Standard of living around the world varies greatly: A data visualization report

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***Abstract*—The standard of living around the world is a vital factor to recognise, as it is a subject that accounts for widespread interest due to its relevancy for every country. This paper examines the principal characteristics of how the standard of living varies in correlation to the state of global development indicators, based on evidence highlighted through data visualisation and design. The aim of this study is therefore to evaluate and visualise essential development indicators for living in relation to population growth, gross domestic product (GDP), mortality rate, education, death- and birth-rate, as well as the average life expectancy between genders. The results showcases that its primarily countries within the African region which proposes highest population growth throughout the years, while there is no clear indication what specific region has the lowest population growth in the years past. The global GDP for 2020 was appalling primarily due to the COVID-19 pandemic that proposed consequences for the worldwide economy and the death rate in certain countries such as India, while the world overcame the pandemic in the years after. Namibia has the highest literacy which likely correlates to the government's expenditure on education. Furthermore, the results proposes that females generally have a higher life expectancy in contrast to males in the vast majority of countries, while it indicated a higher mortality rate was present for males in contrast to females.**

***Index Terms*—Data visualization, Data science, Dataset, World Development Indicators**

I. Background and Motivation

In the realm of data science, the art of transforming raw information into meaningful insights is illustrated by the craft of data visualization. This project, centered around the World Development Indicator dataset, presents an exciting opportunity to delve into the fusion of data visualisation techniques, to explore the global development trends in the last decade. The World Development Indicator dataset, is a comprehensive compilation of indicators spanning over various aspects of global development, which serves as a rich canvas for the application of data visualisation methodologies. The impact of visualisations in making complex information accessible and engaging is quite appreciable because of the nature of the project.

The World Development Indicator dataset is captivating due to its potential to unveil patterns and trends shaping global development. Rooted in prior coursework and research interests, the curiosity about socio-economic dynamics and international relations naturally led to this dataset as an avenue for deeper exploration. Additionally, the allure of the World Development Indicator dataset also lies in its potential to unveil the dynamics of global development. This project represents an opportunity to bridge the academic passions with practical data exploration and also serves as a mean to explore and visualise the multifaceted dynamics of the world. The visualisations achieved from this project will give meaningful insights into different standards of living and how different indicators affect these properties across the world spanning over a decade.

Data visualisation, as a field, plays a pivotal role in refining complex datasets into actionable insights. In the context of global development, where multiple indicators shape the understanding of progress and challenges, the ability to visually communicate these insights becomes paramount in driving informed decision-making. Through compelling visualisations, complex data points can be refined into accessible narratives, promoting an in-depth understanding of the challenges and opportunities that defined the interconnected world. This project seamlessly aligns with the objectives of the project, providing a practical application of the techniques and tools acquired to present the world development indicators into meaningful visuals. Throughout this project, it was aspired to unravel the intricate stories hidden within the data, contributing to a broader knowledge of global development and standard of living through visual exploration.

II. Project Objectives

The living standards vary a lot around the world, therefore this project will both focus and investigate the different living standards around the world. Multiple variables are studied where the aim is to visualise the studied data in a meaningful

manner. The project would give a better understanding of how data can be processed and visualised with different types and tools, in order to achieve the most efficient and meaningful way of presenting the data. Furthermore, the project would accomplish to visualise and compare the living standards in different countries with the use of global development indicators, while achieving a better understanding of data visualisation. The point of interest is to compare the standard of living in different countries in correlation with the state of global development indicators. Additionally, the hypothesis to be examined is *"the standard of living around the world varies greatly"*. The research questions were defined to investigate the hypothesis and are as following:

A. Research questions

1) How has the global population growth progressed throughout the years?
2) Has the GDP of all countries grown positively within the last decade?
3) How large of a proportion of the country's GDP is spent on education?
4) How has the death- and birth rate of different countries progressed over the years?
5) What gender has the highest life expectancy generally in the years past?

The different visualisations would answer the stated research questions, while addressing the different variations of the global development indicators.

III. Data

After the project initialization where the problem and its research questions were defined, a suitable dataset was to be found. The selected dataset should then be processed, where the missing values should be cleaned and removed from the data. The different visualisations can be developed from the processed data to accommodate the questions proposed. Before finding the dataset, considerations was made to ensure that the selected data is sufficient and if there is enough velocity to work with. Some of the requirements were that the dataset must at least have ten columns and not select a extensive large dataset. The selected dataset should also have metadata or a corresponding codebook that would describe the variables accordingly. Times series data would be most sufficient to visualize how the data changes over time.

A. Data from The world bank

The selected dataset was from the website called *"The World Bank"* where the chosen dataset was called *"World Development Indicators"*, which contained the needed variables over time of different countries. The website provides multiple indicators of the global development variables, where the databank makes it possible to define and select the necessary properties and variables needed for the user's interest. This means that users can create and fetch unique datasets based on defined requirements [1]. When defining the needed variables of the dataset, multiple databases can be selected. Afterwards the countries can be selected, where unique data properties can be chosen. At last a suitable time frame can provided, whereas the dataset can be downloaded in either an Excel or CSV format respectively. Table I states all the relevant variables that were utilized for the visualizations.

TABLE I: Data series utilized from the world development indicators dataset.

Series	**Definition**
Population growth (annual %)	Defines how the population for a country has grown for a specific year.
Population, female	Total amount of females in a county for a specific year.
Population, female (% of total population)	Defines the percentage of females of the whole population in a specific country and year.
Population, male	Total amount of males in a country for a specific year.
Population, male (% of total population)	Defines the percentage of males of the whole population in a specific country and year.
Population, total	Defines the total amount of people for a specific country and year.
Death rate, crude (per 1,000 people)	This defines how many people die per 1.000 people.
Birth rate, crude (per 1,000 people)	This defines how many people is born per 1.000 people.
Life expectancy at birth, total (years)	Defines the expected number of years that a person can live for a specific country when born.
Life expectancy at birth, male (years)	Defines the expected number of years that a male can live for a specific country when born.
Life expectancy at birth, female (years)	Defines the expected number of years that a female can live for a specific country when born.
Government expenditure on education, total (% of GDP)	This defines percentage of the total GDP is utilized for education.
GDP growth (annual %)	This defines the annual growth of the GDP for a specific year and country with a percentage.
Mortality from CVD, cancer, diabetes or CRD between exact ages 30 and 70, males (%)	This defines the percentage of 30 year old males to die before their 70th birthday from e.g., cardiovascular disease, cancer, diabetes, or chronic respiratory disease.
Mortality from CVD, cancer, diabetes or CRD between exact ages 30 and 70 for, females (%)	This defines the percentage of 30 year old females to die before their 70th birthday from e.g., cardiovascular disease, cancer, diabetes, or chronic respiratory disease.

B. Data clean up

During the data extraction, different data methods were used in RStudio for both processing and cleaning the data. The dataset had missing values for some of the countries and some of the values within the rows were formatted incorrectly. The filter method in RStudio was utilized for filtering the data in order to select the relevant series. Furthermore, the mutate function was utilised to either change the values or the type of values to accommodate the requirements of the visualisations.

IV. VISUALIZATION

Within the following section, ideas for visualisation designs and corresponding approaches, as well as considerations is to be argued thoroughly. Design explanations and justifications for the choices of visual encodings are to be provided accordingly. Additionally, clarifications of features currently used within the project is to be mentioned; however, reasoning for future beneficial and optional utilities are also to be defined as future work.

A. Ideas for visualization design

When proposing ideas for good visualisation designs, it was important that the data were to be accessible in a useful manner, while enabling proper insights to communicate accordingly. It was essential that graphics were to be utilised such as figures, as a mean to grasp the proposed information more efficiently and structurally. The knowledge of perception and cognition were to be applied, while the utilisation of a colorblind-friendly palette was ensured. This meant the choice of colors, the relationships and how the attention were drawn for the viewer was asserted and preserved during the data visualisation. The appropriate dataset applied were of structured nature with already known data types, whereas a general meaning and context behind the data was provided initially. Although the dataset constitutes both of variables and observations, it consolidated of numerical and categorical variable types, whereas numerical data was of continuous nature. It was essential that concepts within data visualisation were inherited for the design, where marks and channels were applicable for each feature, both to represent elements and to change the appearance dynamically. Additionally, the type of channels to be used were crucial as they were between identity and magnitude channels, each supporting a degree of effectiveness and expressiveness. This aggregates for two types of approaches followed for project and the underlying visualisation design, static and animated graphs, each following their own subsequent considerations.

B. Approaches and considerations

When considering the approach to be followed for the visualisation, different routes could be partaken; however, the main objective were to contemplate what types of graphs to be used and how. When differentiating the types, it was primarily between univariate, bivariate and multivariate graphs as well as time-dependent graphs and maps. All of these aspects had to be examined before usage within the project, whereas corresponding visualisation packages had to be assessed for both static and animated graphs respectively.

1) R and Rstudio: To benefit the visualisation, the integrated development environment (IDE) RStudio was utilised as the main framework for the development of both the initial fixed graphs and for the subsequent dynamic graphs as part of the final dashboard. RStudio provides a suite of tools already pre-installed with the utility; however, it also enables external features to be incorporated if required. When using RStudio, it was a prerequisite to make use of the programming language R for statistical computing. It provides a suite of different statistical and graphical benefits. The environment supplies with essential qualities for efficient dataset manipulation, through calculations, and graphical presentations. R's strengths enabled ease of use to accommodate the project development; however, the underlying visualisation packages used were equally as important and is to be examined [2].

2) Package: ggplot: Initially static graphs were developed by installing the external package defined as a *ggplot2*, which was a package to declaratively develop suitable graphics for visualisation purposes. As the developer needs statistical charts, the developer provides the dataset to be analyzed, and inform the tool to map the variables with relationships. Additionally, details were to be provided by the tool itself. The amount of extensions provided by the package enables great ease of use and the ability to construct stylish plots [3].

3) Package: gganimate: To append upon the addition of *ggplot2* in the project, the extension of *gganimate* was practiced upon. Besides inheriting the advances of static plots from *ggplot2*, it includes the capabilities of animations. It contributes with the ability to use a set of new classes to adapt the static plots to change across time. The usage of *gganimate* corresponds relatively to *ggplotly*, which meant both packages were applicable for dynamic graphs [4].

4) Package: ggplotly: The use of *ggplotly* as an R package applies similar functionality as *gganimate*, which corresponds to converting static graphs into interactive charts. Besides utilizing both packages for the visualisation design, Plotly provided a useful library for adapting plots to be dynamic easily [5].

5) Package: Shiny: To consolidate the use of both static and animated graphs together with a coherent story for the established problem and research questions, the R package Shiny was used to construct an interactive web dashboard in an easy manner. Shiny enabled the visualisation design to be placed in one application, enabling public access to the environment through hosting and deployment with *Shinyapp.io* [6].

C. Features

The dataset that will be used for this project is a dataset of structured data. The dataset contains of both numerical and categorical data, and appropriate types of graphs are needed to visualise the data. For purpose of visualising the numerical and categorical data, the following types of graphs has been necessary in this project:

1) Line chart: Line charts visualises data as a series of data points which are connected by straight lines. Such charts can thereby present the correlation between the different data points. Furthermore, they can display the trend of data over time intervals. The dataset utilised for the project contains data over several years, therefore it will be fitting to make use of line charts to visualise how the data changes.

2) Bar chart: Bar charts are used to represent categorical data and since the dataset contains different countries, it is a great way to visualise the countries proportional to their

coherent values. In this way comparisons can be made of the different countries and their representing values.

3) Grouped bar chart: Grouped bar charts are used to present the comparisons of selected variables and since the dataset contains different population data series, it is a suitable chart to utilise. The benefits are in correlation to showing comparisons over the years with timeliness.

4) Scatter plot: Scatter plots visualises two-dimensional data by using data points. The points present values of two different variables and shows relation between the two variables. Scatter plots gives an overview of the distribution of the data and a trend can be discovered by the correlation.

5) Map chart: Map charts utilises a geographical map to visualise information related to individual geographic locations. Elements such as colors or shades are used on the locations to display the data and thereby the different locations can be compared, and relationships can be found. The dataset utilised for the project contains data of all the countries around the world, and it would therefore be suitable to utilise map charts to have a visual representation of the data over all the countries.

D. Future work

Artificial Intelligence (AI) is rapidly evolving and generative AI it has become a transformative tool in areas such as coding. It is therefore a trending topic on how to best utilise the capabilities of generative AI. It would therefore be interesting to investigate how it could be utilised within data visualisation. Currently a lot of different generative AI tools exists that makes use of Generative Pretrained Transformers (GPTs) and VizGPT is one amongst those tools. VizGPT has the ability to turn complex data into visual elements such as graphs, chart and maps [7]. It requires a dataset, and through prompting it can generate suitable visualisations. This does however require a bit of training to get the best output. AI has the ability to revolutionise the way humans work, and it should therefore not be overlooked. It would therefore be interesting to make use of such tools in this project and look into how it can be utilised for data visualisation.

V. Results

In the project initialisation, the project objectives were defined, and the research questions were made. These research questions would then be answered through a dashboard where different visualisations were developed in Rstudio. These visualisations within the dashboard should tell a coherent story when going through the visualisations. In the subsections below, every stated research question will be answered thoroughly with the completed visualisation while accommodating how it could be improved.

A. How has the global population growth progressed throughout the years?

The above stated question was analysed where the datasets series were taken into account to examine how it could bring value to the question. The examined and chosen data series for this question was the *"Population growth (annual %)"*. This data series was filtered and mutated for the purpose of getting the top 20 countries with the highest population growth and the top 20 countries lowest population growth. A bar chart is most suitable for visualising the population growth while having a blue color gradient that emphasises the visual representation of the highest population growth. To deduct how the global population growth has progressed throughout the years, the first aspect to be analysed is the countries with the highest population growth. To analyse this, a slider has been attached to ensure the capability to go back in time. When doing so, it is primarily countries within the African region that propose the highest population growth over the years. Caution must be exercised, as it only shows the top 20 countries with the highest population growth when specifying a certain year. As seen in figure 1, the top 20 countries with the highest population growth in 2022 is showcased.

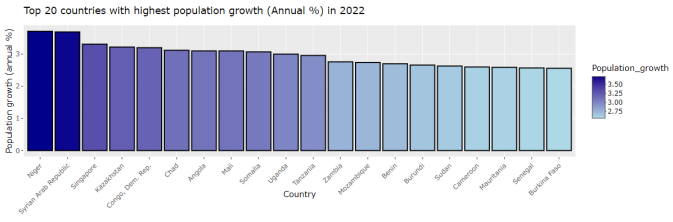

Fig. 1: Bar chart: Top 20 highest population growth

The countries Niger and the Syrian Arab Republic have the highest population growth which also has the darkest colour. Furthermore, the bar chart is interactive which means the user can hover over each country in order to see the specific annual percentage. The last bar chart would visualise the top 20 countries with the lowest population growth. To clarify how the global population growth has progressed throughout the years, the second aspect to be analysed is the countries with the lowest population growth. To analyse this, a slider has been attached to ensure the capability to go back in time as well. Remarkably due to the Russian/Ukrainian war in Europe, Ukraine had around -14.1% decrease in population growth which is above the double of what Bulgaria had of -6.19% as seen in figure 2. There is no clear indication of what region currently have the most decrease in population growth over the years. There are some outliers within certain years that goes again e.g., Marshall Islands, Libya, and Lebanon.

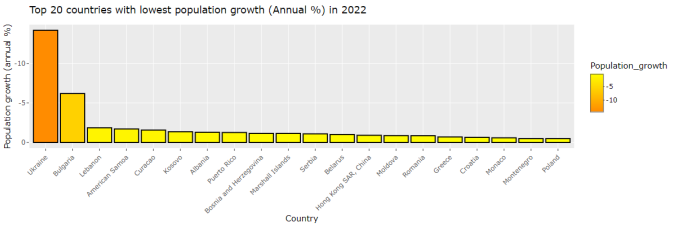

Fig. 2: Bar chart: Top 20 lowest population growth

Overall, these interactive bar charts visually present the top 20 highest and lowest population growth where the slider can be utilised to examine the growth over the years. Furthermore, the tooltip content is showcased when the user hovers over the bar chart,which would display the specific percentage of the growth. For future improvements, there could be created a drop-down selection menu, below the input slider, where the user could select specific countries based on the user's interest. To conclude both bar charts visually presented how the global population growth has progressed over the years, where the top 20 countries with the lowest and highest population were visualised.

B. Has the GDP of all countries grown positively within the last decade?

To investigate the GDP growth of all the world's countries, the annual GDP growth data series was utilised. The dataset contains data of countries' GDP growth percentage from year 2010 to 2022. A map chart has been chosen to visualise the annual GDP growth, since the data is for each country of the world. Therefore, a map chart would be optimal to both get an overview of the whole world but also to compare the GDP growth of individual countries. The chart is a geographical map of the world where a colour range from blue to orange has been utilised on the countries to represent their GDP growth. The map chart of the GDP growth rate of all the countries in 2010 can be seen on figure 3.

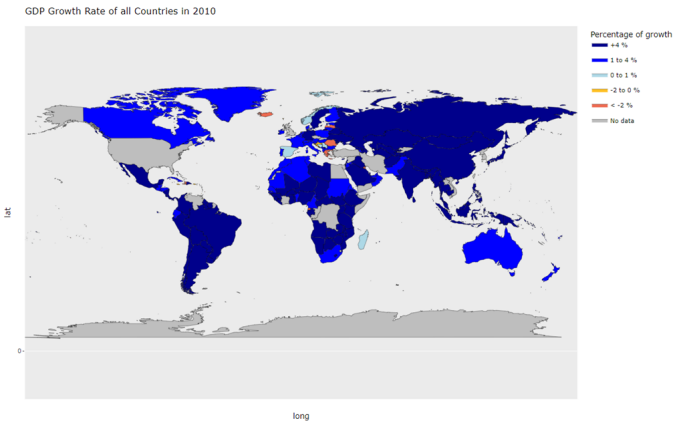

Fig. 3: Map chart: GDP growth rate in 2010

The orange colours shows a negative a growth, which means the growth percentages are below zero. The blue colours shows a positive growth which are percentages above zero. The grey colours are countries with no available data. In 2010 the majority of the countries in the world had a positive GDP growth and only a few had a negative growth. Utilising the slider and going through years it can be seen that most of the countries had a positive growth hence the wide range of blue colours on the map; however, 2020 stands out notably. In 2020 majority of the countries had a negative growth and remarkably less countries had a positive growth. The map chart of the GDP growth rate for all the countries in 2020 can be seen in figure 4.

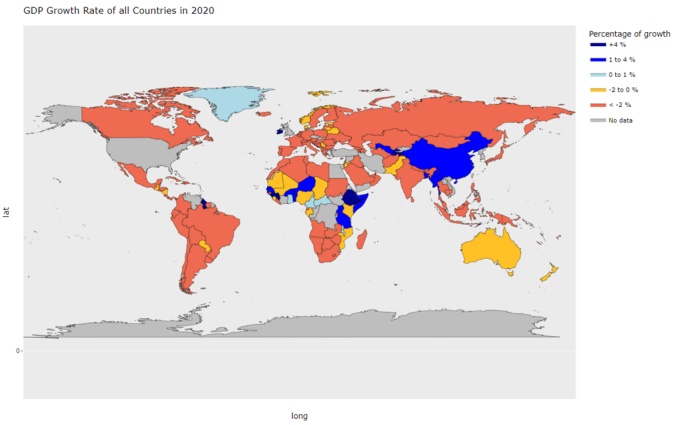

Fig. 4: Map chart: GDP growth rate in 2020

The orange colours stands out, with a large number of countries having a darker orange colour, which means their negative GDP growth was below -2%. This shows that 2020 has been a terrible year for the global GDP. This is because of the global COVID-19 pandemic that had a serious negative impact on the economy; however, the subsequent year, only a few countries had a negative growth and most of the countries had a growth above 4%. In year 2022, which can be seen on figure 5, Russia, Ukraine and nearby countries stands out with a negative GDP growth below -2%.

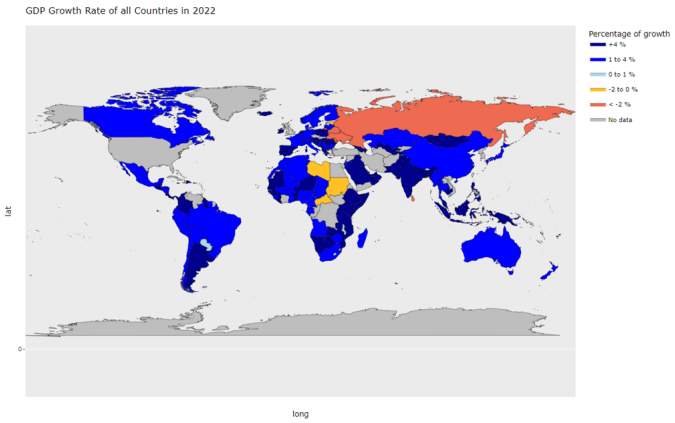

Fig. 5: Map chart: GDP growth rate in 2022

This could be an impact of the Russian invasion of Ukraine that Russia launched in the beginning of 2022. It further seems like the conflict did not only impact Russia and Ukraine but also the neighbouring countries. Looking into the GDP growth of Russia and Ukraine, the map shows that Russia had a negative GDP growth of -2.07% while Ukraine had a negative growth of -29.1%. This further reveals that Ukraine was much more impacted by the conflict compared to Russia. In addition to the map chart, two bar charts were created to visualise the GDP growth. One bar chart for the 20 countries that have had the highest growth over the years, and one bar chart for the 20 countries that have had the lowest growth. These will give further insights into specifically the highest and lowest GDP

growths. Examining the 20 countries with the highest growth, it reveals that for all years except one, the GDP growth has been above 6% from the 20th country. The exception is year 2020, which can be seen figure 6, where the GDP growth has been low. In 2020 it is only from the 4th country that the GDP growth has been above 6%.

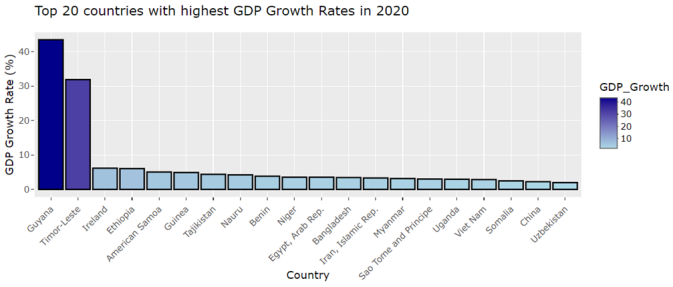

Fig. 6: Bar chart: Highest GDP growth rate in 2022

This further showcases the low GDP growth the world had in 2020 during the global COVID-19 pandemic. Examining the bar chart for the 20 countries with the lowest GDP growth, one country stands out in year 2011, which is Libya with a negative growth under -50%. This can be seen in figure 7.

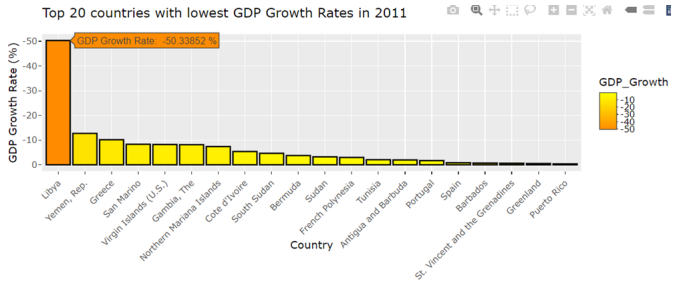

Fig. 7: Bar chart: Lowest GDP growth rate in 2011

The economy in Libya collapsed due to the Libyan civil war in 2011, where economic activities such as oil production had a drastic decline [8]. However, the subsequent year in 2012, the war ended and Libya was able to recover greatly, and had an exceptional GDP growth, which can be seen on figure 8:

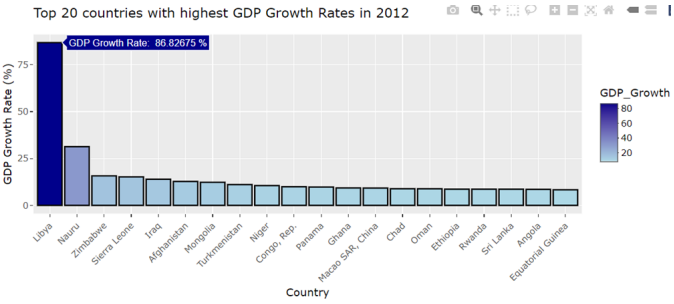

Fig. 8: Bar chart: Highest GDP growth rate in 2012

In year 2012 Libya had a GDP growth of roughly 86.8% because of the recovery from the war, and Libya stands out from the other countries, being the country with the highest GDP growth.

The map chart works well to give an overview of how the GDP growth of all the countries has progressed for each year. Furthermore, it could be utilised to compare countries, such as neighbouring countries, and investigate their differences. The bar charts are great way to get a more in depth look into the highest and lowest countries as well as individual countries.

C. How large of a proportion of the country's GDP is spent on education?

To investigate how much countries spend on education of their total GDP, the government expenditure on education data series will be utilised. This data series contains the percentage of country's total GDP that is spend on education, from 2010 to 2022. The data is for each country, therefore a map chart is suitable to visualise the countries' expenditure on education. The chart is a geographical map of the world, where a colour range from white to blue has be utilised to represent the expenditure percentages. As an example, the map chart of the government expenditure on education in 2012 can be seen on figure 9.

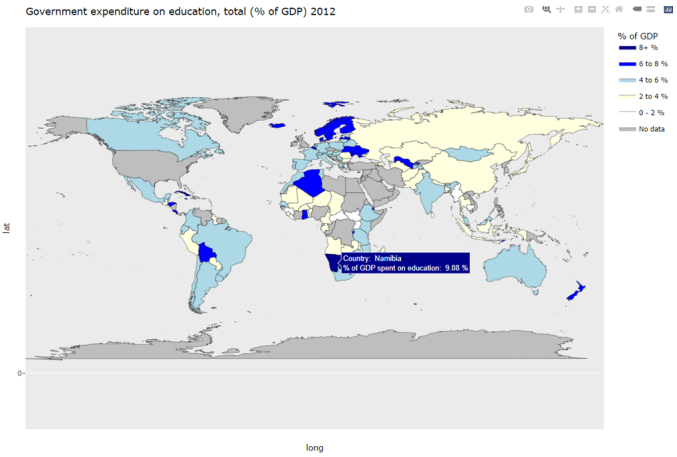

Fig. 9: Map chart: Government expenditure on education in 2012

The white colour illustrates a percentage between zero and two, the yellow colour represents a percentage between two and four and the blue colours illustrates percentages above four. The grey colours are countries that had no available data. Utilising the slider and examining the map through the different years, it is noticeable that Namibia had a dark blue colour consistently throughout all the years. This means that the country has spent more than 8% of their GDP on education. Namibia is one of the countries in Africa that has the highest literacy, and this could therefore be correlated to the government expenditure on education [9].

The map chart, however, has not worked effectively to visualise the data of the government expenditure on education. This was because the dataset was missing data for a large number of countries in the world, which resulted in a great

extent of the map being grey. This further resulted in being difficult to get an overall overview of expenditure on education in the whole world, and therefore also difficult to compare individual countries.

D. How has the death- and birth rate of different countries progressed over the years?

The dataset was analysed where two data series were selected which were the *"Death rate, crude (per 1,000 people)"* and *"Birth rate, crude (per 1,000 people)"*. The selected data series would bring value to examining the death- and birth rates in different countries over the years. A scatter plot was utilised where the data was selected, filtered, and cleaned for non-existing values in order to visualise the data in the most meaningful manner. The scatter plot was chosen as the visualisation in order to examine and explore how both data series were related as seen in figure 10. This would mean that the user could examine if there was context between the death and birth rate for a specific country. A searchable drop-down menu was implemented so the user could examine different countries.

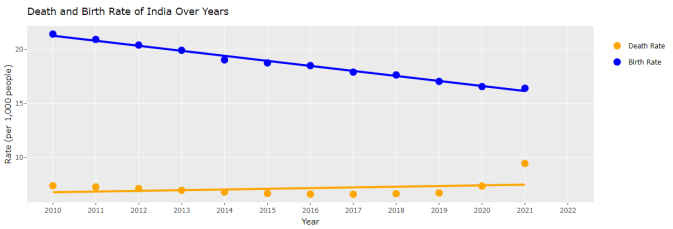

Fig. 10: Scatter plot: Death and birth rate for India

Furthermore, two line charts were developed in order to visualize the birth and death rates of five different countries in order to compare the properties. The line chart was created with five predefined countries which were China, Denmark, India, Nigeria, and the United States. This made it possible to establish an overview of the birth and death rates of the different countries. The country Nigeria had the highest death rate as seen in the figure 11.

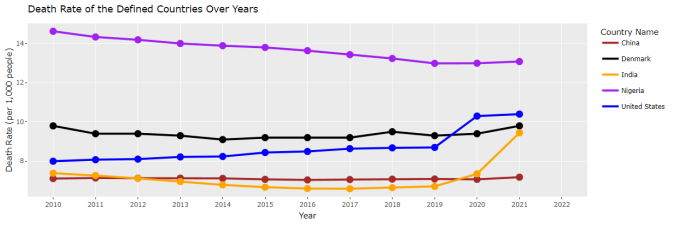

Fig. 11: Line chart of death rate

The last line chart which visualizes the birth rate, was created with the same predefined countries to keep the consistency. The birth rate showcased that Nigeria had the highest birth rate as seen in figure 12.

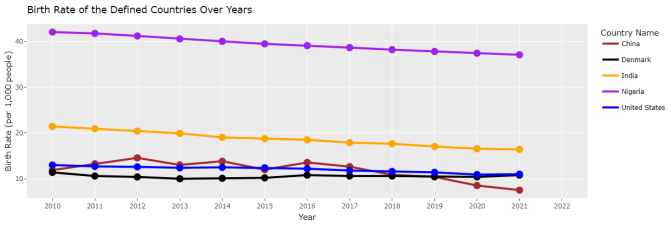

Fig. 12: Line chart of birth rate

The line charts were chosen for the purpose of showcasing the predefined countries' rates on the same chart to compare and examine the values. This gave a great overview to visualize the differences between the countries. In the future, a searchable selection menu could be implemented in order to visualize the countries based on the user's interest. Overall, both the scatter plot and line chart gave a great visualization of the birth and death rate. Furthermore, the developed visualizations were interactive which meant that the user could hover over each chart and examine each data point.

E. What gender has the highest life expectancy generally in the years past?

To explore the life expectancy of males and females in the different countries, the datasets for male and female life expectancy at birth will be employed. The datasets accommodate the average years males and females are expected to live from the timeframe of 2011 to 2021. To visualise the two datasets, a grouped bar chart has been created to compare the life expectancies of males and females. As an example, the grouped bar chart both for the male and female life expectancies at birth in China can be seen in figure 13.

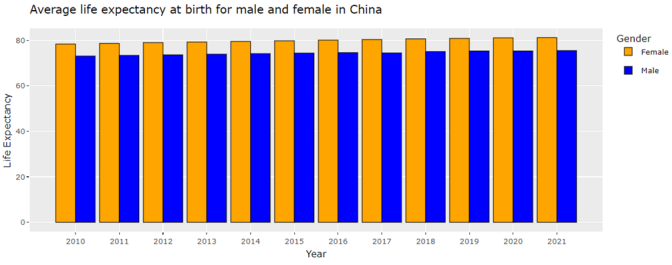

Fig. 13: Grouped bar chart: Life expectancy of males and females in China

The orange bars represent the female life expectancy, while the blue bars represent the male life expectancy. As can be seen the female life expectancy is higher than the male throughout all the years. However, this is not only the case for China. Utilising the list of countries and investigating each country, it is visible that for all the countries the life expectancy for females is always higher than the male. To further investigate what could affect the life expectancies of males and females, data of the mortality from cardiovascular diseases (CVDs), cancer, diabetes or chronic respiratory diseases (CRDs) will be employed. This includes a dataset for each gender and

the data is between the ages of 30 to 70. An animated line chart was created to visualise the two datasets and investigate how they progressed compared to each other. A snippet of the animated line chart the male and female mortality from diseases in China, can be seen in figure 14.

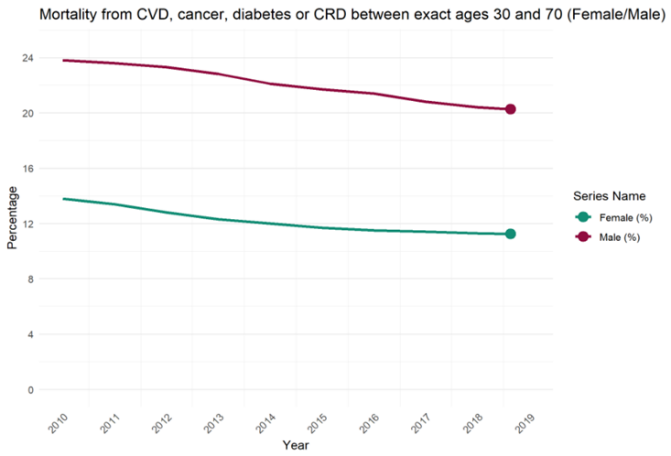

Fig. 14: Animated line chart: Mortality rate from diseases in China

As can be seen, the male and female mortality are slowly falling, but they are progressing with an almost consistent gap between them, where males have a higher percentages of mortalities diseases compared to females. Furthermore, an interactive line chart was created where all countries could be examined. Again, for all the countries it was common that the male had a higher mortality rate from CVD, cancer, diabetes and CRD. The mortality from disease could therefore explain why the general life expectancy at birth for the male population is lower compared to the female, in all of the countries in the world. The grouped bar chart worked well to give a quick visual comparison of the two life expectancies and gives an overall overview how they differentiate. Furthermore, the line charts work well to investigate how the mortality from diseases of the two genders progressed compared to each other. The visualization dashboard composing the developed charts has been published on *shinyapps.io* and can be located here: https://kavim19.shinyapps.io/Shiny/

VI. Conclusion

Our work has led us to conclude that the standard of living around the world varies greatly based on the evidence implied and highlighted when proposing the results as well as throughout the visualisation design. The point of interest devised were to compare the standard of living in different countries in correlation with the state of global development indicators. To accommodate the interest, the utilisation of data from The World Bank consolidating world development indicators in all countries, were used to conduct the procedure. When approaching the study, considerations had to be made, whereas certain key features were utilized to benefit the research, which consolidated of line charts, bar charts, grouped bar charts, scatter plots as well as map charts. Interaction design and animations were subsequently added to the figures, to demonstrate the findings in a suitable manner through dashboard interaction. The findings of this study analysed how the global population growth have progressed throughout the years while suggesting if the measurement of GDP of all countries have grown positively within the last decade. In correlation, further evidence has been provided to prove how large of a proportion of a country's GDP is spent on education, whereas the progression of death- and birth-rate respectively is being demonstrated as well. Taken together, the analysis of what gender have the highest life expectancy in the years past is also outlined. We have obtained comprehensive results showing that the progression of the global population is evidently split into two categories, highest and lowest. It is primarily countries within the African region that proposes the highest population growth, while due to the Russian/Ukrainian war in Europe, Ukraine had around 14.19% decrease in population growth which is above the double of what Bulgaria had, with a decent of 6.19%. However, by proceeding further back in time, there is no clear indication of what region concurrently have the most decrease in population growth, although there were outliers reported such as the Marshall Islands, Libya, and Lebanon. The global GDP for 2020 was appalling primarily due to the COVID-19 pandemic that proposed serious negative impact on both the global economy as well as the death rates in certain countries such as India, whereas the world subsequently overcame the pandemic in the years after resulting in a paradigm shift for the better. Furthermore, Namibia is one of the countries in Africa that has the highest literacy which likely correlates to the government's expenditure on education. Additionally, when averaging the life expectancies at birth for both males and females respectively, it is crucial to clarify that in every country provided within the results, females generally have a higher life expectancy at birth in correlation to males, while it indicated a higher mortality rate was present for males in contrast to females. Finally, the present research has only examined some of the many variables within world development indicators, whereas many more observations can be conducted if the sample size of variables were to be increased for future work. This would however increase the number of research questions needed, as the variables would be limited to what answers they can provide. The results provided for visualization has so far have been very encouraging to highlight the potential for data science and data visualisation. This implies the course conducted at University of Southern Denmark has enhanced the importance of during a thorough and comprehensive visualisation design when highlighting research opportunities. Despite a trivial challenge in maintaining a coherent story to be explained when proposing the findings, there were no critical or serious challenges that hindered the project development. This was mainly due to the excellent exercises provided during the course as well as the provided theory and utilities by the lecturer to conduct data visualisation. To further the research, we suggest that Artificial Intelligence is to be utilized for data

visualisation, as it is to become a transformative tool in areas such as coding. One of such tools could be VizGPT which has the ability to automatically generate complex data into visual elements.

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