

MM802 - Visualization Mini-project

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Shang Lu with Liwen Chen

Project Title: **Estimates of Mental Disorders on Country Economic Status**

Abstract

Depressive and anxiety disorders are two common mental disorders which affect millions of people. Prevalence and health loss are two indicators demonstrating how such disorders affect global society, which evaluated by WHO [11]. Such indicators differ a lot between high-income and low/middle-income countries. So we combined the indicators of disorders and economic together, displaying the data in interactive way to attract public attention on mental health. Furthermore, we put such data visualization onto a web page based on Azure remote server so that we can advertise more widely.

1 Introduction

Mental health matters. Current researches show that the mental disorders are brain diseases caused by defects in brain structure and neuron function [8]. Mental disorders lead to considerable losses in health and functioning [11], becoming the major cause disabling people in some countries [8]. So we conducted this project, showing how prevalent and how severe the mental disorders are, in order to stress the mental health issues and invoke public attention.

1.1 Mental Disorders

There are dozens of mental disorders around the world [6]. Due to limited time and data accessibility, we focused on common mental disorders, which refer to two main diagnostic categories: depressive disorders and anxiety disorders.

Depressive disorders

According to [11], depressive disorders, usually known as depression, are characterized by sadness, loss of interest or pleasure, and feelings of guilt or low self-worth, accompanying by other physical symptoms, such as disturbed sleep or appetite. Depression can be long-lasting or recurrent, impairing daily life functionality and work efficiency. Extremely severe depression can lead to suicide [11].

Anxiety disorders

Anxiety disorders are characterized by feelings of anxiety and fear, including generalised anxiety disorder (GAD), panic disorder, phobias, social anxiety disorder, obsessive-compulsive disorder (OCD) and post-traumatic stress disorder (PTSD) [11]. Such symptoms can range from mild

to severe while their durations are chronic usually [11].

1.2 Dataset of Mental Disorders

World Health Organization (WHO) works very hard to provide reliable and up-to-date estimate data about such mental disorders. In 2017, WHO published a report [11] on global estimate of depressive and anxiety disorders with data collected in 2015. In this report [11], WHO also listed the detail digits on both prevalence and health loss for each country for either disorder. In appendix, the data are shown in tabular form with each row presenting a country and each column demonstrating an indicator of certain disorder. The data cover 183 countries divided in 6 regions [11]. We transferred all the data into csv file within the same format, adding extra column indicating country's region.

Prevalence

The prevalence of either disorder is demonstrated in two values: 1) the total number of cases of either disorder; 2) the percentage of country population suffering from it [11]. In our project we thought both values are important. Countries with similar numbers of cases can have different prevalence percentages due to their different populations. So usually the percentage is important in comparison between different countries. However, the total number of cases, which is usually a bigger number, can easily catch audience attention.

For the common mental disorders as a whole, this report [11] does not provide the country-specific prevalence values. WHO mentions that it is inappropriate to simply add the two prevalence figures together because many people experience both disorders simultaneously [11]. However, since we were doing a public advertisement instead of a strict research, we took the sum of the figures from both disorders as the total prevalence of common mental disorders.

Health Loss

When scholars talk about the losses in health and functioning caused by certain disease, they quantify the losses at the population level by multiplying the prevalence of such disease by the average level of disability associated with it, to give estimates of Years Lived with Disability (YLD) [11]. This indicator reflects the burden of the disease.

[11] provides two values related to YLD to reflect health loss under either disorder: 1) the total YLD caused by depressive or anxiety disorders; 2) the percentage of YLD caused by depressive or anxiety disorders among the YLD of all diseases. The same with prevalence, we took both values into account, also took the sum of YLD of both mental disorders as the indicator for total health loss caused by common mental disorders.

1.3 Dataset of Economic Status

In [11], WHO mentions that high-income countries sometimes bear different prevalences or health losses comparing with low- and middle-income countries. Such as the number of persons with common mental disorders in low-income countries increased more significantly; 78% of global suicides occurred in low- and middle-income countries in 2015 [11]. Other researches confirm that countries with different economic levels produce different prevalences; however, their results support that high-income countries bear more depression problems [7, 9]. We thought importing country economic status as an independent variable into our model can reveal the pattern behind the data, helping the audience understand the mental disorders problem better.

After comparing different open databases [5, 4], we finally generated the economic digits upon United Nations Statistic Division [4], which covers more countries and is more user-friendly. We chose two indices to reflect country economic status: GDP per capita and GDP growth rate. We chose the year of data as 2015 to match WHO data.

GDP per capita

There are several other indices we can use, such as Gross National Income (GNI) and Value Added by Economic Activity. Furthermore, each index can be calculated via several methods. We are not economists; also the major focus of this project is not economic. What we needed was an index to reflect the economic status. So we chose Gross Domestic Product (GDP) because it is well-known and popular. Country GDP as a whole is affected by country population, thus can not reflect the average situation of citizens. As a result we used GDP per capita.

On the United Nations Statistic Division website [4], we selected ALL countries/areas, then chose *GDP, Per Capita GDP - US Dollars* as series, then chose year 2015, finally clicked submit button. Through these steps we got a table with each row containing country name and its GDP per capita in 2015. The website generates data for 242 countries/areas, more than WHO list. So we removed those who are not in WHO list out of our data. We added GDP per capita values as an extra column in csv file.

GDP growth rate

In everyday life, people can be satisfied when things are getting better even right now are not good. In bigger picture, GDP per capita can not reflect the development trend of a country. We speculated that a country's development trend can affect its citizens' mood or confidence, thus influences mental disorders prevalence. So we added GDP growth rate for each country to our data.

Similar to generation of GDP per capita, we kept most options the same but use *GDP, Annual Rate of Growth - Percentage* as series. The result is in the same format. After removing those countries which are not in WHO list, we added GDP growth rate as an extra column in data.

After the steps mentioned above, we got a csv file with each row presenting statistics of a country, including country name and region, prevalence and health loss of mental disorders and its economic indices. While doing the research, we found that the GapMinder website [3] gave a very good example on how to deal with statistics of multiple countries. We decided to adopt a similar visualization style with our own code and data.

So we displayed the country-specific statistics about mental disorders and economic status in an interactive way. We hoped our audience can find the relationship between economic and mental disorders, then realize the severity of mental disorders globally.

2 Project Status

We successfully constructed a webpage using HTML and JavaScript. We added interactive components into the webpage, thus users can choose different variables to display the data and highlight certain data to view it in detail. Furthermore, we built a remote server then uploaded the data and the webpage. As a result we generated a real website with all the components displayed according to our expectation. Consequently, although some improvements can be done in the future, we think we have reached our goal.

Work done by me

I collected and pruned the data, designed the major part of the webpage, and constructed most of the webpage using HTML, CSS and JavaScript.

Work done by Liwen Chen

Liwen built the server and set it up. He also finetuned the webpage with JQuery.

3 Development Environment

We used NetBeansIDE 8.2 with Java 1.8.0_162 on Windows 10 to code the webpage. In the webpage, we employed D3.js to run most functions. The official website of D3 [2] and the reference book provided by the tutor [10] supported us a lot. JQuery was loaded through <https://ajax.googleapis.com/ajax/libs/jquery/3.3.1/jquery.min.js>.

To build a remote server, we employed Microsoft Azure server, following the instruction in [1]. Finally, we can display our project through a public IP address.

4 Development Work

4.1 Developing tools

D3

We employed d3.js [2] in our HTML web page. We used its functions to read csv file, append and adjust components, and control interactions of the web page.

Azure Server

As mentioned above, we followed the instruction [1] to build a Azure server. So after creating the Azure account, we ran the Azure Cloud Shell through Azure portal. In Cloud Shell we created a deployment user, then a resource group in Canada Central region. Azure app service plan created, we then built a web app in Cloud Shell. The web app was empty at first before we put our files in Git and pushed them to the Azure remote server. After such steps, others can access the web page through a public IP address via all kinds of browser.

4.2 How To

1. To access the web page we built, users can either go to <http://mm802ass3html.azurewebsites.net/>, or set up a local server then load the web page through a browser. The web page is named "index.html" in "public.html" folder, with the dataset named "mental health world - Sheet1.csv".
2. On top of the web page, there are two select forms for choosing X and Y variables. Users can choose X variable between *GDP growth rate* and *GDP per capita*, choose Y variable among *Prevalence of Depressive Disorder*, *Prevalence of Anxiety Disorder*, *Prevalence of Both Mental Disorder*, *Health Loss of Depressive Disorder*, *Health Loss of Anxiety Disorder* and *Health Loss of Both Mental Disorder*.

3. After choosing X and Y variables, users have to click the "Create" button. Then the graph is generated. On the graph, each circle presents a country, with its X and Y position presenting values on X and Y variables, its color presenting region it belongs to, and its size presenting certain index. On top of the graph, the title shows the corresponding X and Y axes names. Under the title, an explanation tells the meaning of circle sizes. Under that, the mapping between circle colors and WHO regions is shown. See Figure 1 for example.

4. When users move their mouses onto a circle, the circle will becomes grey. Also a text box will pop out showing the country name and the index value of the circle size for corresponding circle. Two dashed lines appear as well, passing the circle and being perpendicular to each axis, assisting users in knowing the exact values on X and Y variables.

5. When X variable is chosen as *GDP per capita*, the X axis is transferred into Log function in order to display the data evenly.

4.3 Understanding the Output

Since we produced 12 graphs totally, we will focus on some major outputs listed below.

Analysis on GDP per capita

The left graph in Figure 2 shows an obvious correlation between the prevalence of both disorders and the country's GDP per capita. It seems that in richer countries, mental disorders occur more often comparing to poorer countries. However, if we check the YLD caused by mental disorders among all the diseases (Figure 2 right), the correlation seems weaker, with the difference between rich and poor countries becomes smaller.

There are several reasonable explanations behind such difference. Such as people in richer countries are under higher stress, or seeing more inequity, or more willing to care their mental states. Since our project is a display of data, lacking the ability to prove any hypothesis, we are not going to discuss the explanations in details.

Analysis on GDP growth rate

Due to several outliers in the graph of Figure 3, the distribution pattern is not very clear. However, if we merely focus on countries whose growth rate between -10 to 10%, we can see that those countries developing faster seems to suffer less from mental disorders in both prevalence and health loss. Again, we will not discuss such pattern in details.

Effect of regions

As we labeled countries in different colors according to their regions, it is quite clear that countries in the same region tend to locate in the same location in the graph, which means they share similar values on prevalence or health loss. See Figure 2 and 3. This can be attributed to regional culture or regional economic status. For example, Latin American countries share similar culture while most European countries are developed with low growth rate.

4.4 Limitation

From the perspective of networking technique, we only developed the client side of application, although we set the files on Azure server. So the data was pre-read in the front end, with no

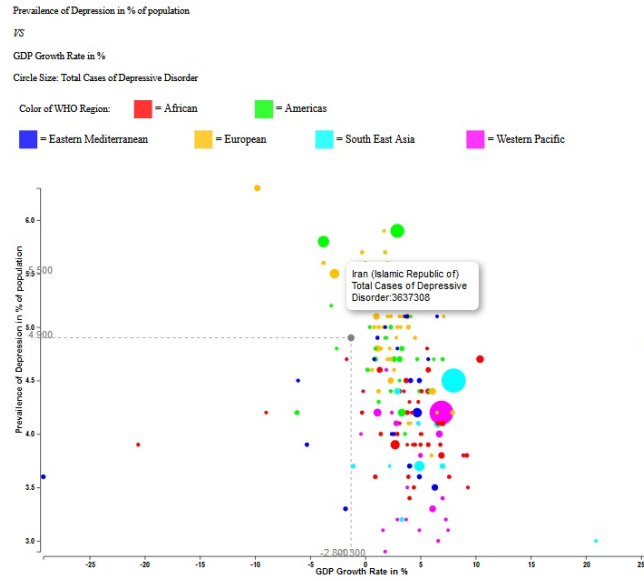


Figure 1: Layout of the web page

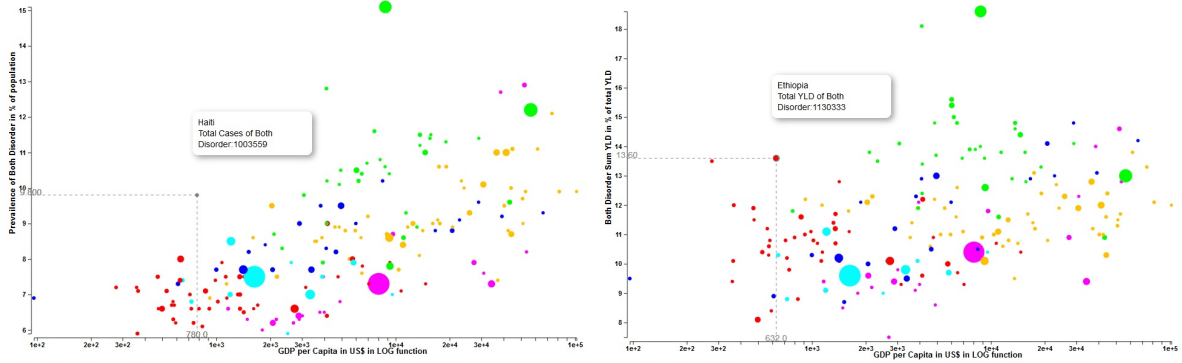


Figure 2: Left: Prevalence of both disorders on GDP per capita. Right: Percentage of YLD caused by both disorders on GDP per capita

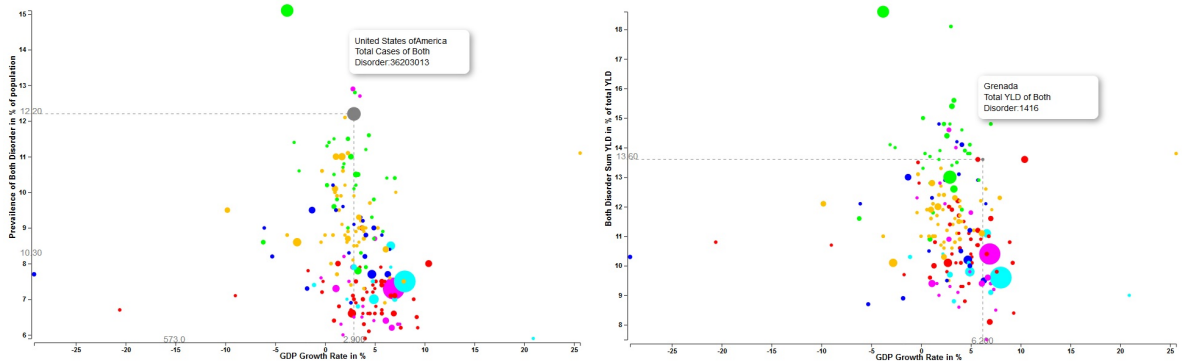


Figure 3: Left: Prevalence of both disorders on GDP growth rate. Right: Percentage of YLD caused by both disorders on GDP growth rate

update can be easily accessed during the process. Furthermore, since there is no server part, no Get and Post requests between the pages and server are deployed. All this setups limit the interaction between client and data.

From the perspective of visualization content, our project is just a display of data. Although it reveals some data patterns visually, it does not support further analysis or any filter.

5 Concluding Remark

We successfully built a data display webpage containing interactive components which help users easily perceive the data patterns. Through this project, we learnt how to build a webpage through HTML and JavaScript, how to import JavaScript libraries, and how to build an online remote server. In the future the project can be extended to include more data (such as prevalences of other diseases), more visualization functions (such as filtering and correlation calculation), and a server side of the network for maintaining data easily.

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