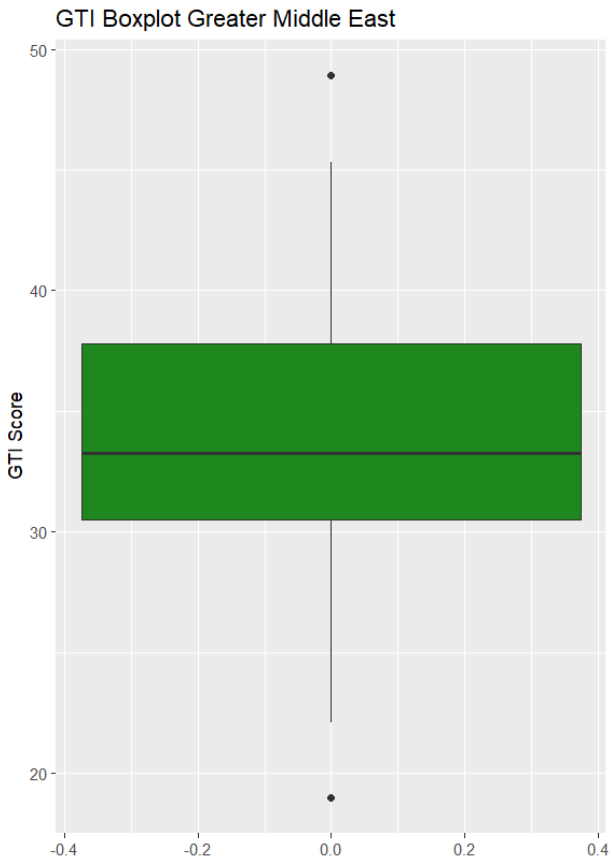
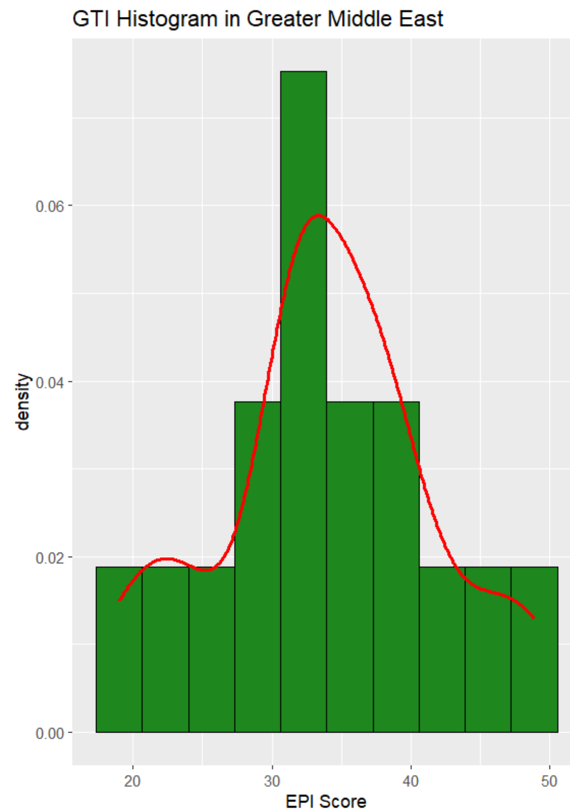
Abedalah Safi 10/14/2025

Variable Distributions:

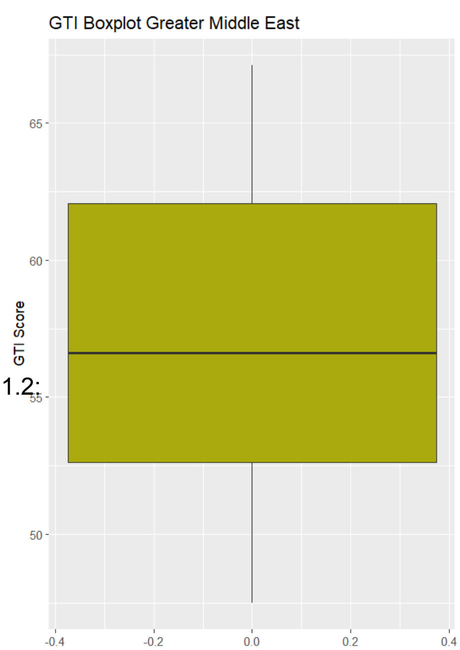
1)

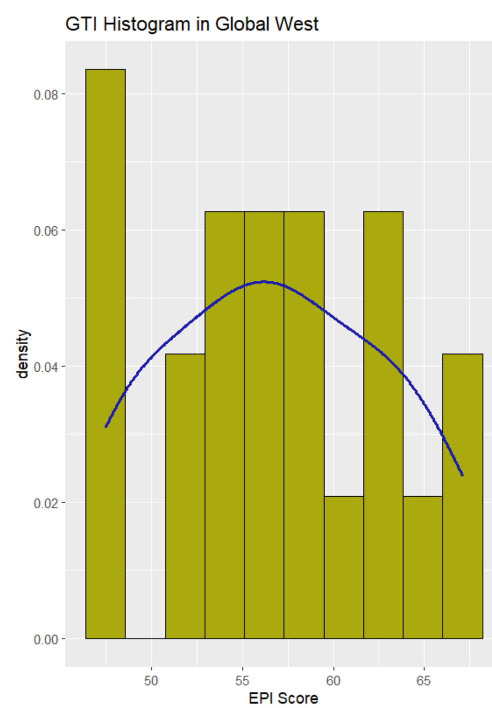
1.1:





1.2:





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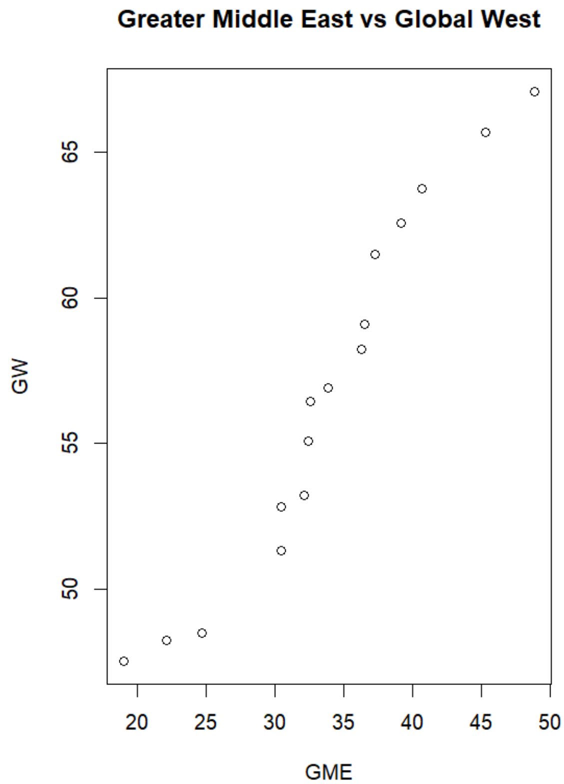


2)

2.1:

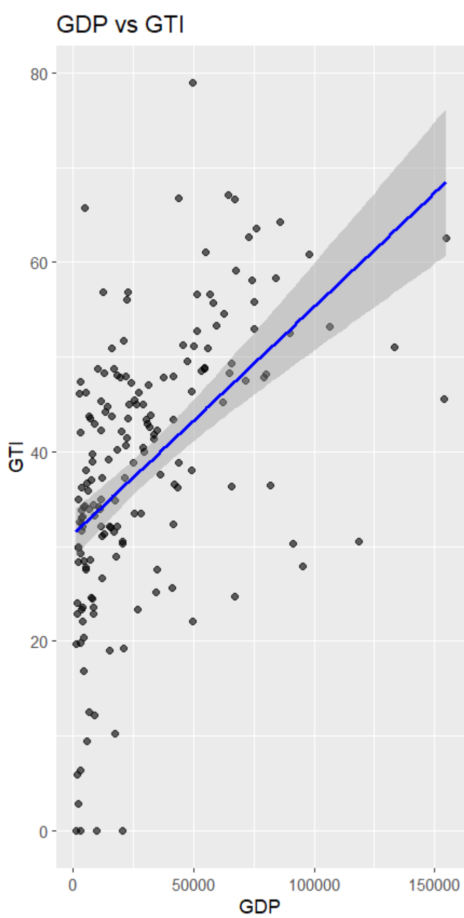
GTI vs GDP Model

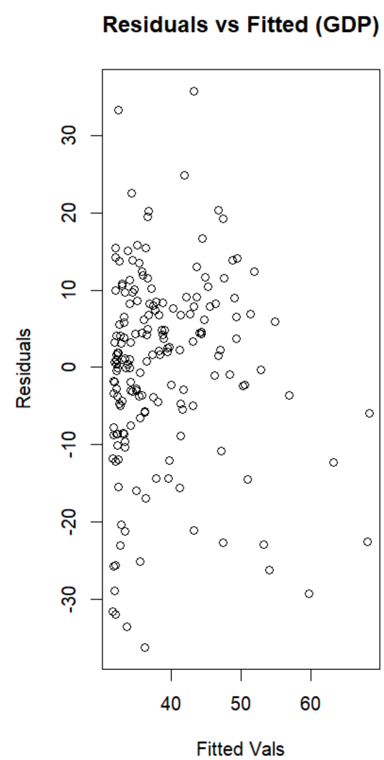
```
                    Call:
lm(formula = GTI.new ~ gdp, data = Data)

Residuals:
   Min      1Q  Median      3Q     Max
-36.204  -5.547   1.632   7.911  35.694

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) 3.129e+01  1.312e+00  23.851  < 2e-16 ***
gdp         2.399e-04  3.064e-05   7.827 4.39e-13 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 12.42 on 177 degrees of freedom
  (1 observation deleted due to missingness)
Multiple R-squared:  0.2571,    Adjusted R-squared:  0.2529
F-statistic: 61.26 on 1 and 177 DF,  p-value: 4.389e-13
```

GTI vs Population Model

```
Call:
lm(formula = GTI.new ~ population, data = Data)

Residuals:
    Min      1Q  Median      3Q     Max 
-38.841  -8.373   0.742   9.209  40.050 

Coefficients:
              Estimate Std. Error t value Pr(>|t|)    
(Intercept)  3.886e+01  1.125e+00  34.544   <2e-16 ***
population  -4.287e-09  6.941e-09  -0.618    0.538    
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 14.47 on 177 degrees of freedom
  (1 observation deleted due to missingness)
Multiple R-squared:  0.00215,	Adjusted R-squared:  -0.003488 
F-statistic: 0.3814 on 1 and 177 DF,  p-value: 0.5377
```

GDP is the better predictor





2.2:

GTI vs GDP (Log)

```
Call:
lm(formula = GTI.new ~ log(gdp), data = Data)

Residuals:
    Min      1Q  Median      3Q     Max
-39.846  -6.131   1.394   6.678  36.333

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -30.7403     7.3042  -4.209 4.08e-05 ***
log(gdp)      7.1093     0.7442   9.553  < 2e-16 ***
---
Signif. codes:
0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 11.71 on 177 degrees of freedom
  (1 observation deleted due to missingness)
Multiple R-squared:  0.3402,    Adjusted R-squared:  0.3365
F-statistic: 91.27 on 1 and 177 DF,  p-value: < 2.2e-16
```

GTI vs Population (Log)

```
Call:
lm(formula = GTI.new ~ log(population), data = Data)

Residuals:
    Min      1Q  Median      3Q     Max
-39.171  -8.186   0.890   8.878  39.187

Coefficients:
                Estimate Std. Error t value Pr(>|t|)
(Intercept)      48.0307     8.7514   5.488 1.39e-07 ***
log(population)  -0.5887     0.5460  -1.078    0.282
---
Signif. codes:
0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 14.44 on 177 degrees of freedom
  (1 observation deleted due to missingness)
Multiple R-squared:  0.006526,    Adjusted R-squared:  0.0009136
F-statistic: 1.163 on 1 and 177 DF,  p-value: 0.2824
```

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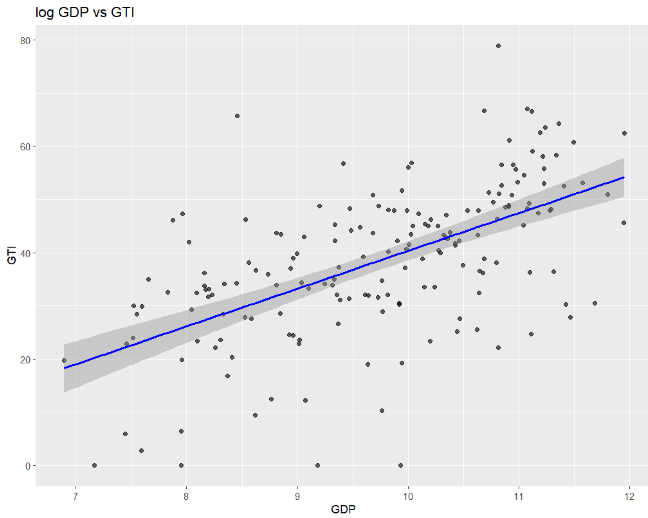

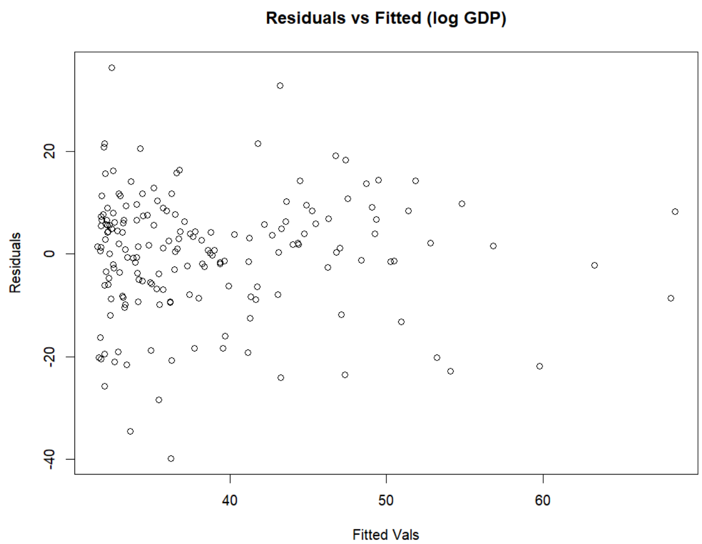

The log transformation is better than the original model. This is because p remained highly significant while decreasing residual standard error.

3)

3.1:

k=5

Confusion Matrix:

```
                            Actual
Predicted                     Asia-Pacific Global West Latin America & Caribbean
  Asia-Pacific                           3           0                         2
  Global West                            0           0                         0
  Latin America & Caribbean              5           2                        12
  Southern Asia                          0           0                         0
  Sub-Saharan Africa                     0           0                         0
                            Actual
Predicted                     Southern Asia Sub-Saharan Africa
  Asia-Pacific                            1                  1
  Global West                             0                  0
  Latin America & Caribbean               0                  0
  Southern Asia                           0                  0
  Sub-Saharan Africa                      0                  1
```

Accuracy:

```
> print(paste("Model 1 Accuracy:", round(accuracy, 4)))
[1] "Model 1 Accuracy: 0.5926"
```

3.2:

Confusion Matrix:

```
                            Actual
Predicted                     Asia-Pacific Global West Latin America & Caribbean Southern Asia
  Asia-Pacific                           5           0                         2             1
  Global West                            0           1                         0             0
  Latin America & Caribbean              3           1                        12             0
  Southern Asia                          0           0                         0             0
  Sub-Saharan Africa                     0           0                         0             0
                            Actual
Predicted                     Sub-Saharan Africa
  Asia-Pacific                                 0
  Global West                                  0
  Latin America & Caribbean                    1
  Southern Asia                                0
  Sub-Saharan Africa                           1
```

Accuracy:

```
> print(paste("Model 2 Accuracy:", round(accuracy2, 4)))
[1] "Model 2 Accuracy: 0.7037"
```

Model 2 is a better model as it achieved ~70% accuracy whereas the first reached ~59%. Model 2 also was more correct across more regions.