GDP_Analysis

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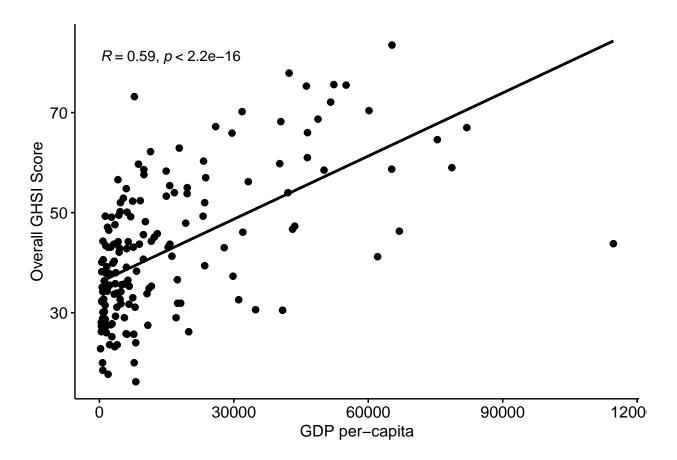
Imports & Pre-processing

```
# import libraries
library(tidyverse)
library(lubridate)
library(ggpubr)
library(dplyr)

# load sixmonth data, omitting NA values
sixmonth_data = na.omit(read.csv(".\\prepped_data\\sixmonth.csv", check.names = FALSE))

# add gdp_pc quartile
sixmonth_data$gdp_pc_quartile <- ntile(sixmonth_data$gdp_pc, 4)</pre>
```

Correlation between GDP per-capita and overall GHSI index



Baseline: Outcomes vs overall GHSI

Cases per-capita vs overall GHSI

```
summary(lm(casepc ~ overall, data = sixmonth_data))$coefficients
##
                    Estimate Std. Error
                                              t value
                                                          Pr(>|t|)
## (Intercept) 1.21187052 1.40027022 0.8654548 0.38801614
                 0.06405954 0.03142626 2.0384078 0.04306759
par(mfrow=c(2,2), mar=c(5,4,2,1))
plot(lm(casepc ~ overall, data = sixmonth_data))
                                                                            Normal Q-Q
                   Residuals vs Fitted
                                                     Standardized residuals
                         O148
                                                                                                   1480
                                                           9
     30
Residuals
                        018
                                                                                                   O18
                                                                                              0138
     10
     -10
                  3
                                   5
                                           6
                                                                     -2
                                                                            -1
                                                                                   0
                                                                                                2
                                                                         Theoretical Quantiles
                        Fitted values
√|Standardized residuals
                     Scale-Location
                                                                      Residuals vs Leverage
                                                     Standardized residuals
                                                                     O148
     2.0
                        O18
                                                                     O18
     1.0
     0.0
                  3
                                   5
                                           6
                                                               0.00 0.01 0.02 0.03 0.04 0.05
                        Fitted values
                                                                               Leverage
```

Deaths per-capita vs overall GHSI

Fitted values

```
summary(lm(deathpc ~ overall, data = sixmonth_data))$coefficients
##
                       Estimate
                                    Std. Error
                                                    t value
                                                                  Pr(>|t|)
## (Intercept) -0.108134228 0.0379110729 -2.852313 4.882255e-03
## overall
                   0.005015641 0.0008508381 5.894941 1.983611e-08
par(mfrow=c(2,2),mar=c(5,4,2,1))
plot(lm(deathpc ~ overall, data = sixmonth_data))
                                                                             Normal Q-Q
                   Residuals vs Fitted
                                                      Standardized residuals
      0.8
                                                                                                   1390
0013
Residuals
      0.4
      -0.2
                                                            0
             0.00
                        0.10
                                   0.20
                                              0.30
                                                                      -2
                                                                                                  2
                                                                                    0
                        Fitted values
                                                                          Theoretical Quantiles
/|Standardized residuals
                     Scale-Location
                                                                       Residuals vs Leverage
                                                      Standardized residuals
      2.0
                                   130
                                                                        04
                                                                                                          0.5
                                                                                             630
      1.0
      0.0
             0.00
                                              0.30
                                                                0.00
                                                                      0.01
                                                                                                 0.05
                        0.10
                                   0.20
                                                                             0.02
                                                                                    0.03
                                                                                         0.04
```

Leverage

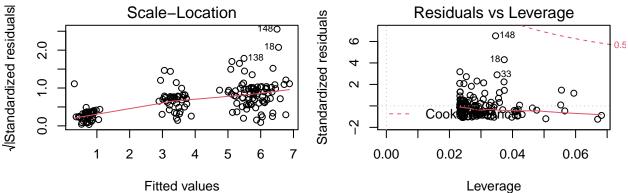
Case-fatality ratio vs overall GHSI

```
summary(lm(cfratio ~ overall, data = sixmonth_data))$coefficients
##
                    Estimate Std. Error t value
                                                            Pr(>|t|)
## (Intercept) 0.35619156 0.78762500 0.452235 0.6516796540
## overall
                  0.05965234 0.01767667 3.374637 0.0009167863
par(mfrow=c(2,2),mar=c(5,4,2,1))
plot(lm(cfratio ~ overall, data = sixmonth_data))
                                                                             Normal Q-Q
                   Residuals vs Fitted
                                                      Standardized residuals
      30
             O193
                                                                                                    1930
Residuals
     20
      10
                                860130
                  2
                           3
                                              5
                                                                      -2
                                                                                    0
                                                                                                  2
                                    4
                        Fitted values
                                                                          Theoretical Quantiles
/|Standardized residuals
                     Scale-Location
                                                                       Residuals vs Leverage
                                                      Standardized residuals
     3.0
     2.0
                                860130
                                              0
                                                                                                          0.5
      0.0 1.0
                                                                                             630
                  2
                                              5
                                                                      0.01
                           3
                                                                0.00
                                                                             0.02
                                                                                    0.03
                                                                                          0.04
                        Fitted values
                                                                                Leverage
```

Confounding GDP per-capita (quartiles): Outcomes vs overall GHSI

Cases per-capita vs overall GHSI & GDP per-capita quartiles

```
summary(lm(casepc ~ overall + factor(gdp_pc_quartile), data = sixmonth_data))$coefficients
##
                                 Estimate Std. Error
                                                        t value
                                                                     Pr(>|t|)
## (Intercept)
                               1.55776251 1.50561734
                                                       1.034634 3.023449e-01
## overall
                              -0.02527216 0.03787453 -0.667260 5.055326e-01
## factor(gdp_pc_quartile)2
                              2.76984317 1.19249030
                                                       2.322739 2.140674e-02
## factor(gdp_pc_quartile)3 5.03675100 1.23358525
                                                       4.083018 6.897863e-05
## factor(gdp_pc_quartile)4 5.98175241 1.47560607
                                                       4.053760 7.731597e-05
par(mfrow=c(2,2), mar=c(5,4,2,1))
plot(lm(casepc ~ overall + factor(gdp_pc_quartile), data = sixmonth_data))
                 Residuals vs Fitted
                                                                    Normal Q-Q
                                                Standardized residuals
                                                                                         1480
                                                     9
     30
Residuals
                                                                                         O18
     10
     -10
                                                                                      2
                   2
                                                              -2
                        3
                                                                          0
                     Fitted values
                                                                  Theoretical Quantiles
                   Scale-Location
                                                               Residuals vs Leverage
                                                                           0148
                                                     9
```



Deaths per-capita vs overall GHSI & GDP per-capita quartiles

```
summary(lm(deathpc ~ overall + factor(gdp_pc_quartile), data = sixmonth_data))$coefficients
##
                                    Estimate Std. Error
                                                                            Pr(>|t|)
                                                              t value
## (Intercept)
                                -0.115369404 0.042609873 -2.707574 0.0074872119
## overall
                                 0.003956551 0.001071872
                                                             3.691254 0.0003023344
## factor(gdp_pc_quartile)2
                                0.054665989 0.033748191
                                                             1.619820 0.1071691733
## factor(gdp_pc_quartile)3
                                 0.075954095 0.034911202
                                                             2.175637 0.0309963860
## factor(gdp_pc_quartile)4
                                 0.078097574 0.041760536 1.870129 0.0632266298
par(mfrow=c(2,2), mar=c(5,4,2,1))
plot(lm(deathpc ~ overall + factor(gdp_pc_quartile), data = sixmonth_data))
                                                                         Normal Q-Q
                  Residuals vs Fitted
                                                   Standardized residuals
                                                        2
     9.0
                                   130
Residuals
     0.2
     -0.2
                                                                                            2
        -0.05
                   0.05
                             0.15
                                        0.25
                                                                  -2
                                                                               0
                       Fitted values
                                                                      Theoretical Quantiles
/|Standardized residuals
                    Scale-Location
                                                                   Residuals vs Leverage
                                                   Standardized residuals
     2.0
                                   130
                                                                           O139
O13
                                                                                          40
     1.0
     0.0
        -0.05
                   0.05
                                                            0.00
                                                                       0.02
                                                                                 0.04
                             0.15
                                        0.25
                                                                                           0.06
```

Leverage

Fitted values

Case-fatality ratio vs overall GHSI & GDP per-capita quartiles

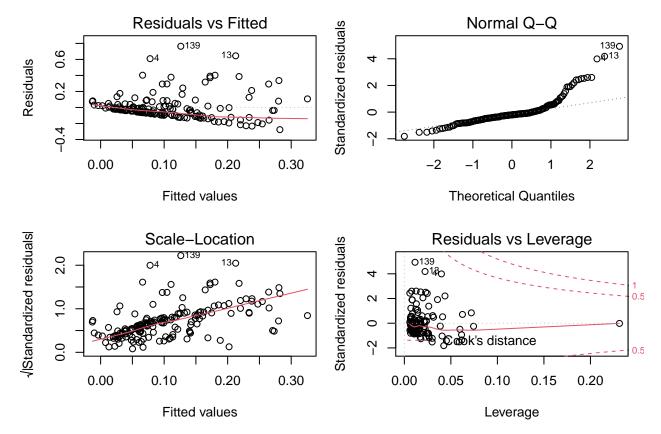
```
summary(lm(cfratio ~ overall + factor(gdp_pc_quartile), data = sixmonth_data))$coefficients
##
                                   Estimate Std. Error
                                                                        Pr(>|t|)
                                                            t value
## (Intercept)
                                 0.97370161 0.88994222
                                                          1.094118 0.275488399
## overall
                                 0.06000638 0.02238692
                                                          2.680421 0.008094517
## factor(gdp_pc_quartile)2 -1.02194884 0.70485869 -1.449863 0.148983314
## factor(gdp_pc_quartile)3 -1.15292749 0.72914914 -1.581196 0.115736788
## factor(gdp_pc_quartile)4 -0.34845304 0.87220312 -0.399509 0.690031701
par(mfrow=c(2,2), mar=c(5,4,2,1))
plot(lm(cfratio ~ overall + factor(gdp_pc_quartile), data = sixmonth_data))
                                                                        Normal Q-Q
                  Residuals vs Fitted
                                                   Standardized residuals
                    O193
                                                                                              1930
     25
Residuals
     15
                                                                                          2
                                         08
     5
            1
                   2
                           3
                                         5
                                                                               0
                                                                                           2
                                                                  -2
                       Fitted values
                                                                     Theoretical Quantiles
√|Standardized residuals
                                                                  Residuals vs Leverage
                    Scale-Location
                                                   Standardized residuals
     3.0
     2.0
                                                        9
     0.
     0.0
                   2
                                         5
                                                            0.00
                                                                      0.02
                                                                                          0.06
                           3
                                                                                0.04
                       Fitted values
                                                                           Leverage
```

Confounding GDP per-capita (raw): Outcomes vs overall GHSI

Cases per-capita vs overall GHSI & GDP per-capita

```
summary(lm(casepc ~ overall + gdp_pc, data = sixmonth_data))$coefficients
##
                                                                   Pr(>|t|)
                       Estimate
                                    Std. Error
                                                     t value
## (Intercept)
                  3.114038e+00 1.463130e+00
                                                  2.1283401 0.0347669521
                 -1.345746e-02 3.775897e-02 -0.3564043 0.7219849758
                  9.319766e-05 2.684985e-05 3.4710685 0.0006589819
## gdp_pc
par(mfrow=c(2,2), mar=c(5,4,2,1))
plot(lm(casepc ~ overall + gdp_pc, data = sixmonth_data))
                  Residuals vs Fitted
                                                                           Normal Q-Q
                                                     Standardized residuals
                            1480
                                                                                                  1480
                                                          9
     30
Residuals
                                                                                             000 138
     9
                                    10
                                           12
                                                                                  0
                                                                                               2
                       6
                                                                    -2
                       Fitted values
                                                                        Theoretical Quantiles
VStandardized residuals
                     Scale-Location
                                                                     Residuals vs Leverage
                                                     Standardized residuals
     2.0
     1.0
                                                                            ds distance
     0.0
                                                              0.00
                              8
                                    10
                                           12
                                                                      0.05
                                                                              0.10
                                                                                      0.15
                                                                                              0.20
                       6
                       Fitted values
                                                                              Leverage
```

Deaths per-capita vs overall GHSI & GDP per-capita



Case-fatality ratio vs overall GHSI & GDP per-capita

Fitted values

```
summary(lm(cfratio ~ overall + gdp_pc, data = sixmonth_data))$coefficients
##
                      Estimate
                                   Std. Error t value
                                                             Pr(>|t|)
## (Intercept) 4.552971e-01 0.8517375017 0.534551 0.59366711
## overall
                 5.561360e-02 0.0219807700 2.530102 0.01232255
## gdp_pc
                 4.855726e-06 0.0000156302 0.310663 0.75644192
par(mfrow=c(2,2), mar=c(5,4,2,1))
plot(lm(cfratio ~ overall + gdp_pc, data = sixmonth_data))
                                                                           Normal Q-Q
                   Residuals vs Fitted
                                                     Standardized residuals
     30
            O193
                                                                                                  1930
     20
Residuals
     10
                                                                                              900 0386
                               860130
     0
                 2
                          3
                                            5
                                                                     -2
                                                                                  0
                                                                                                2
                       Fitted values
                                                                        Theoretical Quantiles
/|Standardized residuals
                     Scale-Location
                                                                     Residuals vs Leverage
                                                     Standardized residuals
     3.0
     2.0
                                                          9
     1.0
     0.0
                 2
                          3
                                   4
                                            5
                                                              0.00
                                                                      0.05
                                                                              0.10
                                                                                      0.15
                                                                                              0.20
```

Leverage