

The background image shows a blurred office or meeting environment. In the foreground, three white wind turbine models are placed on a wooden table. To the left, a person is partially visible, working on a laptop. The overall scene suggests a focus on sustainable technology or environmental research.

Air Pollution

Motivations

The inspiration for this topic was pulled from our interests as a group.

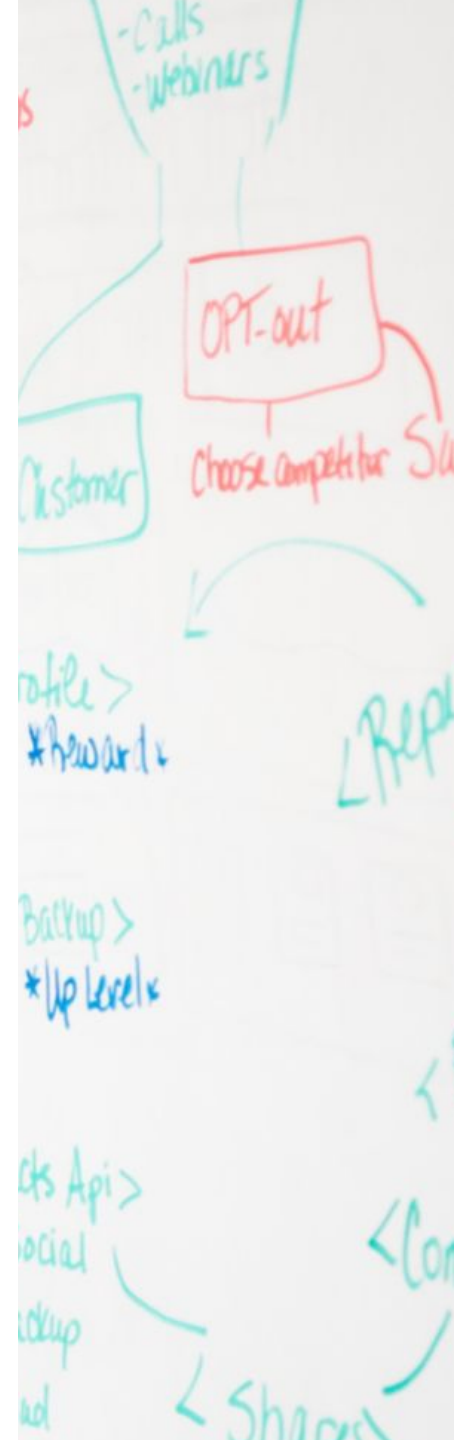
As growing professionals we wanted to use our analytical abilities to answer basic, first step, questions about our world:

1. What is the current trend of air pollution?
2. What is the magnitude of air pollution around the world in regards metrics reviewed such as, CO2 and PM2.5?
3. Is air pollution correlated to a country production (GDP) and/or population density?
4. Can we find other metrics that correlate with the historical trend of air pollution and find something interesting?



Agenda

- 1 Hypotheses
- 2 Data Source
- 3 Data Cleanup
- 4 Data Elements
- 5 Data Analysis & Visualizations
- 6 Conclusions
- 7 Post Mortem
- 8 Q&A



Hypotheses

Air Pollution & Population

If the population grow, the amount of air pollution will grow accordingly.

There is a positive correlation between the growth rate of population and air pollution indicators

Air Pollution & GDP

The higher GDP is for a country, air pollution level is higher.

There is a positive correlation between the growth rate of GDP and air pollution indicators

GDP Overview:

GDP represents the monetary value of all goods and services produced within a nation's geographic borders over a specified period of time.

Source: *Investinganswers.com*



Data Sets

Properties of Data:

- Main dataset: World Development Indicator from The World Bank
- Historical data from 1960 - 2017
- Main indicator for air pollution: CO2 and PM2.5
- Data set download as CSV format
- Efficient data structure for analysis
- 1,600 World Development Indicators
- Not all indicators have complete current or historical data available

Search...

World Development Indicators

DATA ACCESS AND LICENSING

This dataset is classified as **Public** under the Access to Information Classification Policy. Users inside and outside the Bank can access this dataset.

This dataset is licensed under **CC-BY 4.0**



RELATED LINKS

- [WDI products page](#)
- [Data Updates and Errata](#)
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- [International Debt Statistics](#)

AVAILABLE FORMATS



The primary W
the most curre

Overview

Acronym:

Type:

Topics:

Economy Cover

Languages Sup

Number of Eco

Data Cleanup

Data Sources

Remove unnecessary indicators in .csv file.

Data Merging

Merge different data sources
Remove summarized regional information
Match country names in different data sources
Clean up numerical values

Data Analysis

Choose appropriate data visualization elements
Analyze outliers

Data Elements



Air Quality Indicators



Population



Gross Domestic Product



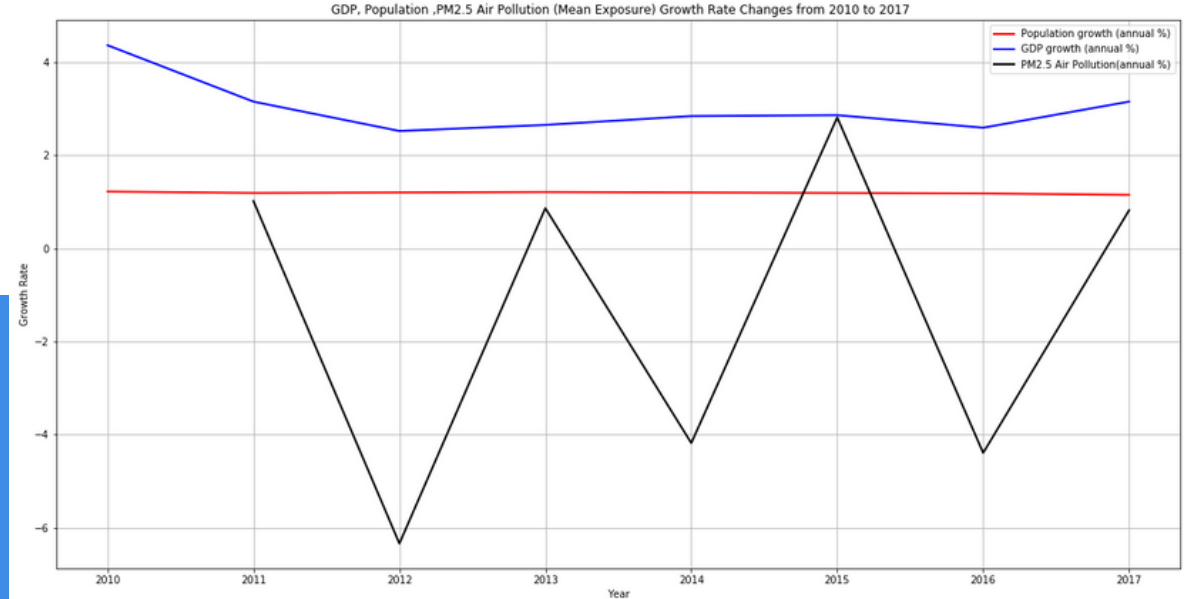
Energy

Data Analysis: Air Pollution (PM2.5)

PM2.5, which measures the concentration of particles less than 2.5 micrometers in size in a given volume of air

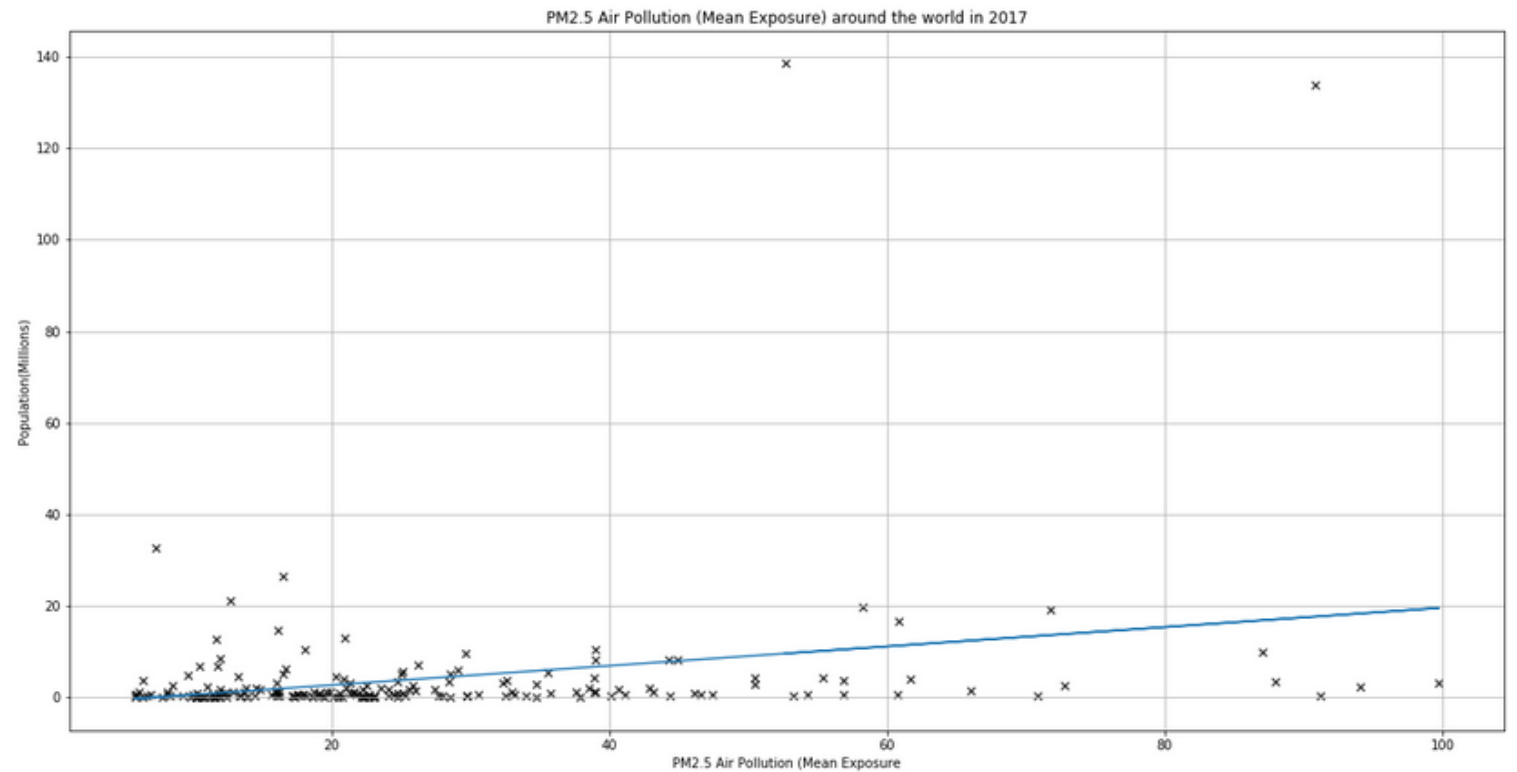
What is PM2.5 and its correlations with Population and GDP

From growth rate perspective, there is no correlation between population growth and PM 2.5 exposure or GDP growth and PM 2.5 exposure



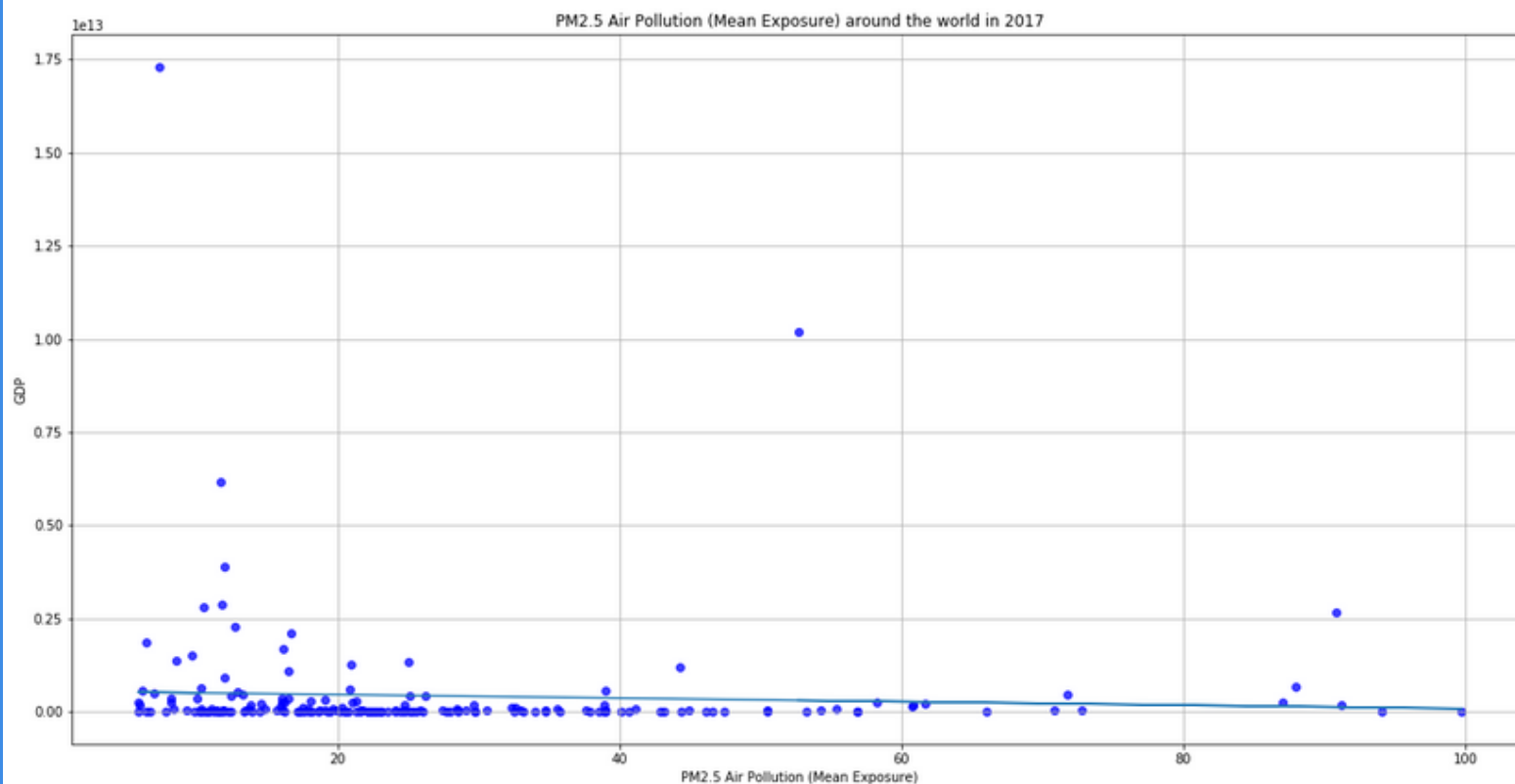
Data Analysis: Air Pollution (PM_{2.5}) and Population

There is a positive correlation between population and PM 2.5 Exposure in 2017 (0.2734).



Data Analysis: Air Pollution (PM2.5) and GDP

There is a negative correlation between GDP and PM 2.5 exposure in 2017 (-0.0553).



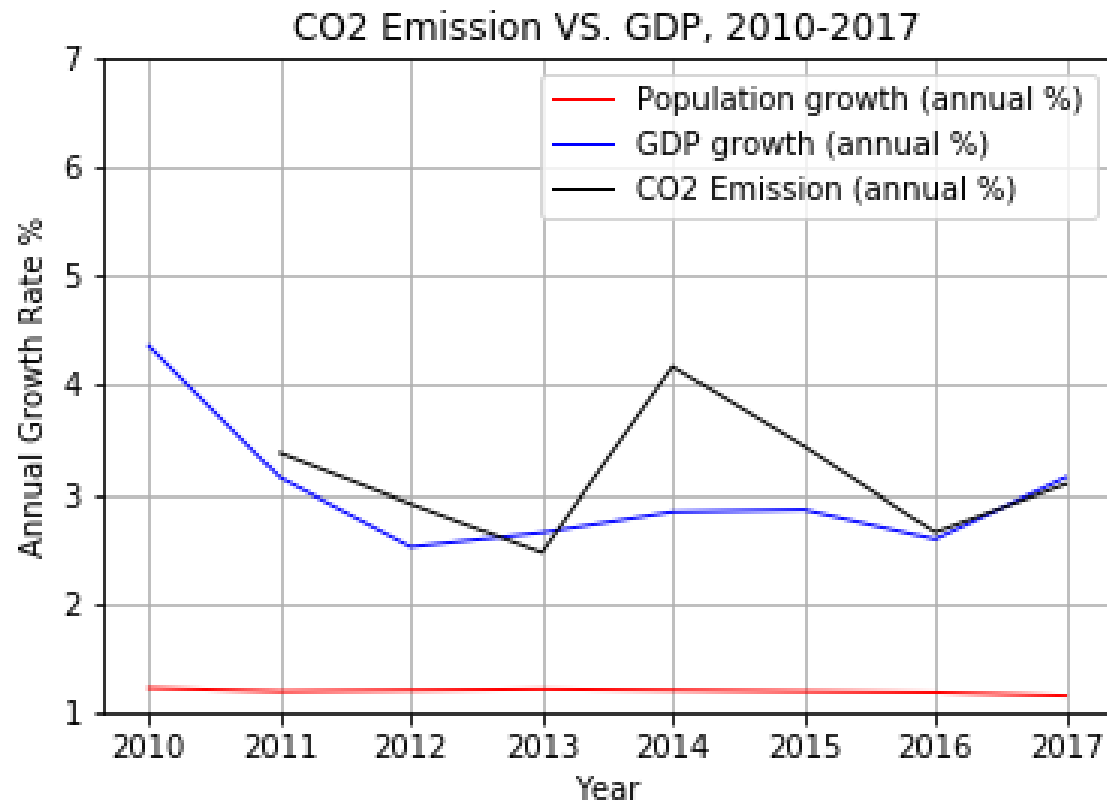
Data Analysis: Correlations from 2011 to 2017

Correlation is an effect size and so we can verbally describe the strength of the correlation using the guide that suggests for the absolute value of r:

.00-.19 “very weak” .20-.39 ”weak” .40-.59 “moderate” .60-.79 ”strong” .80-1.0 “very strong”

Population vs PM2.5	2011	2012	2013	2014	2015	2016	2017
Positive - Weak	0.3545	0.3085	0.3319	0.3289	0.2744	0.2739	0.2734
GDP vs PM2.5	2011	2012	2013	2014	2015	2016	2017
Negative - Very Weak	-0.05886	-0.06672	-0.05189	-0.05351	-0.05871	-0.06087	-0.05525

Data Analysis: Air Pollution (CO2 Emission)

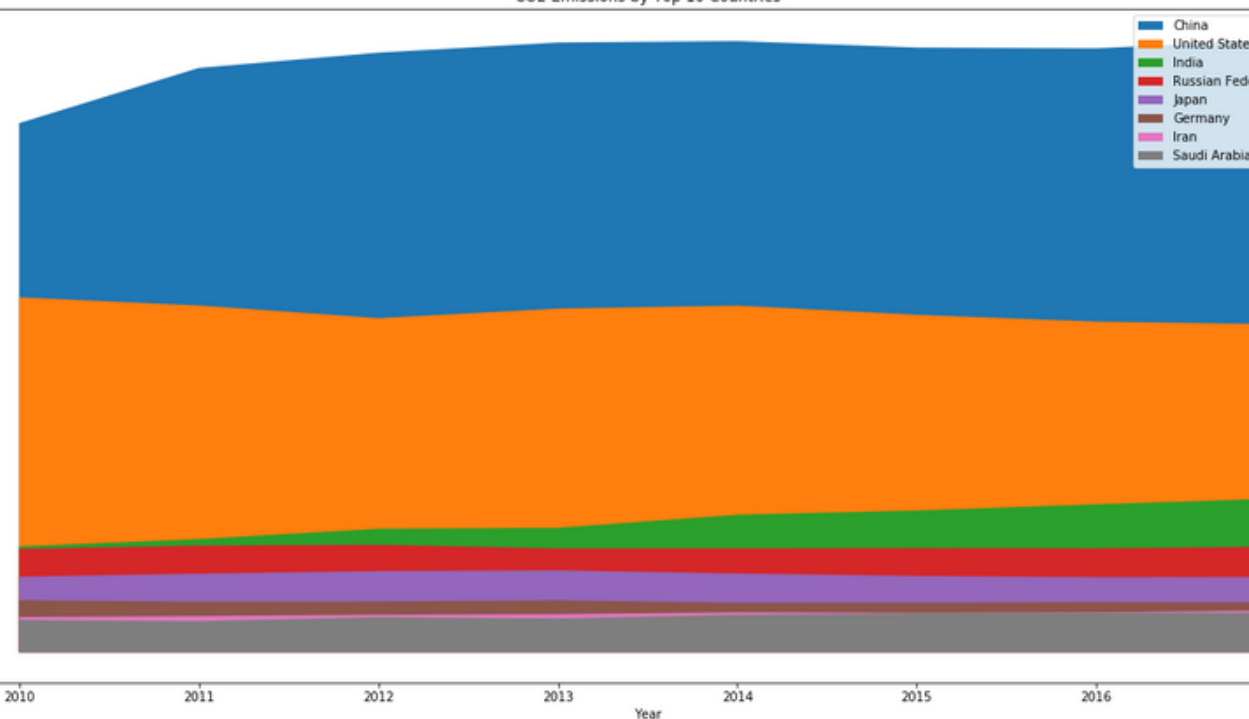


From growth rate perspective, there is no correlation between CO2 Emission and population.

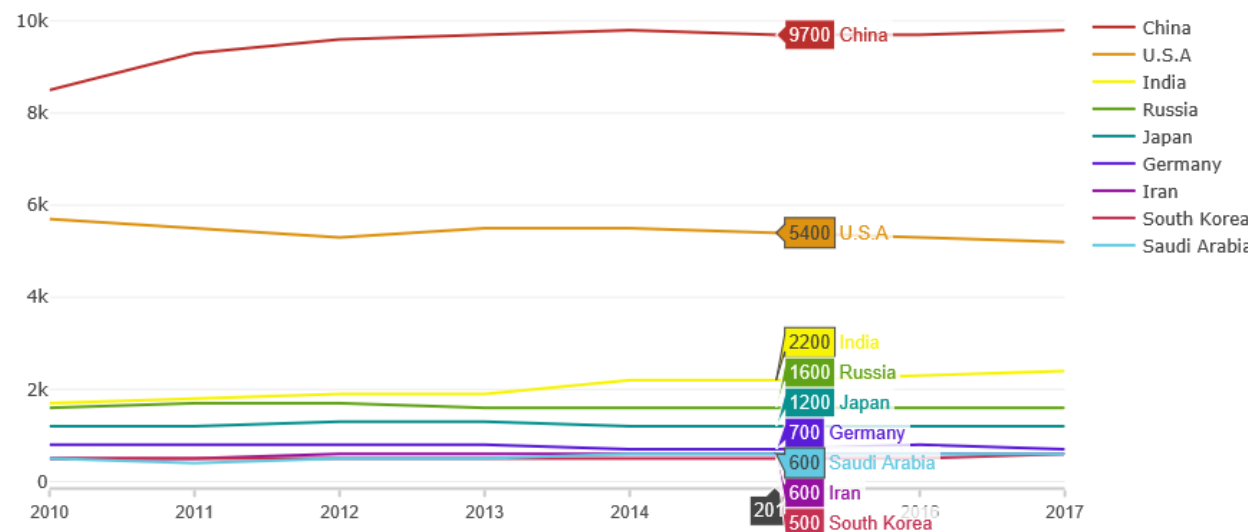
Since 2014, CO2 Emission growth rate has dropped even though GDP growth rate continues to increase.

Data Analysis: Air Pollution (CO2 Emissions)

CO2 Emissions by Top 10 Countries

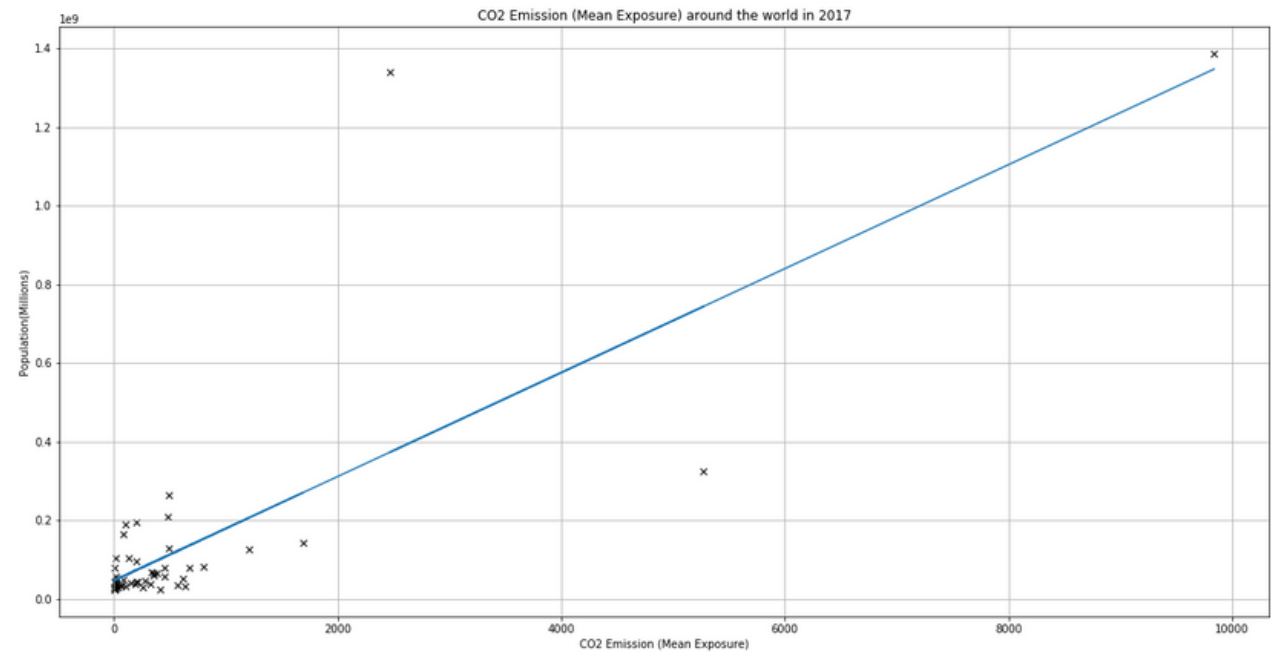


CO2 Emissions by Country



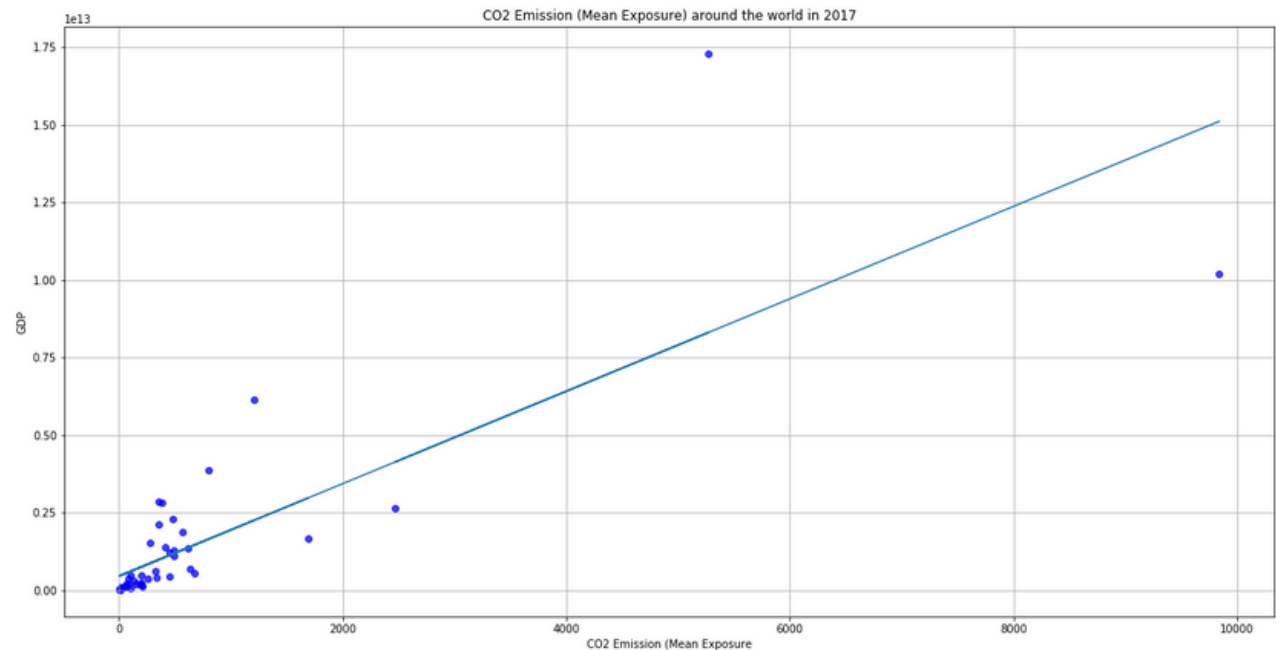
Data Analysis: Air Pollution (CO2 Emission) and Population

There is a positive correlation between population and CO2 Exposure in 2017 (0.79).



Data Analysis: Air Pollution (CO2 Emission) and GDP

There is a positive correlation between GDP and CO2 Exposure in 2017 (0.8).



Data Analysis: Correlations from 2011 to 2017

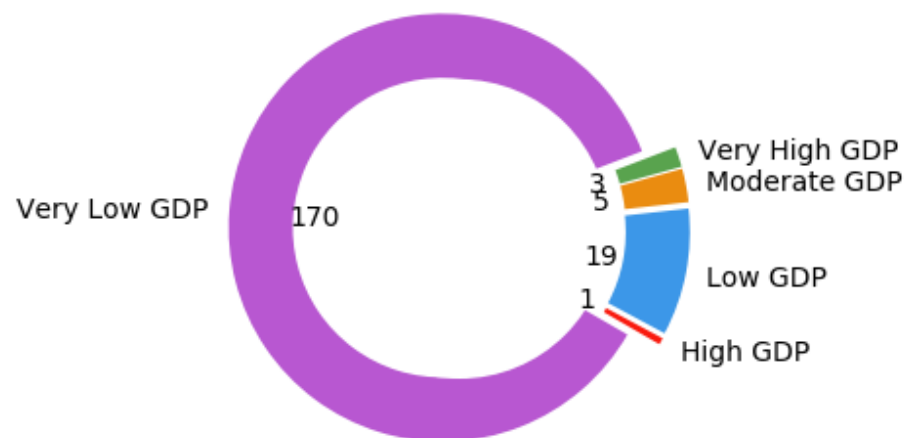
Correlation is an effect size and so we can verbally describe the strength of the correlation using the guide that suggests for the absolute value of r :

.00-.19 “very weak” .20-.39 “weak” .40-.59 “moderate” .60-.79 “strong” .80-1.0 “very strong”

Population vs CO2	2011	2012	2013	2014	2015	2016	2017
Strong	0.76	0.77	0.77	0.78	0.78	0.79	0.79
GDP vs CO2	2011	2012	2013	2014	2015	2016	2017
Strong - Very Strong	0.76	0.75	0.77	0.78	0.79	0.8	0.8

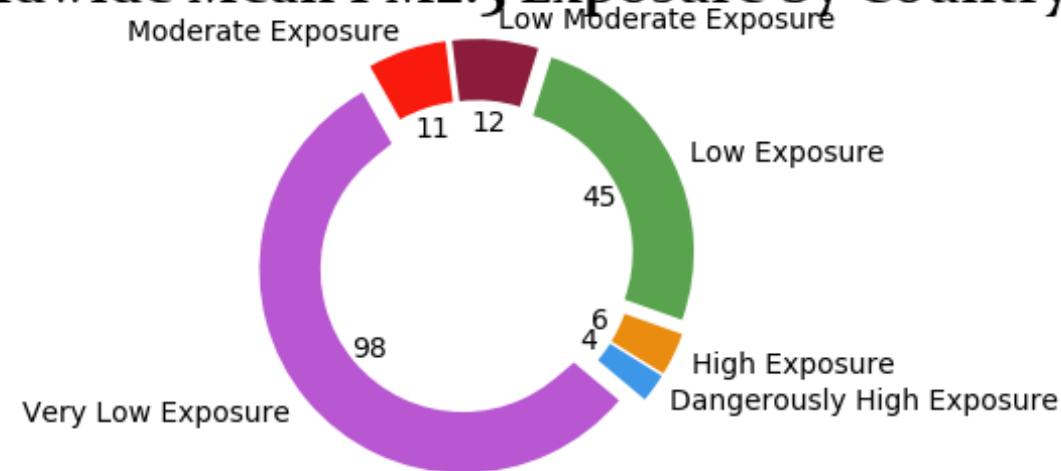
Distribution Summary Chart by Metric

Worldwide GDP Distribution by Country



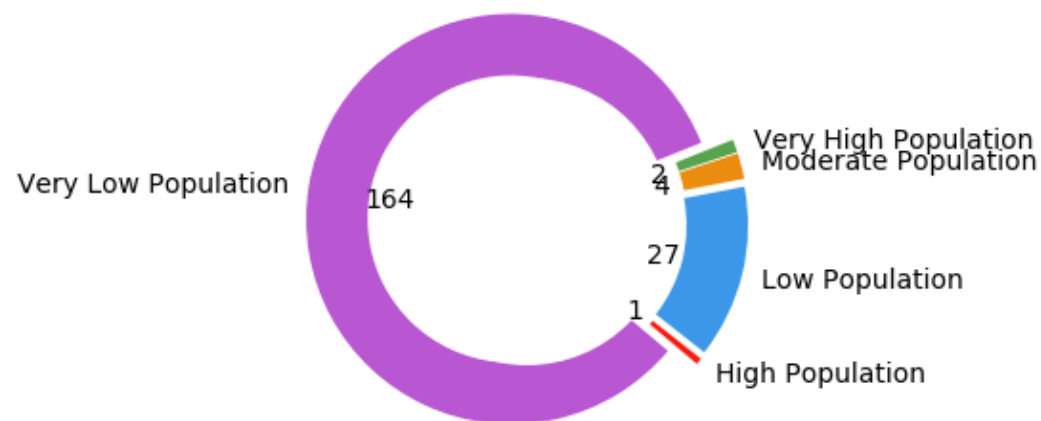
* Number of Countries per Zscore

Worldwide Mean PM2.5 Exposure by Country



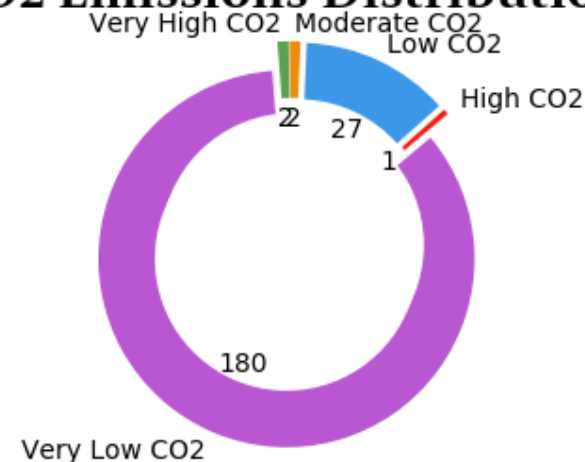
* Number of Countries per Zscore

Worldwide Population Distribution by Country



* Number of Countries per Zscore

Worldwide CO2 Emissions Distribution by Country

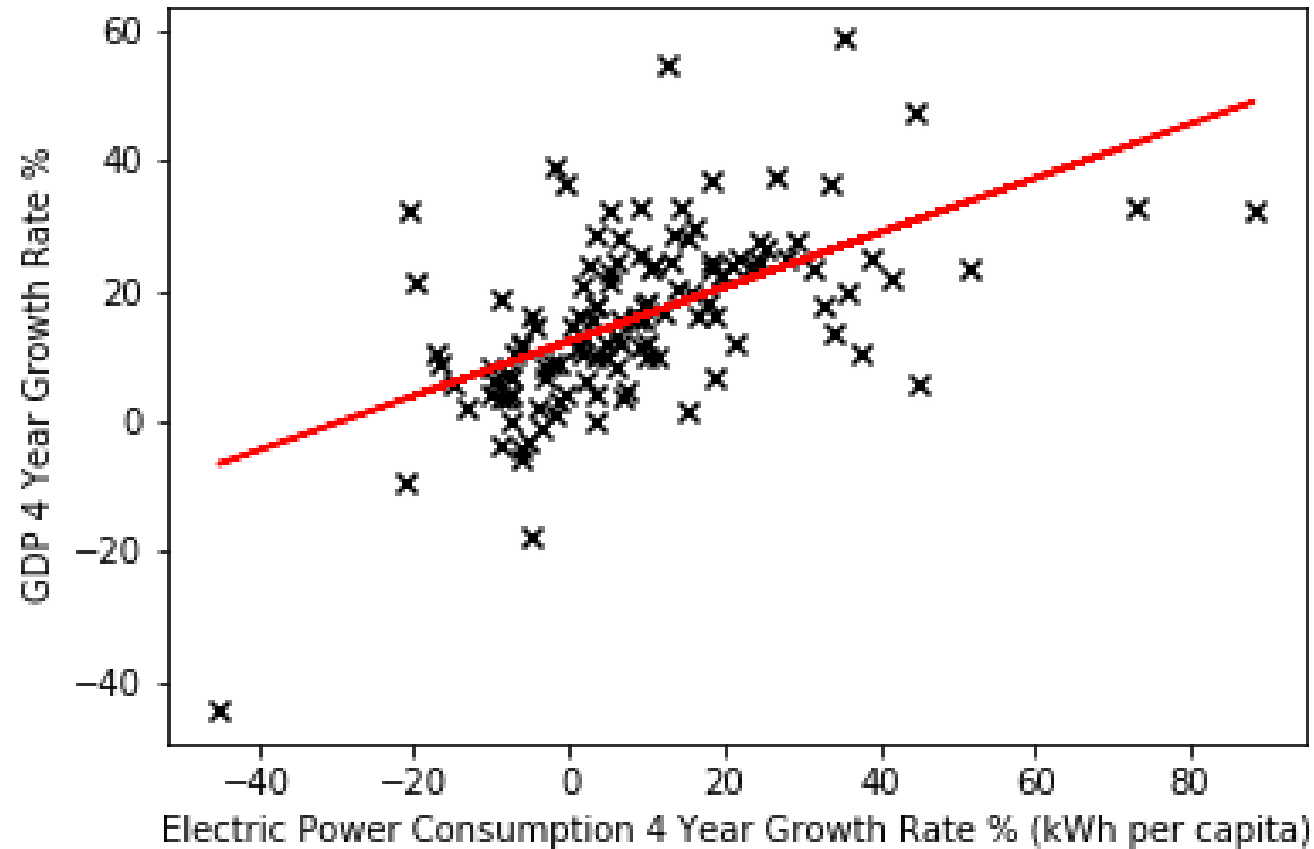


* Number of Countries per Zscore

Summary Chart of Results by Category

	Country Name	Total PM2.5 Bins	Population Bins	Total GDP Bins	CO2 Bins
21	United States		High Population	Very High GDP	Very High CO2
17	Saudi Arabia	Dangerously High Exposure		Low GDP	Low CO2
16	Qatar	Dangerously High Exposure			
8	India	Dangerously High Exposure	Very High Population	Moderate GDP	High CO2
12	Nepal	Dangerously High Exposure			
1	Bahrain	High Exposure			
2	Bangladesh	High Exposure	Low Population		
3	Cameroon	High Exposure			
9	Iraq	High Exposure	Low Population		
15	Pakistan	High Exposure	Moderate Population		Low CO2
13	Niger	High Exposure			
19	Tajikistan	Moderate Exposure			
18	Sudan	Moderate Exposure	Low Population		
14	Nigeria	Moderate Exposure	Moderate Population	Low GDP	
0	Afghanistan	Moderate Exposure			
20	Uganda	Moderate Exposure	Low Population		
7	Eritrea	Moderate Exposure			
6	Equatorial Guinea	Moderate Exposure			
5	China	Moderate Exposure	Very High Population	Very High GDP	Very High CO2
4	Chad	Moderate Exposure			
11	Libya	Moderate Exposure			
10	Kuwait	Moderate Exposure			

Additional Analysis: Digital Transformation



Conclusions

Growth Rate

There is no correlation between population growth and PM 2.5 exposure or GDP growth and PM 2.5 exposure. Same as the correlation for CO2 Emission

Population vs PM2.5

There is a weak positive correlation between population and PM 2.5 Exposure in 2017

GDP vs PM2.5

There is a very weak negative correlation between GDP and PM 2.5 exposure

Population vs CO2 Emission

There is a strong positive correlation between population and CO2 Emission in 2017

GDP vs CO2 Emission

There is a very strong positive correlation between GDP and CO2 Emission exposure

Digital Transformation

There is a positive correlation between GDP and energy consumption per capita.

Post Mortem

Sustainable Energy Practices

- New energy initiatives in performed by countries and what is the impact for air pollution.
- Under the Clean Air Act (CAA), EPA sets limits on certain air pollutants, including setting limits on how much can be in the air anywhere in the United States.

Digital Economics

- “The digital economy has grown 5.6% in the 11 years through 2016” - Bloomberg

Improvements in energy efficiency

Carbon Dioxide Emissions went down in the past 4 years even as the global economy grew. This was the result of growing renewable power generation, switches from coal to natural gas, improvements in energy efficiency.

API: Big Query (Google Cloud Platform)

Open AQ Big Data Query

Google Cloud Platform

BigQuery FEATURES & INFO

Query history

Recent queries

Query history

Queries

Scheduled queries

Engine

Resources + ADD DATA

Search for your tables and datasets

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Questions & Answers

