ECONOMETRICS-I

TRENDS IN ECONOMIC GROWTH AND GROUNDWATER QUALITY

Presented by: Group-18

Background

Efforts to support expanding populations and economies frequently outpace the consideration of environmental impacts.

Unfortunately, this pattern often persists until the oversight leads to significant health crises.

The Environmental Kuznets Curve would suggest that as an economy develops, environmental degradation increases up to a certain point, But as income continues to rise beyond this threshold, the trend reverses, leading to environmental improvements.

We seek to test this hypothesis by examining the relationship between economic growth and groundwater quality through the measure of soil pH (Potential of Hydrogen).

Piecing the Dataset Together

In order to prepare the dataset for the operations to be performed as part of the assignment, We first adjusted the SDP spreadsheet with the base year 2011-2012, iteratively multiplying preceding values with the requisite adjustment factors.

We proceeded to merge it with the primary GWQ spreadsheet, taking ‘district’ and ‘year’ as the common keys. Finally, We mapped each district to its Gini index, as calculated by Mohanty et al.

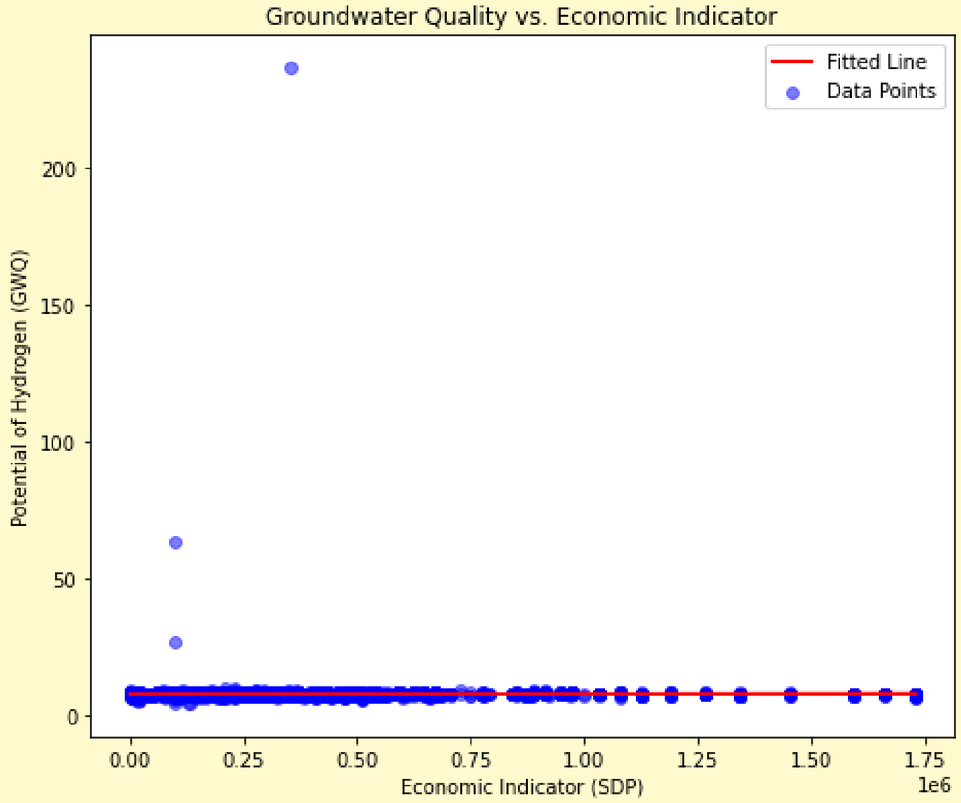
Issues with the Data

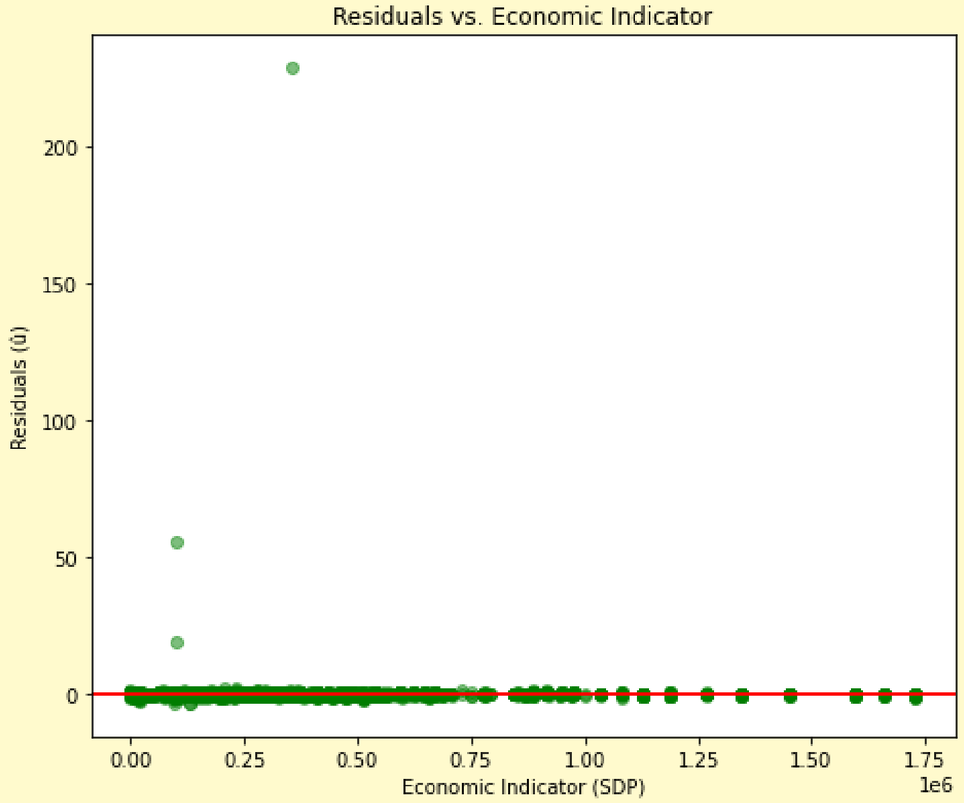
Redistricting: E.g., Warangal had been split into Warangal-Rural (Warangal) and Warangal-Urban (Hanumakoda); these realities aren’t reflected in Mohanty’s Paper.

Spelling Errors: E.g., Beed had been spelled as Bid in Mohanty’s Paper.

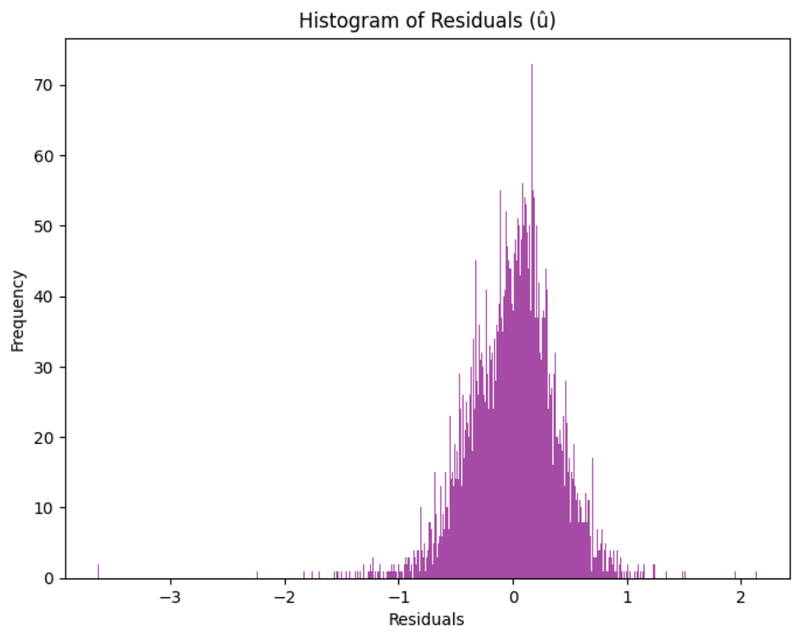
Repetition: E.g., ‘Chittorgarh’ and ‘Chittaurgarh’ represent the same district, yet their being mentioned separately in the GWQ spreadsheet is liable to introduce inaccuracies in our model.

Model Visualisations





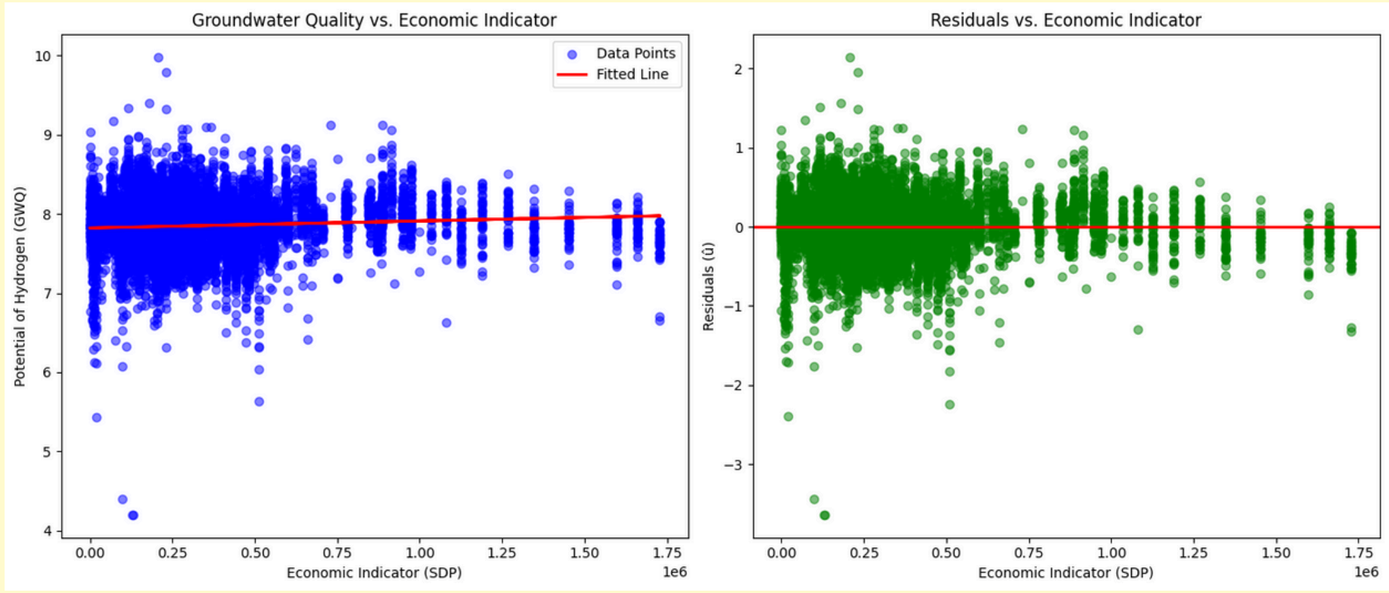
Residuals



Based on these graphs, showing the GWQ alongside the Economic Indicator and the Residuals Similarly, We see the that the Co-relation between the two is low due to no change in pH even with a stronger SDP.

We also find that we have values which are out of the range of pH which are to be removed and fixed. By Removing the afformentioned points, the graph normallises while still giving us the same relation.

By plotting the Residual points on a histogram we see a normal curve like figure centered at 0. This shows us that on addition the sum of residuals is likely to be 0



$$GWQ_{i,t} = \beta 0 + \beta 1 SDP_{i,t} + u_{i,t}$$

Dep. Variable	potential hydrogen	**R-Squared**	0.005
Model	OLS	**Adjusted R-Squared**	0.005
Method	Least Squares	**F-statistic**	36.82
Number of Observations	6969	**Prob(F-statistic)**	1.37e-09
Df Residuals	6957	**Log-likelihood**	-3218.3
Df Model	1	**AIC**	6441
Covariance Type	Non-Robust	**BIC**	6454

Regression-I Results

Variable	Coefficient	Std. Error
const	7.8221	**0.007**
economic_indicator	8.894e-08	**1.47e-08**

$$GWQ_{i,t} = \beta 0 + \beta 1 SDP_{i,t} + \beta 1 SDP_{i,t}^{2} + \beta 1 SDP_{i,t}^{3} + \delta Gini_{i} + u_{i,t}$$

Dep. Variable	potential hydrogen	**R-Squared**	0.010
Model	OLS	**Adjusted R-Squared**	0.009
Method	Least Squares	**F-statistic**	15.65
Number of Observations	6269	**Prob(F-statistic)**	9.58e-13
Df Residuals	6264	**Log-likelihood**	-2882.8
Df Model	4	**AIC**	5776
Covariance Type	Non-Robust	**BIC**	5809

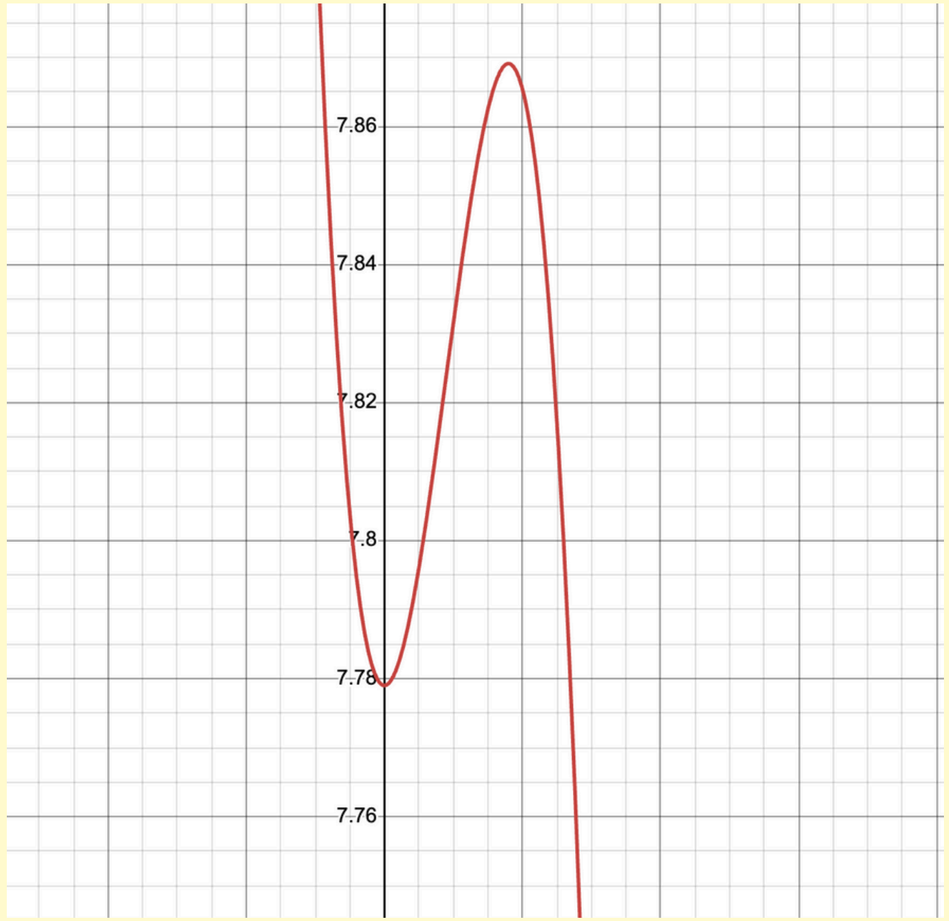
Regression-II Results

Variable	Coefficient	Std. Error
const	7.7779	**0.024**
economic_indicator_pc	5.057e-08	**1.82e-08**
gini	0.1337	**0.085**
squared	836.4064	**214.108**
cubed	-3.102e+04	**9793.446**

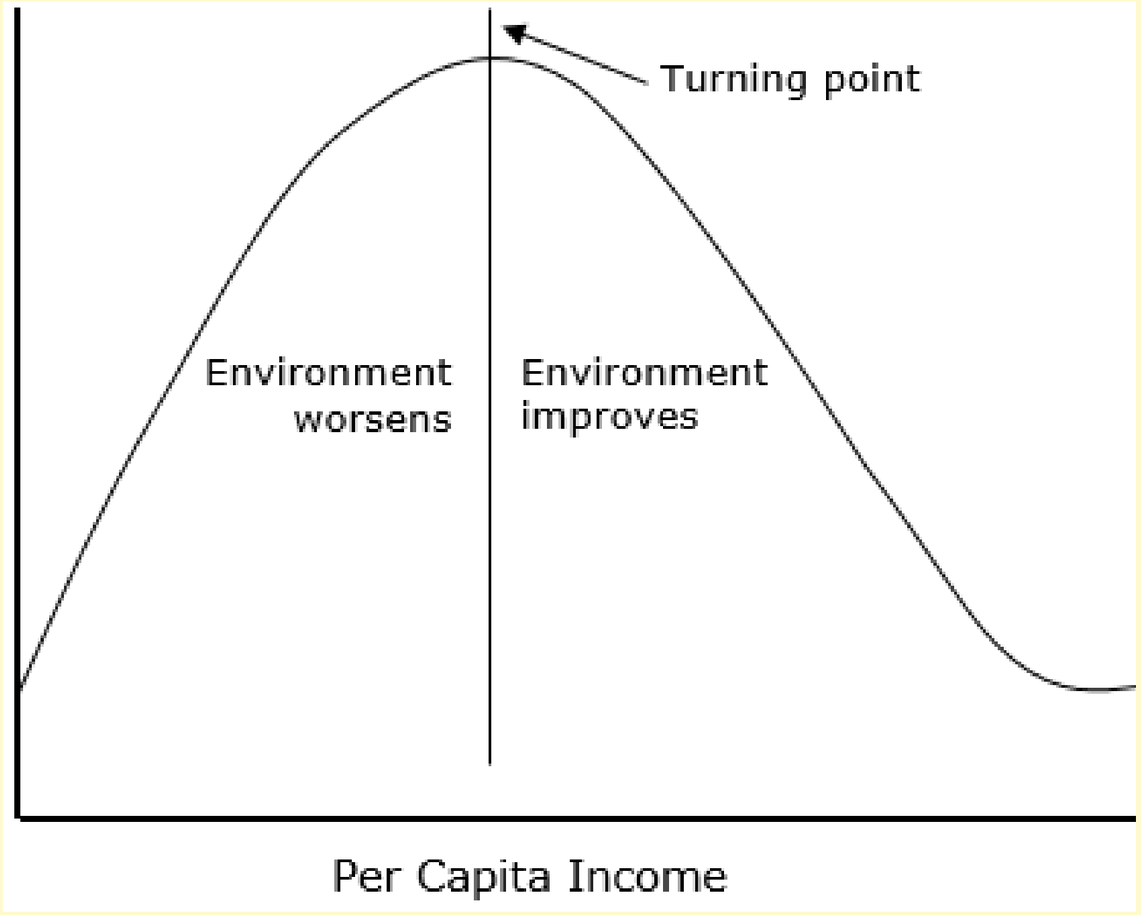
Other Imp. Statistics

Variable	Mean	Median	25th	97.5th
const	1.000000e+00	**1.000000e+00**	**2.42e-10**	**2.44e-10**
economic_indicator_pc	3.761160e+05	**2.892650e+05**	**4.34e-05**	**4.38e-05**
gini	2.729145e-01	**2.600000e-01**	**-6e-11**	**-5.89e-11**
squared	5.617673e-05	**2.841577e-05**	**2.18e-17**	**2.24e-17**
cubed	6.353675e-07	**1.514744e-07**	**6.72e-11**	**6.79e-11**

The Relationship b/w Per Capita SDP and pH

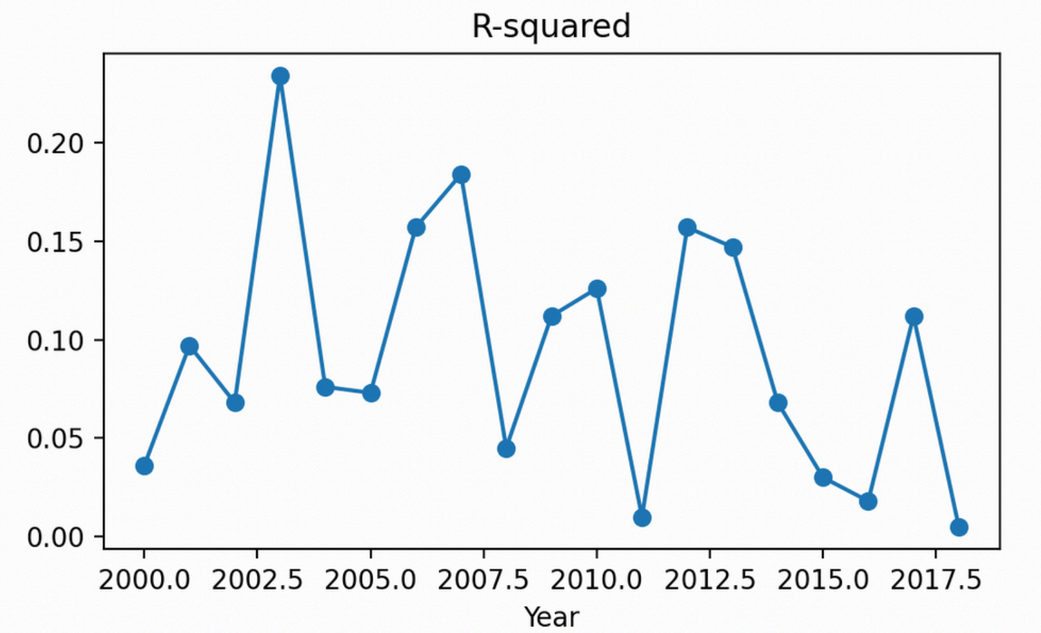


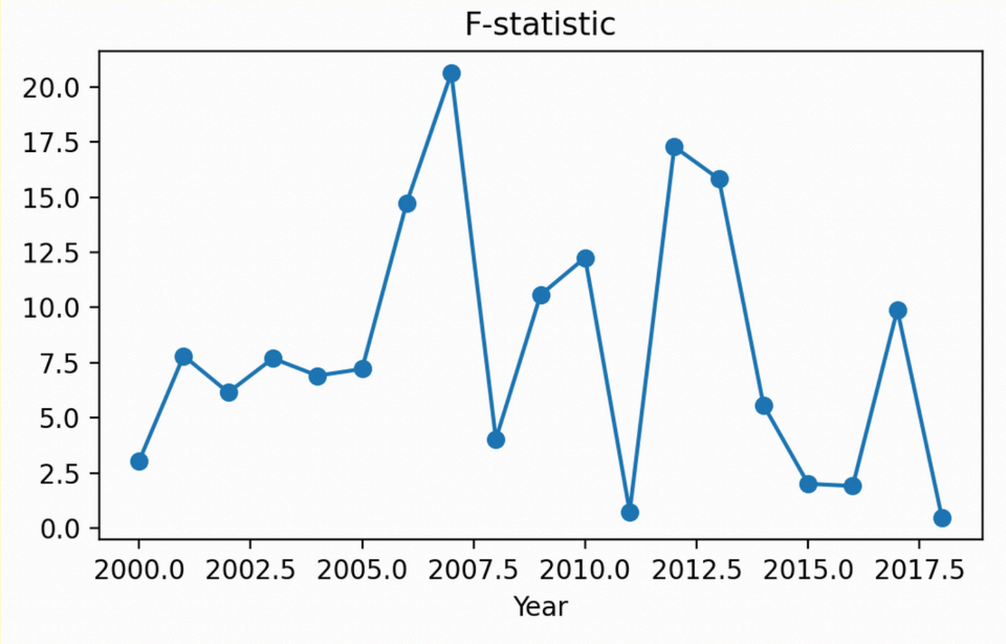
pH vs SDP Curve with Gini Coeff as 0.3



Hypothesised Environmental Kuznets Curve

Performance over the years





	coef	Standard Error
Const	7.7859	0.273
Economic Indicator	-9.466e-08	1.85e-07
Economic Indicator Squared	4109.0006	1976.811
Economic Indicator Cubed	-1.402e+05	8.56e+04
Gini	-0.5995	0.702
Northern Region	0.4773	0.2
North - Eastern Region	-0.0541	0.235
Eastern Region	0.2078	0.221
Central Region	0.0928	0.212
Western Region	0.0757	0.229
Southern Region	0.1411	0.218

Analysis

In our analysis of whether the Statewise Domestic Product has a relationship with groundwater quality concerning pH value as the dependent variable, we primarily utilize the F-statistic and the R-squared value.

From these values, covariance, and the observed graph, we can conclude that the effect on groundwater quality, along with the change of SDP, is minimal.

This observation is supported by a decently high F-statistic value, low R-squared value, and the fact that the graph depicts nearly parallel lines when outliers are removed.

Outliers have been removed by trimming due to it providing the best results.

Limitations

Based on these graphs, which display the GWQ alongside the Economic Indicator and the residuals, we see that the correlation between the two is low due to no change in pH even with a stronger SDP.

We also find that there are values outside the typical pH range, which need to be removed and corrected. By removing the aforementioned points, the graph normalizes while still presenting the same relationship.

By plotting the residual points on a histogram, we observe a figure resembling a normal curve centered at zero. This suggests that the sum of the residuals is likely to be zero.

The primary limitations are:- not having enough data which is not missing along with changes in data.