Population Projection of G20 countries till 2050 : Methodology

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July 2025

1 Project Overview

I have built this project so that people can access population data of every G20 nation from 1950 to 2050 till ease.As the economic and geopolitical situation of nation is heavily dependent on it's population, this project that I have built will be an invaluable source for investors, geopolitical experts, data scientists, statisticians, mathematicians, and people belonging to diverse range of occupations.

2 Objective

1.To produce reliable projections of a country's future population size.
2.To produce a graph that is easy to read.
3.To produce a methodology document that allows the user to understand the mathematical technique that I have used for my projections.

3 Tools and Technologies used

1.Pandas
2.Plotly
3.HTML
4.CSS
5.Excel
6.Numpy

4 Dataset Description

I have compiled data from various sources into a single excel(xlsx) file and operated on that file throughout the project.The xlsx I've used can be found on the methodology page.
Compiling reliable population for some countries was difficult for two countries South Africa and Germany.Germany's was divided into two halves from 1945 - 1990, So I have simply combined the data from both east and west Germany to I have combined both their populations and represented them as one political entity in my dataset even though they were both clearly not. In case of South Africa I have only taken it's population data from it's post apartheid era.
Sources - 1.Wikipedia - Reliable population data for most countries starting from 1950 or even before
2.macrotrends.net - Same use as wikipedia.

5 Methodology

The least square method is an optimization technique from the field of linear algebra, here we use the preexisting data of the country's population to find the value of a,b and c in y = ax**2 + bx + c where y is the population of country at time x using the equation A**T.AX = A**T.B where A is the matrix representation of x**2,x and 1 and B represents the resulting population from years 1950 to 2025.The linear algebra operation was conducted using numpy.We found the values of a, b and c respectively as -220185.1973255019 ,893454190.094779,-904928915103.497 which we used for projecting populations for various different countries for various different times and placed that graph on our website using plotly.

For our projections we use data from the past 20 - 30 years to get a more accurate picture of the dominant demographic trend within that country.If a person was to project a country's population in 2020s using the data from 2000-2019 they would get a more accurate projection than a scenario in which we use data from 1980-1999 so this is why we use data that is more recent and more fresh and can thus give us a more reliable look into the future data.

6 Results

I successfully projected the populations of all G20 nations upto 2050 providing a source for people belonging to various professions to look up population data.

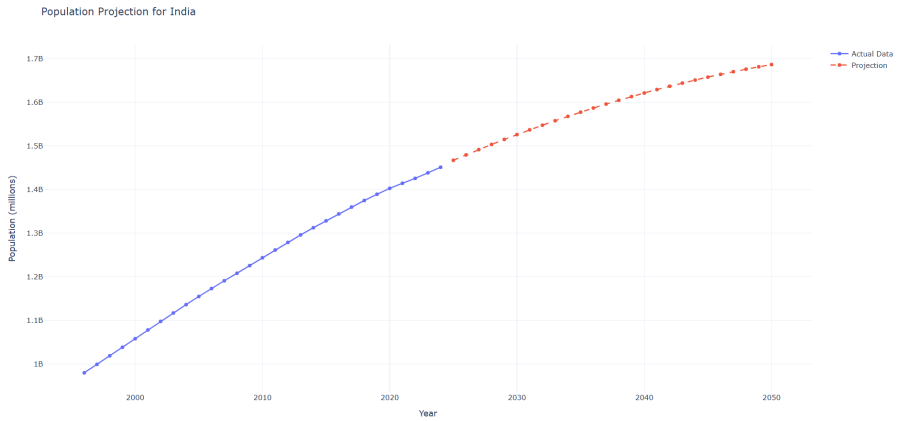

Figure 1: Sample Graph

7 Limitations

The problem with least square method is that we never get the completed accurate answer that we would have gotten we used AX = B.The error rate with least square method is calculated as —AX(ls) - B—.
Error for USA : 0.117
Error for China : 0.923
Error for India : 1.103
Error for Japan : 0.137
Error for South Korea : 0.814
Error for Russia : 0.0616
Error for Canada : 0.155
Error for Indonesia : 1.201
Error for Argentina : 1.0212
Error for Germany : 1.8
Error for France : 0.0287
Error for UK : 0.289
Error for Saudi Arabia : 0.8244
Error for Australia : 1.838
Error for South Africa : 0.0634
Error for Mexico : 1.0047
Error for Brazil : 0.011
Error for Italy : 1.017
Error for Turkey : 1.4

Average error rate : 0.673

8 Future Work

1.The population projection could have been divided into highest, lowest and average cases like the UN does with it's population projection. 2.More variables like fertility and age related data could have been added. 3.A more complex time series model like ARIMA or generalized least square could have been used.

9 Conclusion

Through this project I have show how mathematical concepts that look abstract and impractical like least square method(Linear Algebra) can be used to solve real world problems and build exciting projects when combined with a little bit of programming knowledge.