1. DECADE WISE GROWTH RATE

Growth rate refers to the percentage change of a specific variable within a specified time interval. In this section, we will calculate the decade wise growth of Iraq's GPD, passengers carried by railway and air transport, goods carried by railway and air transport, per capita GDP and CO2 emission.

The formula used here to calculate the growth rate is:

$$Growth\ rate = \left(\frac{Present\ Value}{Past\ Value} - 1\right) * 100\% \quad \text{... (Eq. 1.1)}$$

- Growth rate of GDP

  Table 1.1 shows the GDP of Iraq for the first available data of a decade and the last available data for the same decade.

YEAR	GDP (current US$)	GROWTH RATE
1962	1954634836	
1970	3281713806	67.89%
1971	3865346535	
1980	52569000000	1260.01%
1981	37823000000	
1990	1.80408E+11	376.98%
1991	407796349.7	
2000	48364250944	11759.90%
2001	36176430129	
2010	1.38517E+11	282.89%
2011	1.8575E+11	
2020	1.67224E+11	-9.97%

Table 1.1. Decade wise growth rate of GDP

- Growth Rate of passengers carried by railways

  Table 1.2 shows the GDP of Iraq for the first available data of a decade and the last available data for the same decade.

YEAR	Railways, passengers carried (million passenger-km)	GROWTH RATE
1995	2198	
2000	379	-82.76%
2001	458	
2010	99.683	-78.24%

Table 1.2 Decade wise growth rate of railway passengers carried

- Growth rate of passengers carried by air transport

  Table 1.3 shows the GDP of Iraq for the first available data of a decade and the last available data for the same decade.

YEAR	Air Transport, passengers carried (million passenger-km)	GROWTH RATE
1971	235600	
1980	619900	163.12%
1981	457000	
1990	701600	53.52%
1991	27700	
1994	31500	13.72%
2011	761778.1744	
2019	2717146	256.68%

Table 1.3 Decade wise growth rate of passengers carried by air transport

- Growth rate of goods carried by Railways

  Table 1.4 shows the GDP of Iraq for the first available data of a decade and the last available data for the same decade.

YEAR	Railways, goods transported (million ton-km)	GROWTH RATE
1995	1120	
2000	867	-22.59%
2001	1109	
2010	249.463	-77.51%

Table 1.4 Decade wise growth rate of goods transported by railways

- Growth rate of goods transported by air transport

Table 1.5 shows the GDP of Iraq for the first available data of a decade and the last available data for the same decade.

YEAR	Air Transport, goods transported (million ton-km)	GROWTH RATE
1971	2	
1980	52	2500.00%
1981	49.20000076	
1990	42.79999924	-13.01%
2011	14.52137319	
2018	16.199317	11.55%

Table 1.5 Decade wise growth rate of goods transported by air transport

- Growth rate of per capita CO2 emission

Table 1.6 shows the GDP of Iraq for the first available data of a decade and the last available data for the same decade.

YEAR	CO2 emissions (metric tons per capita)	GROWTH RATE
1961	1.166517577	
1970	2.410656688	106.65%
1971	2.814291215	
1980	3.336823173	18.57%
1981	2.287286881	
1990	3.722922057	62.77%
1991	2.614389023	
2000	3.173517079	21.39%
2001	3.482294289	
2010	4.042434704	16.09%
2011	4.264563037	
2019	4.895195361	14.79%

Table 1.6 Decade wise growth rate of per capita CO2 emission

- Growth rate of per capita GDP (current US$)

  Table 1.7 shows the GDP of Iraq for the first available data of a decade and the last available data for the same decade.

YEAR	GDP per capita (current US$)	GROWTH RATE
1962	254.7015332	
1970	330.8853685	29.91%
1971	376.8917646	
1980	3850.264419	921.58%
1981	2693.156529	
1990	10356.90305	284.56%
1991	22.79534531	
2000	2058.264401	8929.32%
2001	1494.388802	
2010	4657.280269	211.65%
2011	6045.494567	
2020	4157.484495	-31.23%

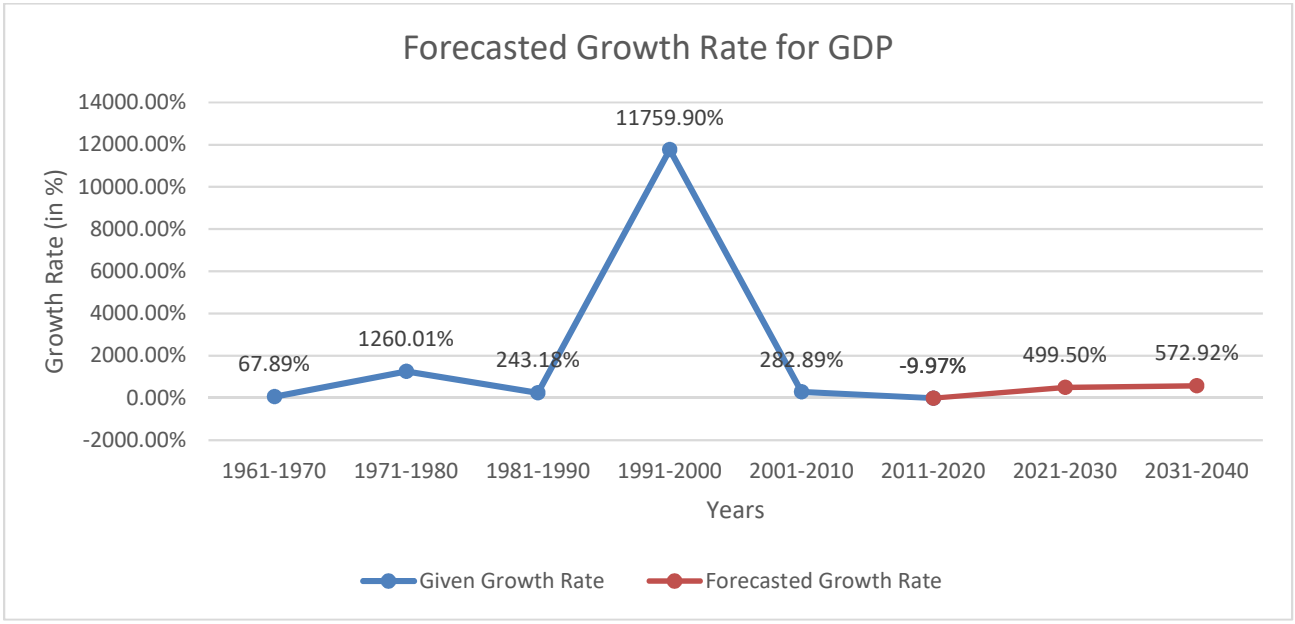
Table 1.7 Decade wise growth rate of per capita GDP (current US$)

2. PROJECTING TREND FOR THE NEXT TWO DECADE

There are many methods to project a trend for the following years. But in this report, the method used is the Exponential Triple Smoothing (ETS) algorithm, which comes pre-installed in MS-Excel. Here, the data for the next two decades is forecasted using the same method and is represented in a graph.

- GDP (Current US$)

Graph 2.1 shows a line graph which plots the given growth rate and predicts the values for the next two decades.

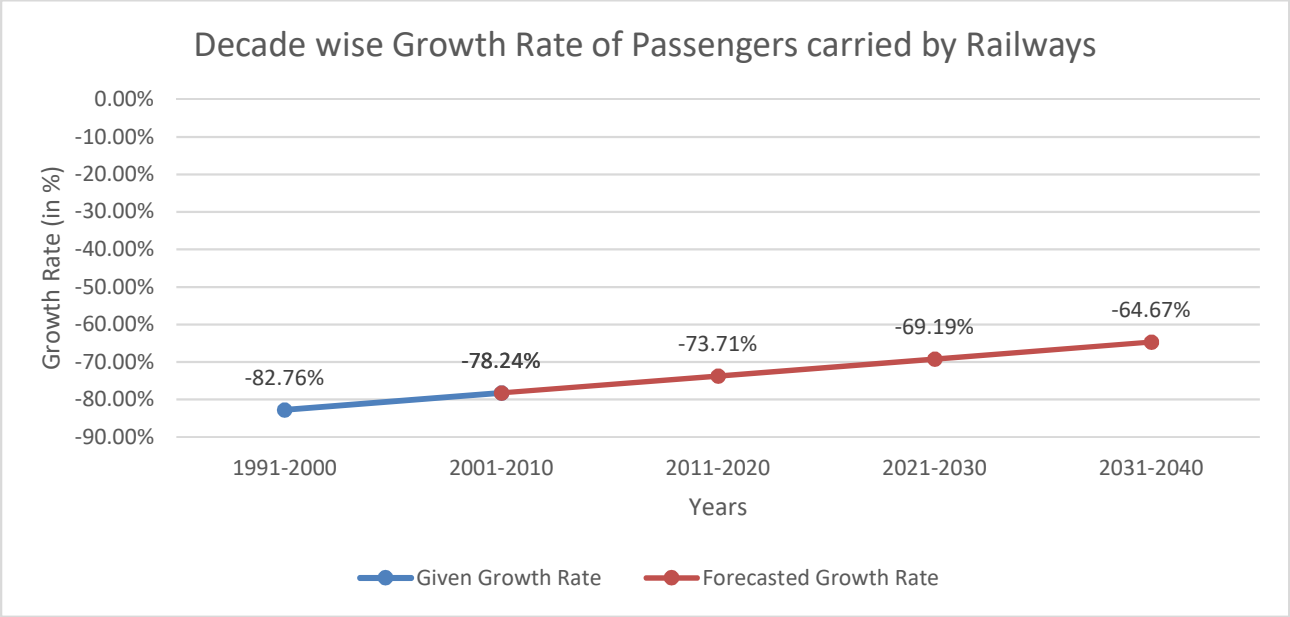


Graph 2.1 Decade wise growth rate of GDP

Therefore, the growth rate is predicted to be 499.50% for the year 2021-2030 and 572.92% for the year 20301-2040.

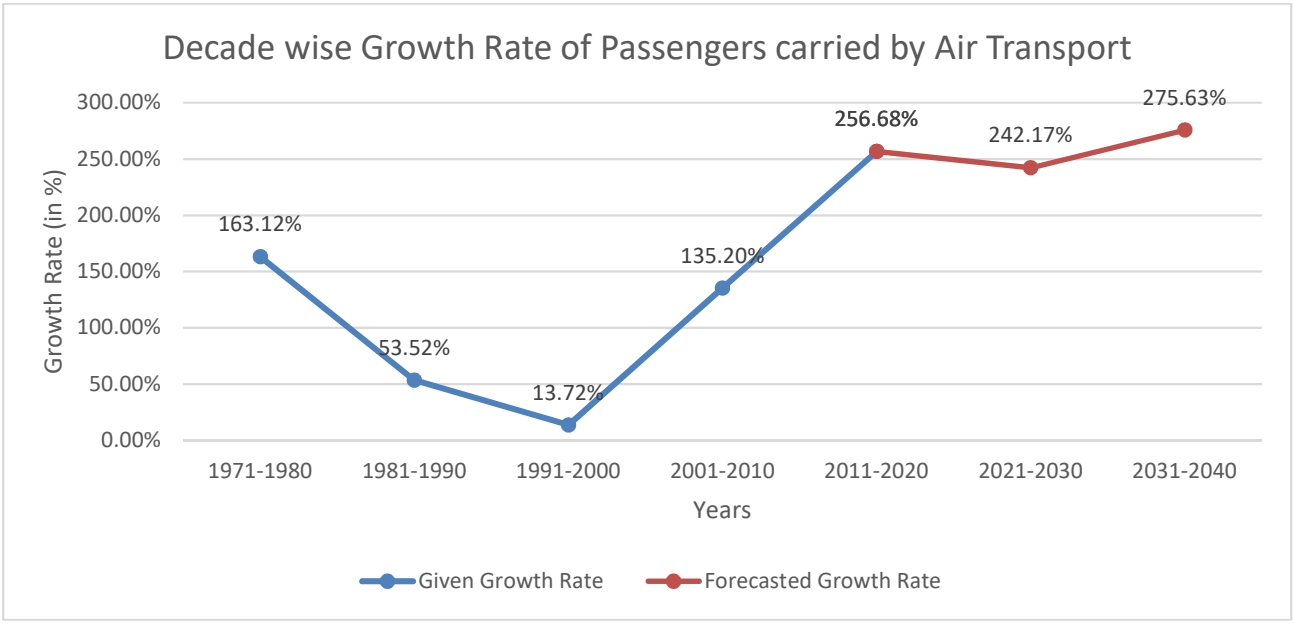
- Passengers carried by railways

From the graph shown below, the predicted growth rate for the year 2021-2030 is -69.19% and for the year 2031-2040 is -64.67%. The data for the year 2011-2020 was not available, so it's also been predicted and the predicted value is -73.71%.



Graph 2.2 Decade wise growth rate of passengers carried by railways

- Passengers carried by air transport

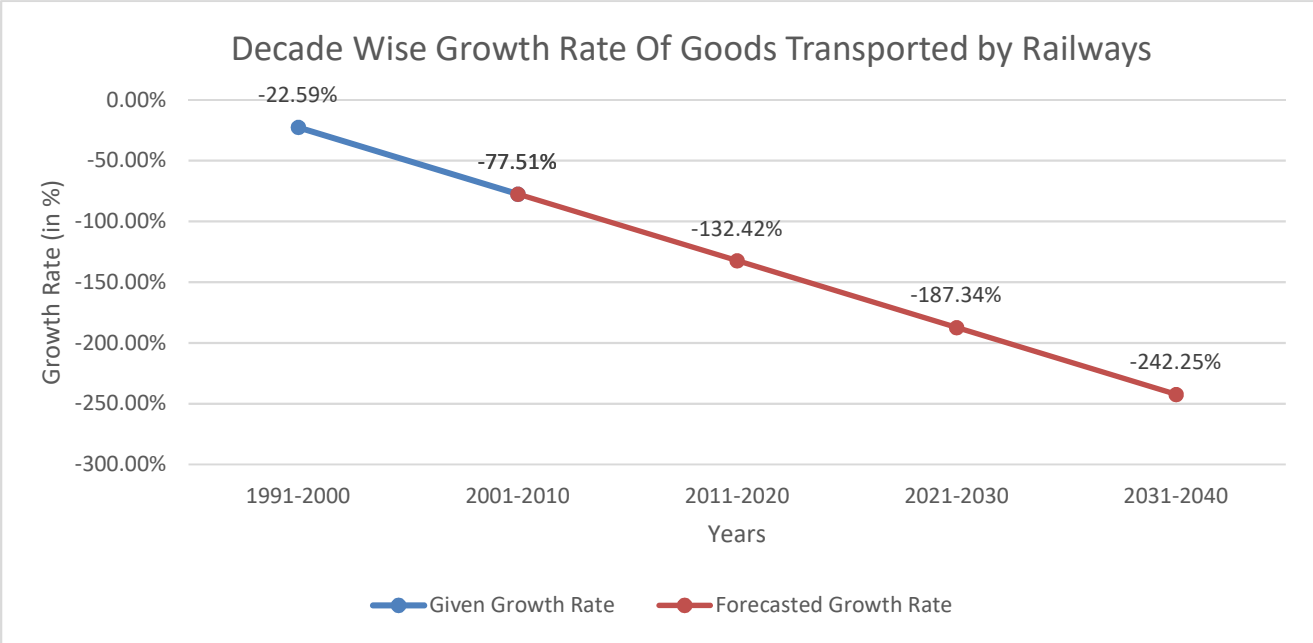


Graph 2.3 Decade wise growth rate of passengers carried by air transport

The forecasted values of the growth rate for the next two decades have been plotted in the graph 2.3. The predicted values are 242.17% and 275.63% for the years 2021-2030 and 2031-2040 respectively.

- Goods Transported by Railways

  For this also, the data was available for only two decades i.e. for 1991-2000 and 2001-2010. So, the data has been predicted for the next three decades. The growth rates are -132.42%, -187.34% and -242.25% for the next three decades



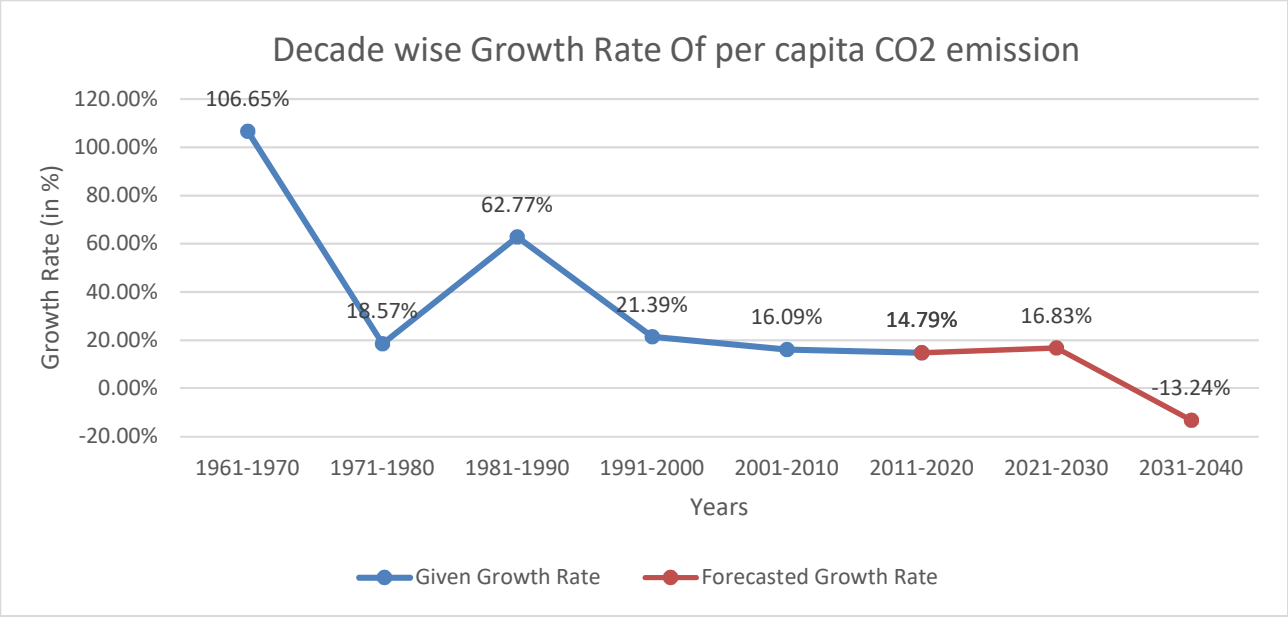
Graph 2.4 Decade wise Growth Rate of goods transported by railways

- Goods Transported by Air Transport

  The data that was available for the goods transported by air transport was not enough to use any of the available methods to project the trendline and predict the growth rate for the next two decades.

- Per capita CO2 Emission

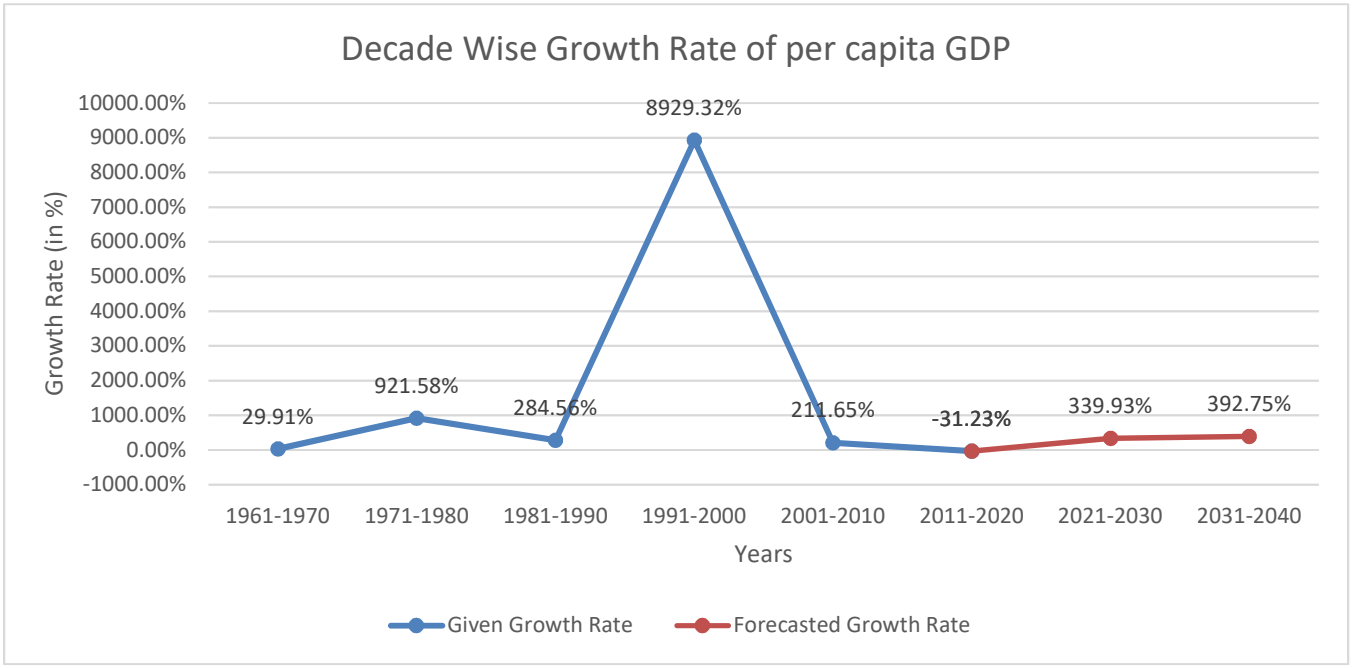
  The growth rate predicted is to be 16.83% for the year 2021-2030 and -13.24% for the year 2031-2040.



Graph 2.5 Decade wise growth rate of per capita CO2 emission

- Per capita GDP

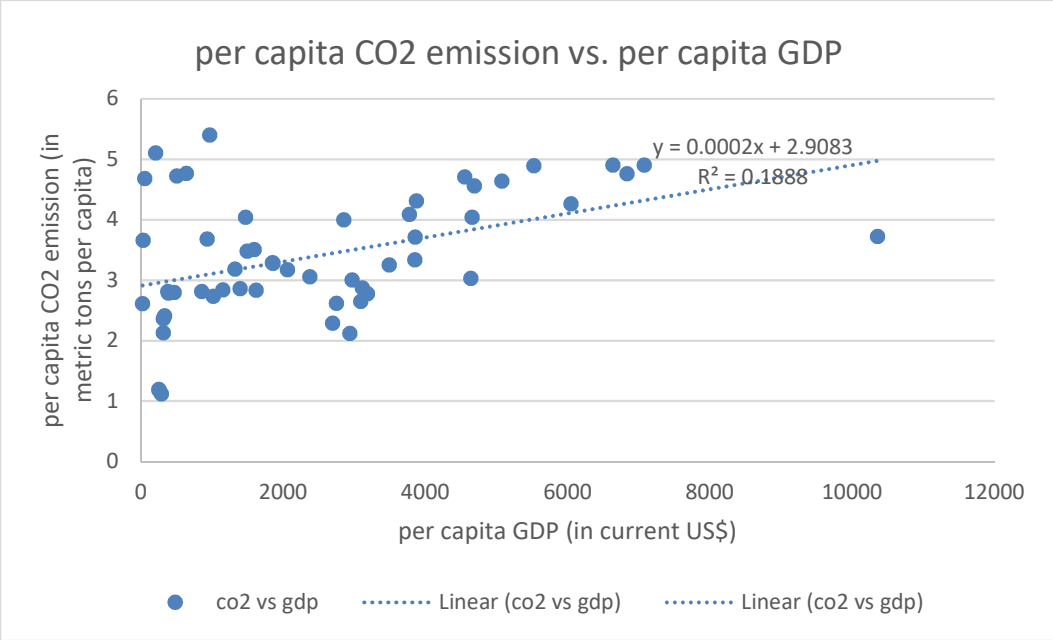
  The forecasted growth rate values of per capita GDP for the Year 2021-2030 is 339.93% and 392.75% for the year 2031-2040.



Graph 2.6 Decade wise growth rate of per capita GDP

3. RELATIONSHIP BETWEEN PER CAPITA GDP AND PER CAPITA CO2 EMISSION

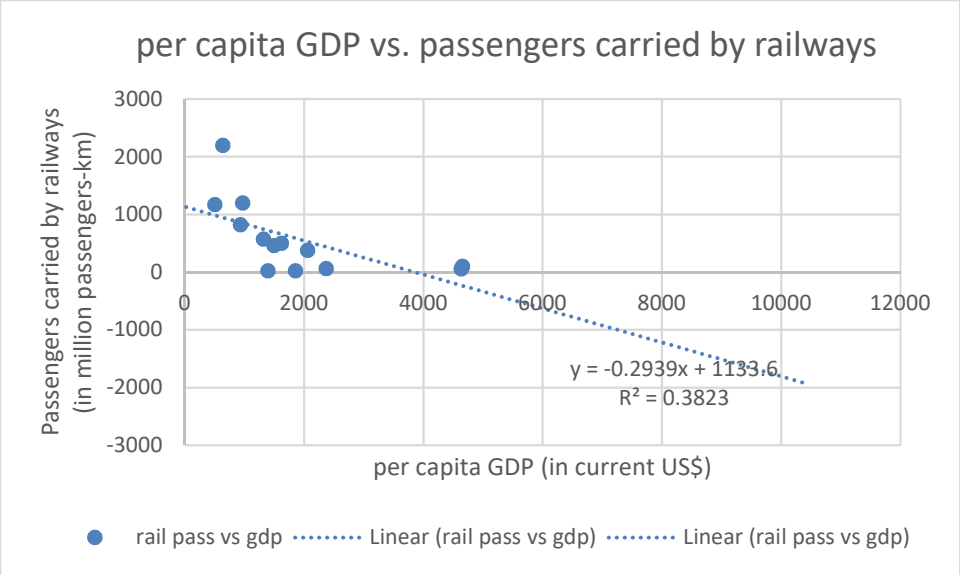
Graph 3.1 plots a scatter graph for per capita CO2 emission vs. per capita GDP. A linear trendline is drawn which shows the correlation of the two factors. It can be seen that as per capita GDP increases, per capita CO2 emission also increases. From the correlation-squared value, they are not perfectly related. Only 18.88% of the values can be explained by the per capita GDP values. The R-value is calculated to be 0.4345 which shows weak association between the 2 data.



Graph 3.1 Relationship between per capita GDP and per capita CO2 Emission

4. RELATIONSHIP BETWEEN PER CAPITA GDP AND PASSENGERS CARRIED BY RAILWAY

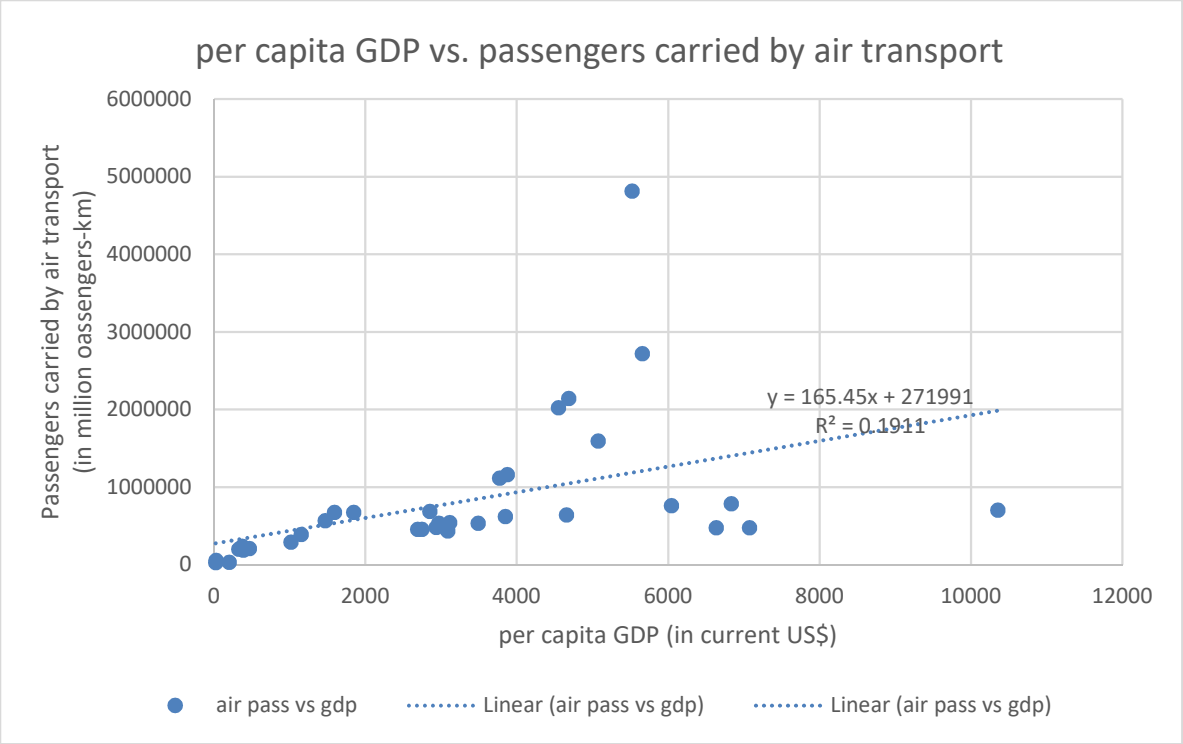
Graph 4.1 shows the scatter plot for the given data. R-value is calculated to be -0.6183 which shows strong negative association, which means most of the values for passengers carried by railways decrease when the per capita GDP value increases. R-squared value also gives good relation.



Graph 4.1 Relationship between per capita GDP and passengers carried by railways

5. RELATIONSHIP BETWEEN PER CAPITA GDP AND PASSENGERS CARRIED BY AIR TRANSPORT

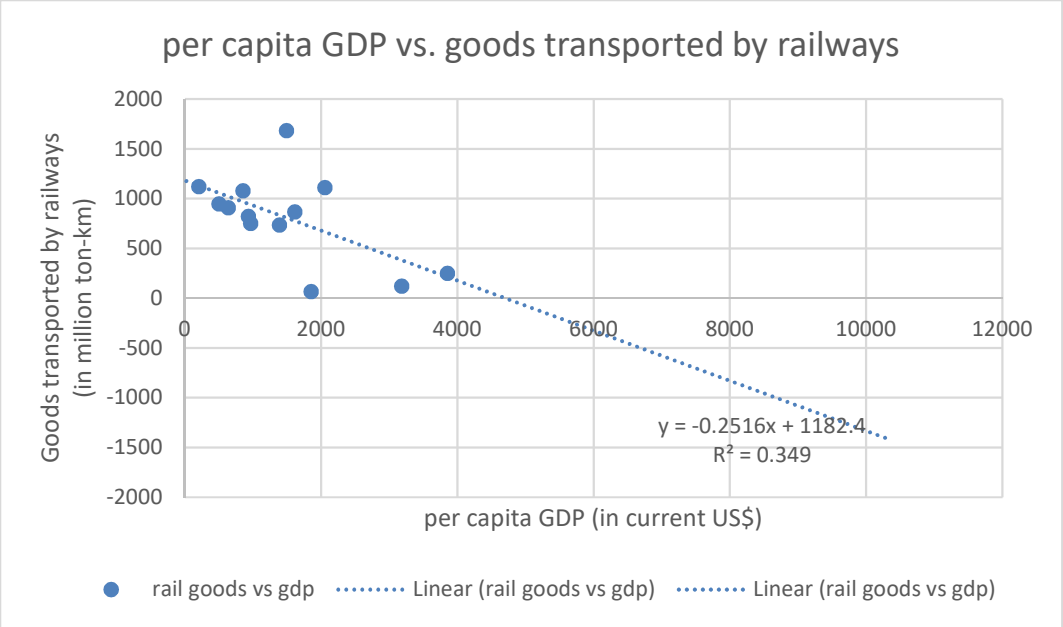
Graph 5.1 shows the relationship between the two factors by using a scatter plot. R-value is 0.4371 which shows moderate positive correlation between per capita GDP and passengers carried by air transport.



Graph 5.1 Relationship between per capita GDP and passengers carried by air transport

6. RELATIONSHIP BETWEEN GOODS TRANSPORTED BY RAILWAYS

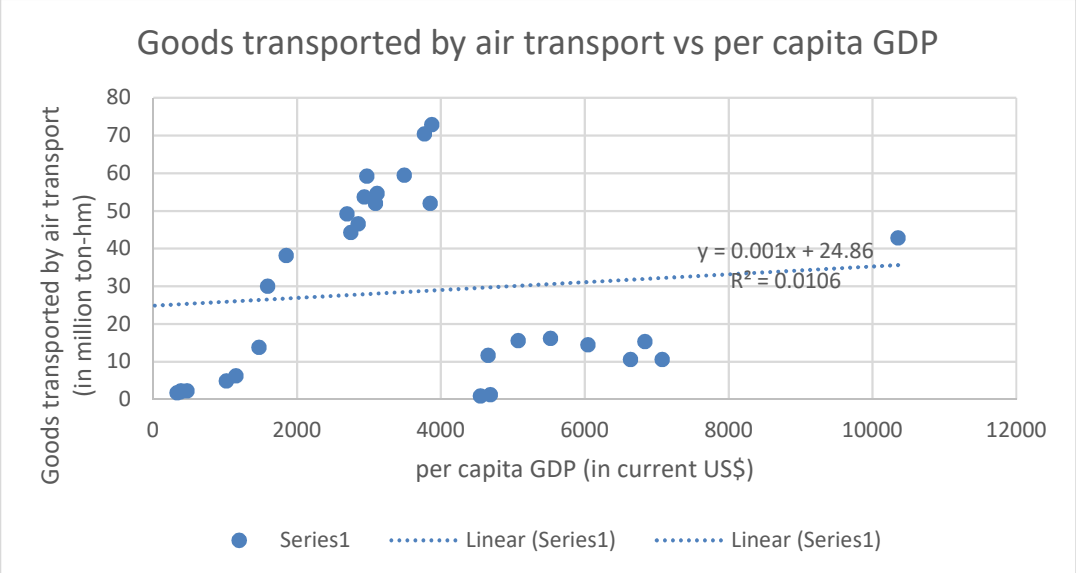
Graph 6.1 shows that there is a negative relationship between these two factors. The R-value is -0.714 which shows strong negative association. R-squared calue is 0.349 which means 34.9% of the data values for goods transported by railways can be explained by the given data values for per capita GDP.



Graph 6.1 Relationship between per capita GDP and goods transported by railways

7. RELATIONSHIP BETWEEN PER CAPITA GDP AND GOODS TRANSPORTED BY AIR TRANSPORT

Graph 7.1 shows the relationship between the above two factors. R-value is 0.103 which shows very weak positive or no association. R-squared value is 0.0106 which shows that only 1.06% of the data values of goods transported by air transport can be explained by per capita GDP values. Hence, there is almost no relationship between these two.



Graph 7.1 Relationship between goods carried by air transport and per capita GDP