Time Series Analysis

Final Project Report

Project: Military Expenditure Forecasting

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Web app: https://hamudi.shinyapps.io/MilitaryExpForcasting/?_ga=2.199229542.910227673.1651358489-2069717747.1651358489

Code: https://github.iu.edu/hamudi/Time-Series-Project/blob/main/app.R

Abstract:

Over time, military expenditure is periodically increasing worldwide. In 2020 data, it has reached around $1981 billion USD, the highest number since 1988. Given the current geopolitical situation, most countries around the globe are planning to renew their military expenditure budget. Even Germany is committing 100 billion euros ($112.7 billion) to invest in its military services. In this project, we tried to predict the precise time-series model by exploring data on the dataset combined from SIPRI (Stockholm International Peace Research Institute), nuclear weapon, and CNTS (cross-National Time-Series) datasets. The topmost countries were evaluated over the period to see the pattern, and trend over the years. We used Facebook's Prophet time-series model for optimal forecasting. This model will predict the military expenditure of the top countries for to next five years.

Objectives:

The objective of our project is to perform a statistical analysis of the Military expenditure data worldwide. Subsequently focusing on individual country's expenditure and growth in the spending. We will explore the fastest-growing countries over the period. Further, identify the topmost countries based on the military spending, and contributing factors provided by multiple data sources. We are also interested in visualizing the correlation between the expenditure and these factors like the size of the military, nuclear weapon capacity, and more.

The main goal is to create a forecasting model with the help of this time-series data and predict National Defense Expenditure for the next five years. Further, we will create a web application of expenditure data where we can visualize and analyze the

statistics of the data. At the same time predict and forecast future levels of expenditure. The programming language we will use for this project is R and shiny app for website designing.

Dataset:

Sources:

SIPRI Military Expenditure Database by STOCKHOLM INTERNATIONAL PEACE RESEARCH INSTITUTE

Nuclear weapons data by Max Roser, Bastian Herre and Joe Hasell

Cross-National Time-Series Data Archive

All this data is collected for research and to provide a measure of the scale of resources absorbed by the military. For initial analysis, we are considering multiple data sources(links are provided) which can be joined by “Year” as an index column. We intend to create a final dataset with relevant features.

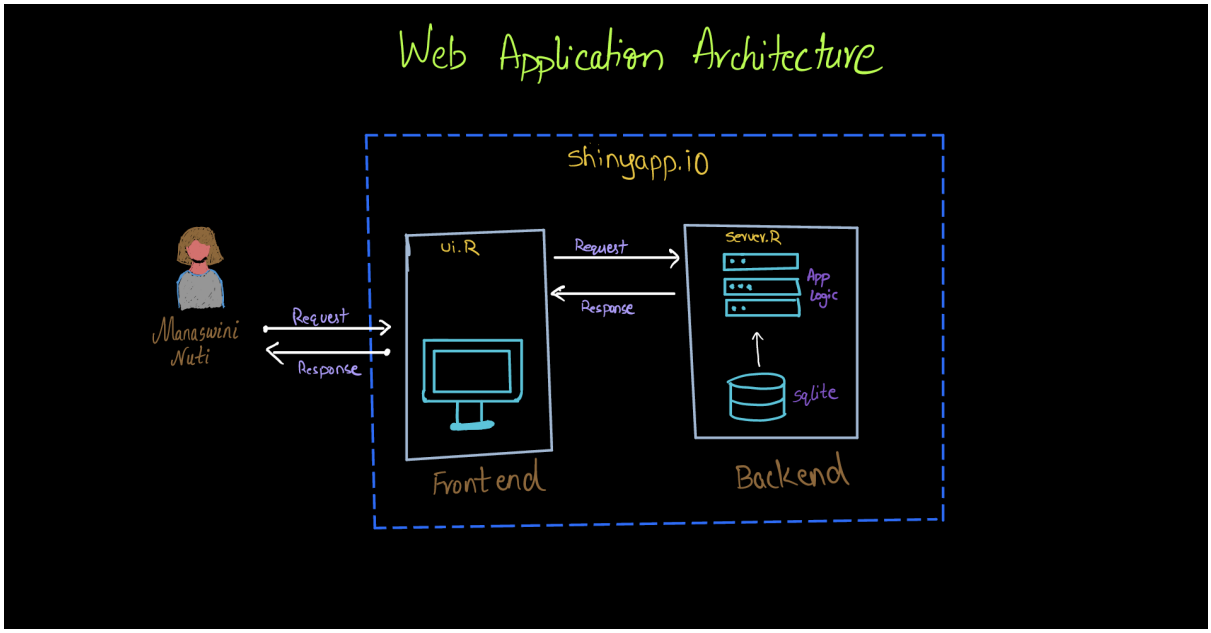
We are using the CNTS dataset as a base, which has around 18000 rows and 195 columns of data spread across 279 countries from 1919 to 2020. There are about 75 columns with NA values of more than 50%. This dataset needs a significant data cleaning starting from identifying and changing datatypes of each column, using relevant imputation methods for filling the null values.

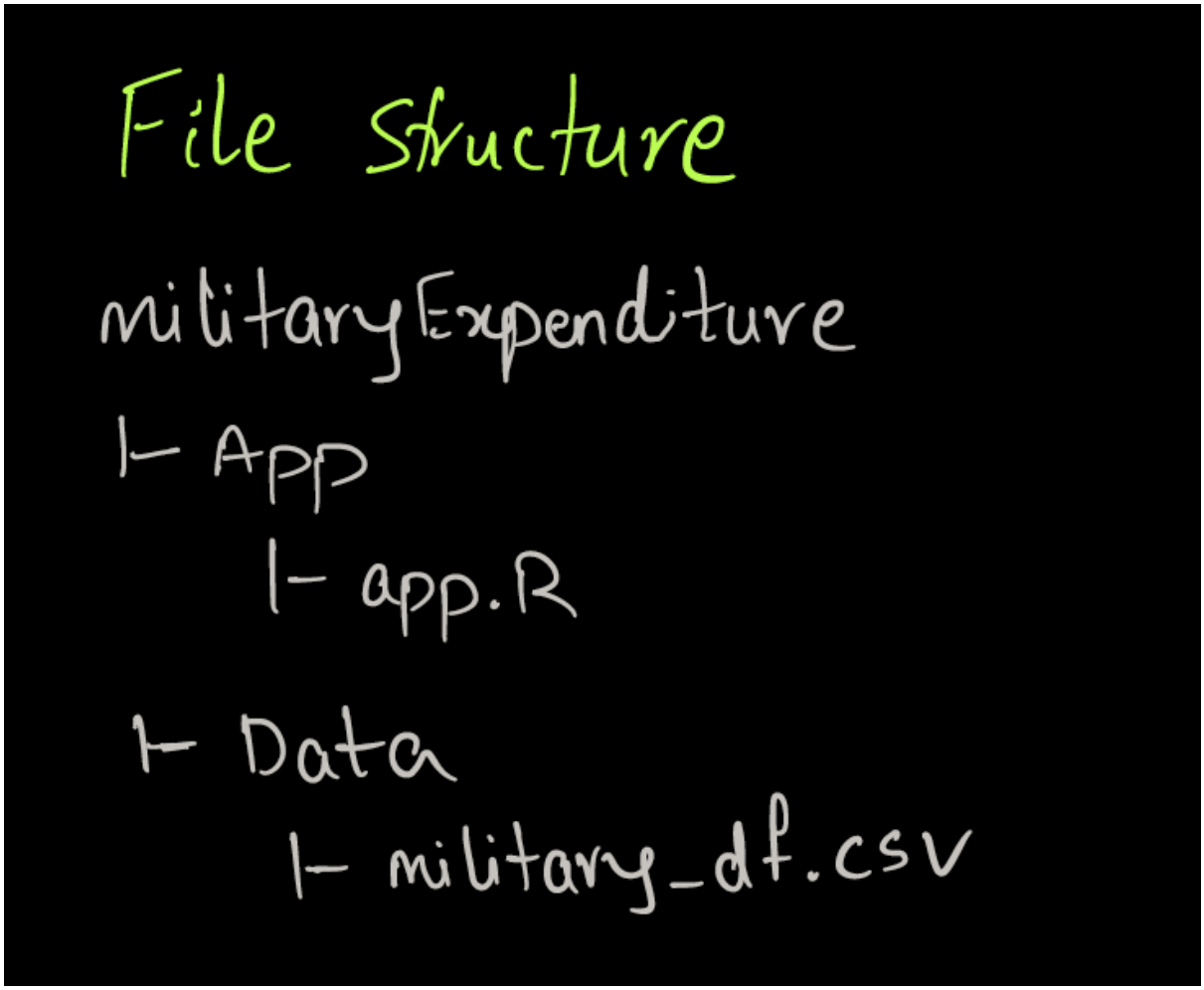
Description of functionalities:

Basic functions: Our web application will provide the following basic functionalities

- Analysis of military expenditure up to the year 2020.
- Provide visualization of military expenditure of the desired country.
- Users can also view the estimates of the expenditures for the next five years through our forecasting models.
- An input of a required year can be taken from the user to display the forecast of the particular year.
- A separate tab is provided to look at the nuclear weapon stockpile for each country over the years.

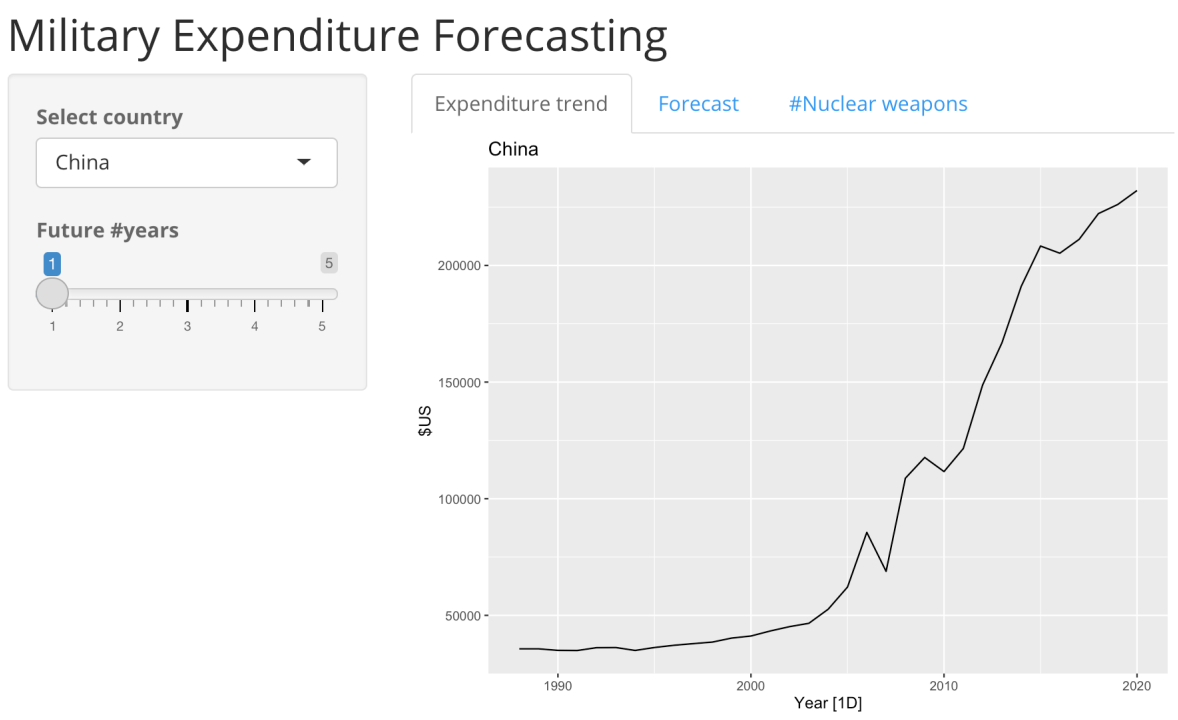
Web App Architecture


Web Application Architecture
Shinyapp.io
Manaswini Nuti
Request
Response
ui.R
Request
Response
Server.R
App Logic
sqlite
Frontend
Backend


File Structure
militaryExpenditure
|- App
|- app.R
|- Data
|- military_df.csv

- We are using shinyapp.io to deploy our project. Data is either stored in SQLite database which comes with a shiny app server or we will directly use the CSV file through flowing project file structure.
- For this application, we are entirely using R.
- Since we are deploying through the shiny app server, we are supposed to create an account to maintain/deploy applications on this server and therefore only we have the authority to change the app or data files.
- To start with, we used the shiny library to design the UI for this project as an initial front-end layout.
- Our application will be deployed on shiny-server.
- The shiny library provides functions for reactivity and we intend to make use of those functions to equip our app with interactivity.

Web App Layout



Military Expenditure Forecasting

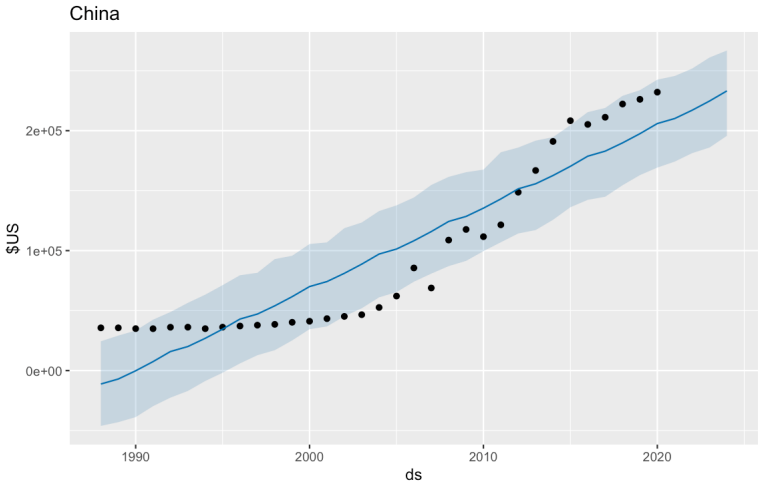
Select country

China

Future #years

1 2 3 4 5

Expenditure trend | Forecast | #Nuclear weapons



Military Expenditure Forecasting

Select country

China

Future #years

1 2 3 4 5

Expenditure trend | Forecast | #Nuclear weapons

Show 10 entries Search:

	Year	Entity	nuclear_weapons_stockpile	Code
1	1988-01-01	China	228	CHN
2	1989-01-01	China	230	CHN
3	1990-01-01	China	232	CHN
4	1991-01-01	China	234	CHN
5	1992-01-01	China	234	CHN
6	1993-01-01	China	234	CHN
7	1994-01-01	China	234	CHN
8	1995-01-01	China	234	CHN
9	1996-01-01	China	234	CHN
10	1997-01-01	China	232	CHN

Showing 1 to 10 of 33 entries Previous 1 2 3 4 Next

- This initial layout is a sidebar layout where the left side has the options to select the country and number of future years to forecast and to the right is where the plots are rendered.

- The menu panel has, as of now, 2 input options to select the country and to select the number of years to forecast and 2 output plots, one shows the expenditure plot of a country until 2020 and one shows the forecasted plot.
- We have decided on 3 tabs, one for expenditure plots over the years, one to display the forecast, and the last tab that shows the nuclear weapon stockpile over the year of the selected country.
- We chose light theme background for this application and bright color for inputs and outputs. This is available in shinytheme() as a ‘spacelab’ theme.

Team Work

- Each team member has split an equal number of countries to try different suitable forecasting methods and data analysis for each country’s expenditures.
- For the app development,
  - Manaswini - web app frontend, and UI
  - Hari - web app backend, and app logic
- Overall, the project work is split equally(50% by Hari and 50% by Manaswini)