HAMOYE

Towards smarter healthcare infrastructure: The AI perspective

Team DataCrafters

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Our team

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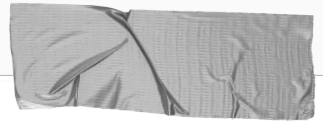


Timilehin Fawale	Presentation, Model deployment
Winner Obayomi	Data Storytelling
Yusuf Hamisu	EDA and Model Building
Tshifhumulo Mapasa	Data storytelling
Caleb Fianku Quao	Data Cleaning
Jane Imoke	Building and evaluating predictive models, presentation
Yusuf Okunlola	Model building and evaluation, Model deployment
Eniola Adetunji	Exploratory Data Analysis

Problem statement

This project focuses on the healthcare Infrastructure.
The IDB Invest forum (a member of the Inter-American development bank group) reported that:

“One of the most basic problems in the health system is that the physical infrastructure is ageing and poorly maintained. The IDB estimates the need for investment in this area at around $100 billion—both to replace old hospitals, clinics and medical equipment and to upgrade infrastructure to meet today’s energy efficiency standards”

The goal of this project therefore is to;
Analyse the data to identify patterns in the distribution of healthcare facilities and anticipate (predict) potential future changes, such as growth or decline.

The objective is to facilitate informed decision-making when it comes to healthcare infrastructure development.

Dataset

The initial dataset contains 283 rows and 8 columns listed below:

Country: Name of the countries

Year : Year which the data was recorded, which is 2010, 2013 and 2014

Total Density per 100,000 population for the following features:

*** Health posts * Health centers * District/rural hospitals * Provincial Hospitals**
*** Specialized hospitals * Hospitals**

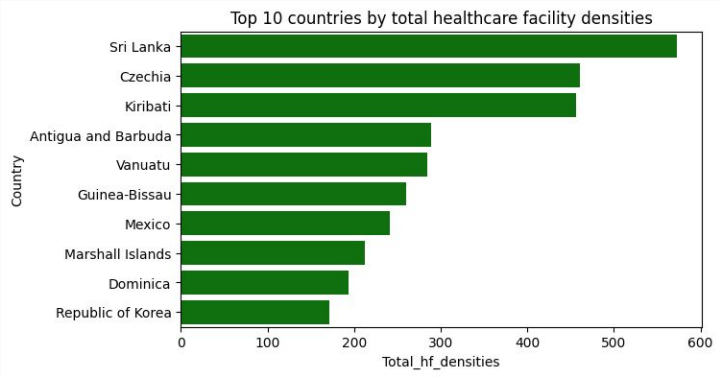
More dataset was also sourced from Kaggle as they will affect healthcare in a country. The features include:
* GDP * Population *Health Expenditure
* GDP Per capita *Population Density

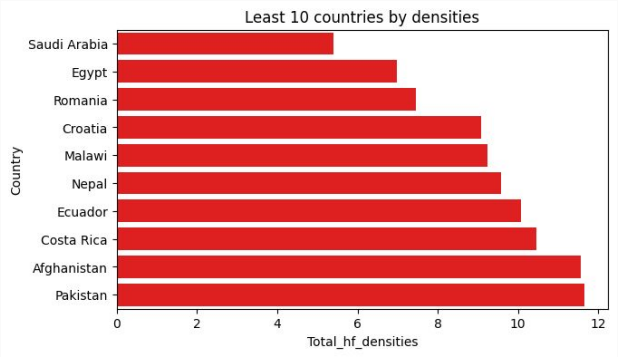
Data Cleaning

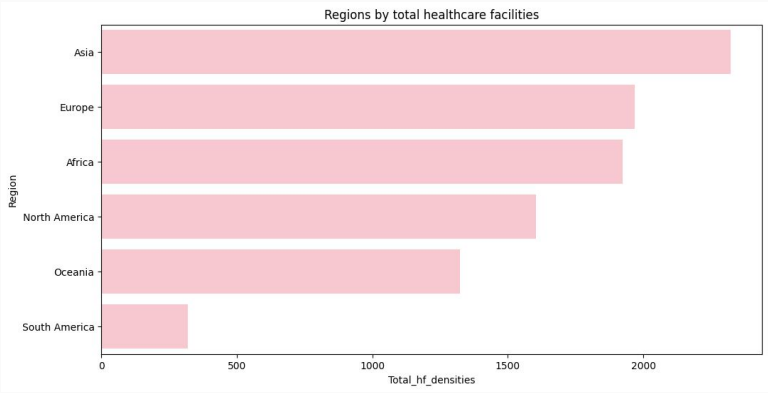
- *Missing values were present in the dataset and filled using mean values*
- *Renaming of column names*
- *The 2 datasets were merged using the Country and Year features*

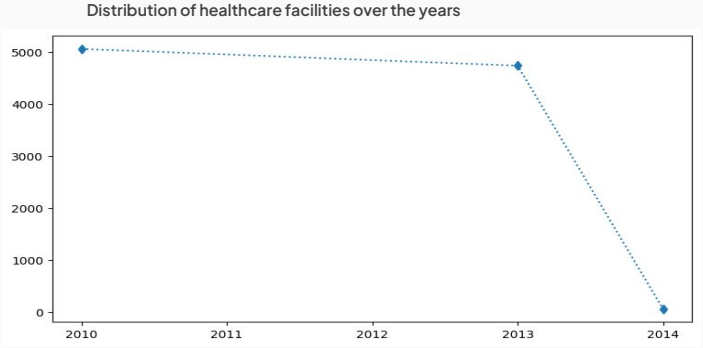
Data exploration

Total number of countries: 144









Data exploration

- The top 10 countries by total healthcare facilities are : Sri Lanka, Czechia,Kiribati, Antigua and Barbuda,Vanuatu, Guinea-Bissau,Mexico,Marshall Islands, Dominica and Republic of Korea.
- The least 10 countries by total healthcare facilities are Saudi Arabia (the very least), Egypt, Romania, Croatia,Malawi, Nepal, Ecuador, Costa Rica,Afghanistan and Pakistan

Mostly Middle-east and African countries (they should be highly considered during Infrastructure planning)

- There's been a global decrease in healthcare facilities from 2010 to 2014. There was a slight decrease from 2010 to 2013 and a significant decrease towards 2014
- The top and least 20 countries by density of each of the healthcare facilities was analysed and It was discovered that Antigua & Barbuda and Guinea-Bissau have the highest specialised hospitals while Marshall Islands and China have the least
- Guinea-Bissau and Democratic People's republic of Korea have the highest district or rural hospitals while Barbados and Saint Vincent of the Grenadines have the least
- Kiribati and Marshall Islands have the highest health centres while Ethiopia and Micronesia have the least
- Sri Lanka and Czechia have the highest health posts while Zimbabwe and Saint Kitts & Nevis have the least
- Monaco and Nauru have the highest Provincial hospitals while Kiribati and Fiji have the least

Model approach

On cleaning the data, the categorical features were transformed using mapping and label encoder.

The explanatory variable (X) and response variable (y) were specified from the dataset and thereafter standardized using a Standard scaler and the data was split into a training set (80%) and test set (20%) .

5 regression algorithms (Linear Regression, Support Vector Regression, Lasso regression, Ridge regression, Random Forest Regression) were fitted on the data set and the evaluation was done using Root Mean Squared Error , Mean Absolute Error and R2 score

The Linear Regression model was used to develop a Streamlit-based web app for predicting health facility densities.

It is available on https://healthfacilities.streamlit.app/

Model performance

	Model	MAE Score	RMSE Score	R2 Score
0	LinearR	0.0000	0.0000	1.0000
1	SVR	21.3414	45.4397	0.0732
2	LassoR	3.5036	17.4394	0.8635
3	RidgeR	0.3348	1.5728	0.9989
4	RandomForest	8.0325	28.5592	0.6339

Model evaluation using 14 explanatory variables

	Model	MAE Score	RMSE Score	R2 Score
0	LinearR	23.9794	46.1494	0.0440
1	SVR	23.9037	48.0434	-0.0361
2	LassoR	24.7955	46.4308	0.0323
3	RidgeR	24.2745	46.2685	0.0390
4	RandomForest	26.3094	53.3980	-0.2799

Model evaluation using 7 explanatory variables

Summary & Recommendations

FURTHER INSIGHTS

- China has the highest population and GDP but but is the second country with least specialised hospitals
- Provincial hospitals is positively correlated with physician per thousand
- Armenia, Yemen, Azerbaijan, Afghanistan ,Iran, e.t.c. have the highest density of out of pocket health expenditure.
- China , Indonesia, Pakistan, Bangladesh, Mexico, Ethiopia, e.t.c have the highest Urban population

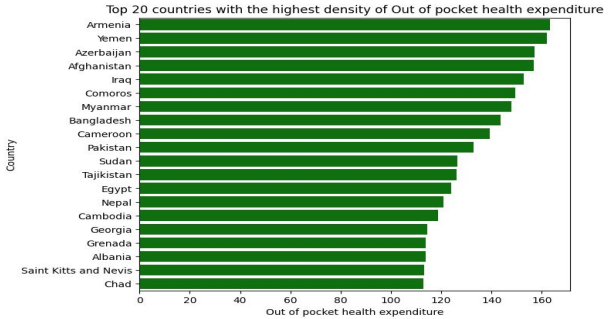
RECOMMENDATIONS

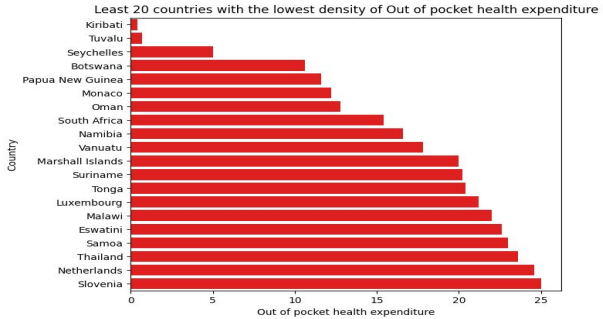
- Given China's high population and GDP, the relatively low number of specialized hospitals is a noteworthy observation. It's recommended for China to invest in expanding its specialized healthcare services to meet the healthcare needs of its large population. This can improve healthcare quality and reduce the need for patients to seek specialized care abroad.

- The positive correlation between provincial hospitals and physicians per thousand suggests that increasing the number of provincial hospitals can help in attracting and retaining healthcare professionals. It is recommended for countries with low physician density to consider establishing or expanding provincial hospitals to enhance access to healthcare services.

Summary & Recommendations

- Countries like the Armenia, Yemen, Azerbaijan, Afghanistan, and Iran with high densities of out-of-pocket health expenditure may need to consider healthcare financing reforms. They should explore options to reduce the financial burden on individuals and households, such as implementing health insurance systems, increasing government funding for healthcare, or regulating healthcare costs to make it more affordable for the population.
- Countries with high urban populations, such as China, Indonesia, Pakistan, Bangladesh, and Mexico, should focus on developing healthcare infrastructure to meet the specific healthcare needs of urban areas. This includes building healthcare facilities in densely populated urban areas, improving transportation for easy access to healthcare, and addressing the unique health challenges that urban populations often face





Thank You!