | NA  |
| ## 23 | Mauritius        | NA  | NA  | NA  |
| ## 24 | Moldova          | NA  | NA  | NA  |
| ## 25 | Monaco           | 147 | NA  | NA  |
| ## 26 | Mongolia         | NA  | NA  | NA  |
| ## 27 | Montenegro       | NA  | NA  | NA  |
| ## 28 | Mozambique       | NA  | NA  | 118 |
| ## 29 | Namibia          | NA  | NA  | NA  |
| ## 30 | Nicaragua        | NA  | NA  | NA  |
| ## 31 | Niger            | NA  | NA  | 144 |
| ## 32 | Papua New Guinea | NA  | NA  | NA  |
| ## 33 | Rwanda           | NA  | NA  | 142 |
| ## 34 | Senegal          | NA  | NA  | NA  |
| ## 35 | South Sudan      | NA  | NA  | NA  |
| ## 36 | Suriname         | NA  | NA  | NA  |
| ## 37 | Tajikistan       | NA  | NA  | 143 |
| ## 38 | Zimbabwe         | NA  | NA  | 134 |

## Lower middle income Upper middle income <NA>

|       |     |     |    |
|-------|-----|-----|----|
| ## 1  | NA  | 125 | NA |
| ## 2  | 133 | NA  | NA |
| ## 3  | NA  | NA  | NA |
| ## 4  | NA  | NA  | NA |
| ## 5  | NA  | NA  | NA |
| ## 6  | NA  | 117 | NA |
| ## 7  | NA  | NA  | NA |
| ## 8  | NA  | NA  | NA |
| ## 9  | NA  | NA  | NA |
| ## 10 | 121 | NA  | NA |
| ## 11 | NA  | NA  | NA |
| ## 12 | NA  | NA  | NA |
| ## 13 | NA  | NA  | NA |
| ## 14 | NA  | 116 | NA |
| ## 15 | 146 | NA  | NA |
| ## 16 | NA  | NA  | NA |
| ## 17 | NA  | NA  | NA |
| ## 18 | NA  | 135 | NA |
| ## 19 | NA  | NA  | NA |
| ## 20 | NA  | NA  | NA |
| ## 21 | NA  | NA  | NA |
| ## 22 | NA  | NA  | NA |
| ## 23 | NA  | 127 | NA |

|       |     |     |     |
|-------|-----|-----|-----|
| ## 24 | 141 | NA  | NA  |
| ## 25 | NA  | NA  | NA  |
| ## 26 | 130 | NA  | NA  |
| ## 27 | NA  | 151 | NA  |
| ## 28 | NA  | NA  | NA  |
| ## 29 | NA  | 123 | NA  |
| ## 30 | 126 | NA  | NA  |
| ## 31 | NA  | NA  | NA  |
| ## 32 | 115 | NA  | NA  |
| ## 33 | NA  | NA  | NA  |
| ## 34 | 119 | NA  | NA  |
| ## 35 | NA  | NA  | 131 |
| ## 36 | NA  | 150 | NA  |
| ## 37 | NA  | NA  | NA  |
| ## 38 | NA  | NA  | NA  |

# ## GDP Ranking Q5:

| ##    | Economy                        | High income: nonOECD | Low income |
|-------|--------------------------------|----------------------|------------|
| ## 1  | Antigua and Barbuda            | NA                   | NA         |
| ## 2  | Aruba                          | 161                  | NA         |
| ## 3  | Barbados                       | 153                  | NA         |
| ## 4  | Belize                         | NA                   | NA         |
| ## 5  | Bhutan                         | NA                   | NA         |
| ## 6  | Burundi                        | NA                   | 162        |
| ## 7  | Cape Verde                     | NA                   | NA         |
| ## 8  | Central African Republic       | NA                   | 165        |
| ## 9  | Comoros                        | NA                   | 182        |
| ## 10 | Dominica                       | NA                   | NA         |
| ## 11 | Eritrea                        | NA                   | 159        |
| ## 12 | Fiji                           | NA                   | NA         |
| ## 13 | Gambia, The                    | NA                   | 175        |
| ## 14 | Grenada                        | NA                   | NA         |
| ## 15 | Guinea-Bissau                  | NA                   | 176        |
| ## 16 | Guyana                         | NA                   | NA         |
| ## 17 | Kiribati                       | NA                   | NA         |
| ## 18 | Lesotho                        | NA                   | NA         |
| ## 19 | Liberia                        | NA                   | 168        |
| ## 20 | Maldives                       | NA                   | NA         |
| ## 21 | Marshall Islands               | NA                   | NA         |
| ## 22 | Mauritania                     | NA                   | 154        |
| ## 23 | Micronesia, Fed. Sts.          | NA                   | NA         |
| ## 24 | Palau                          | NA                   | NA         |
| ## 25 | Samoa                          | NA                   | NA         |
| ## 26 | São Tomé and Príncipe          | NA                   | NA         |
| ## 27 | Seychelles                     | NA                   | NA         |
| ## 28 | Sierra Leone                   | NA                   | 157        |
| ## 29 | Solomon Islands                | NA                   | 174        |
| ## 30 | St. Kitts and Nevis            | NA                   | NA         |
| ## 31 | St. Lucia                      | NA                   | NA         |
| ## 32 | St. Vincent and the Grenadines | NA                   | NA         |
| ## 33 | Swaziland                      | NA                   | NA         |
| ## 34 | Timor-Leste                    | NA                   | NA         |
| ## 35 | Togo                           | NA                   | 156        |
| ## 36 | Tonga                          | NA                   | NA         |
| ## 37 | Tuvalu                         | NA                   | NA         |

```
## 38          Vanuatu          NA          NA
## Lower middle income Upper middle income
## 1          NA          172
## 2          NA          NA
## 3          NA          NA
## 4          169          NA
## 5          167          NA
## 6          NA          NA
## 7          166          NA
## 8          NA          NA
## 9          NA          NA
## 10         NA          183
## 11         NA          NA
## 12         NA          155
## 13         NA          NA
## 14         NA          178
## 15         NA          NA
## 16         160          NA
## 17         189          NA
## 18         163          NA
## 19         NA          NA
## 20         164          NA
## 21         188          NA
## 22         NA          NA
## 23         185          NA
## 24         NA          187
## 25         181          NA
## 26         186          NA
## 27         NA          173
## 28         NA          NA
## 29         NA          NA
## 30         NA          178
## 31         NA          171
## 32         NA          180
## 33         158          NA
## 34         170          NA
## 35         NA          NA
## 36         184          NA
## 37         190          NA
## 38         177          NA
## Number of Countries in Lower middle income group and GDP Rank within 38th
## [1] 5
```

## Answers:

- 224 countries are matched using the country code when merging two files.
- The 13th country from the lowest GDP were “Grenada” and “St. Kitts and Nevis”. They are tied. Their average ranking is 178 (12.5th).
- The average GDP ranking for the “High income: OECD” group was 32.97.
- The average GDP ranking for the “High income: nonOECD” group was 91.91.
- Please see the above box plot and histograms to check the distribution of GDP by income group.
- The summary statistics of GDP by income groups are same as followings.

## ## GDP Summary Table

```
## High income: nonOECD High income: OECD Low income
## Min. : 2584 Min. : 13579 Min. : 596
## 1st Qu.: 12838 1st Qu.: 211147 1st Qu.: 3814
## Median : 28373 Median : 486528 Median : 7843
## Mean :104350 Mean : 1483917 Mean : 14411
## 3rd Qu.:131205 3rd Qu.: 1480047 3rd Qu.: 17204
## Max. :711050 Max. :16244600 Max. :116355
## NA's :215 NA's :208 NA's :201
## Lower middle income Upper middle income
## Min. : 40 Min. : 228
## 1st Qu.: 2549 1st Qu.: 9613
## Median : 24272 Median : 42945
## Mean : 256663 Mean : 231848
## 3rd Qu.: 81448 3rd Qu.: 205789
## Max. :8227103 Max. :2252664
## NA's :184 NA's :193
```

- Please see the above 5 separate quantile groups for the GDP ranking from “RankQ1” ~ “RankQ”.
- There were 5 countries in the ‘Lower middle income’ group among the 38 nations with highest GDP.

## Conclusion

### Technical:

- 224 countries were matched when merging two sets of files from the world bank.
- The GDP rank for “Grenada” and “St. Kitts and Nevis” are tied.

### Data Exploration:

- World Bank categorised the GDP income groups into five groups:

```
* High income: nonOECD,
* High income: OECD,
* Low income,
* Lower middle income,
* Upper middle income.
```

- Summary statistics by each Income groups are same as below.

## ## GDP Summary Table

| ## High income: nonOECD |         | High income: OECD   |          | Low income |        |
|-------------------------|---------|---------------------|----------|------------|--------|
| ## Min. :               | 2584    | Min. :              | 13579    | Min. :     | 596    |
| ## 1st Qu.:             | 12838   | 1st Qu.:            | 211147   | 1st Qu.:   | 3814   |
| ## Median :             | 28373   | Median :            | 486528   | Median :   | 7843   |
| ## Mean :               | 104350  | Mean :              | 1483917  | Mean :     | 14411  |
| ## 3rd Qu.:             | 131205  | 3rd Qu.:            | 1480047  | 3rd Qu.:   | 17204  |
| ## Max. :               | 711050  | Max. :              | 16244600 | Max. :     | 116355 |
| ## NA's :               | 215     | NA's :              | 208      | NA's :     | 201    |
| ## Lower middle income  |         | Upper middle income |          |            |        |
| ## Min. :               | 40      | Min. :              | 228      |            |        |
| ## 1st Qu.:             | 2549    | 1st Qu.:            | 9613     |            |        |
| ## Median :             | 24272   | Median :            | 42945    |            |        |
| ## Mean :               | 256663  | Mean :              | 231848   |            |        |
| ## 3rd Qu.:             | 81448   | 3rd Qu.:            | 205789   |            |        |
| ## Max. :               | 8227103 | Max. :              | 2252664  |            |        |
| ## NA's :               | 184     | NA's :              | 193      |            |        |

## Total GDP by Income.Group

| ## High income: nonOECD |          | High income: OECD   |          | Low income |        |
|-------------------------|----------|---------------------|----------|------------|--------|
| ##                      | 2400046  |                     | 44517514 |            | 533199 |
| ## Lower middle income  |          | Upper middle income |          |            |        |
| ##                      | 13859828 |                     | 10433153 |            |        |

## Total GDP by Income.Group (RATIO)

| ## High income: nonOECD |             | High income: OECD   |             | Low income |             |
|-------------------------|-------------|---------------------|-------------|------------|-------------|
| ##                      | 0.033453037 |                     | 0.620507294 |            | 0.007431993 |
| ## Lower middle income  |             | Upper middle income |             |            |             |
| ##                      | 0.193185189 |                     | 0.145422486 |            |             |

## Total Country Number by Income Group

| ## High income: nonOECD |    | High income: OECD   |    | Low income |    |
|-------------------------|----|---------------------|----|------------|----|
| ##                      | 23 |                     | 30 |            | 37 |
| ## Lower middle income  |    | Upper middle income |    |            |    |
| ##                      | 54 |                     | 45 |            |    |

- The GDP ratio of U.S. vs. the rest of OECD countries were 1 : 1.74.
- The GDP ratio of U.S. vs. the rest of world was 1 : 3.41.
- Distributions of each income groups followed right-skewed distribution. Low income group shows no tails since the GDP values were very little compared to other countries.
- Summary statistics for the top 38 GDP Ranking values are same as below:

## GDP Summary for the First Quantile group

```
##      Economy      High income: nonOECD High income: OECD
## Length:38      Min.   :19.00      Min.   : 1.00
## Class :character 1st Qu.:28.75      1st Qu.: 6.75
## Mode  :character Median :33.50      Median :14.00
##                Mean  :30.75      Mean   :15.00
##                3rd Qu.:35.50      3rd Qu.:22.50
##                Max.   :37.00      Max.   :33.00
##                NA's   :34        NA's   :20
## Lower middle income Upper middle income
## Min.   : 2.0      Min.   : 7.00
## 1st Qu.:10.0      1st Qu.:15.50
## Median :16.0      Median :26.00
## Mean   :19.4      Mean   :22.82
## 3rd Qu.:31.0      3rd Qu.:29.50
## Max.   :38.0      Max.   :36.00
## NA's   :33        NA's   :27
```

## R-technical:

- map function from mapdata package do not find the countries well with using either country name or country code.
- get\_map function from RgoogleMaps package have some limits on the query frequency per day.