Module: Digital Health (WS 23/24)

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The Use Case: Problem Description and Stakeholders

According to the World Health Organization approximately 1 billion people worldwide had a mental disorder and about 970 million were living with anxiety and depressive disorder in 2019. Mental disorders are the leading cause of disability globally, accounting for 1 to 6 years lived with disability. Different studies have shown the life expectancy of persons with severe mental disorders to be 10 to 20 years shorter than the general population. A review of studies on mental disorders running from 2010 to 2019 found mental disorders to be a major risk factor for suicide. Suffering from depression increases one's risk for developing heart disease, high blood pressure, and diabetes. Stressors resulting from the COVID-19 pandemic caused a 25% rise in anxiety and depression worldwide.

Stakeholders	Challenges resulting from mental disorders
Government	-Increased economic burden from reduced productivity, increased disability, and loss of life -Increased budget for healthcare spending -Increased costs for social welfare programs
Health sector	-Increased demand for mental health services -Increased incidence and prevalence of diseases associated with mental disorders such as hypertension -Longer waiting times for mental health services -Increased workload for healthcare workers -Burnout resulting from increased workload -Loss of skilled labour due to stress and burnout -Poor interpersonal relations with patients
Industrial sector	-Decreased productivity -Financial losses due to absenteeism and sick days -Skilled labour shortages due to stress and burnout
Education	-Poor academic performance -Increased rates of dropping out -Reduced educational attainment
Social welfare	-Increased demands for social welfare programs -Increased financial and labour strain on workers in welfare programs -Reduced access to welfare benefits resulting from high demand -Increased disparities in quality of care among vulnerable groups
General public - including friends, family, colleagues, and persons living with mental illness	-Reduced quality of life associated with poor mental health -Reduced or complete loss of income -Increased healthcare costs from seeking mental health services and medication -The cost of caregiving required for severe cases -Emotional and psychological burden of relating closely with persons living with and/or dying as a result of mental illness -Stress due to stigma and conflict resulting from mental disorders

The Pathway to the Solution

1. **Identifying a problem**
   In 1920, Charles Edward Amory Winslow defined public health as "the science and art of preventing disease, prolonging life, and promoting health through the organized efforts and informed choices of society, organizations, public and private communities, and individuals." Based on the fact that the current course of study covers public health issues worldwide and borrowing from the definition of the phrase, the first step was the identification of a current public health issue of personal interest. In this case, the broad topic was "mental health".

2. **Conducting research**
   In order to narrow down the broad topic selected, a literature review for scholarly articles was conducted using electronic databases such as ResearchGate, Google Scholar, and Pubmed. The key words and phrases used for the search included: "mental health", "mental disorders", "common mental disorders", "trends", "prevalence", "risk factors", "burden of disease", "rates", and "statistics".

3. **Assessing the data**
   Searching further through other articles listed in the references and bibliographies of the articles from the initial search revealed several studies showing a rise in common mental disorders globally. The role of socioeconomic and cultural factors in determining health in general, and mental health in particular, was also highlighted repeatedly. Anxiety and depressive disorders repeatedly came up as two of the common mental disorders with the highest global prevalence currently.

4. **Identifying the stakeholders**
   The data assessment also outlined issues such as gaps in research, existing disparities in mental health service access and delivery, and the need for collaborative efforts by different sectors to address the challenges. This brought to focus the different parties involved in addressing the rise in common mental disorders in a country, the sectors which are adversely affected, and the effects at every level of society including persons living with mental illnesses.
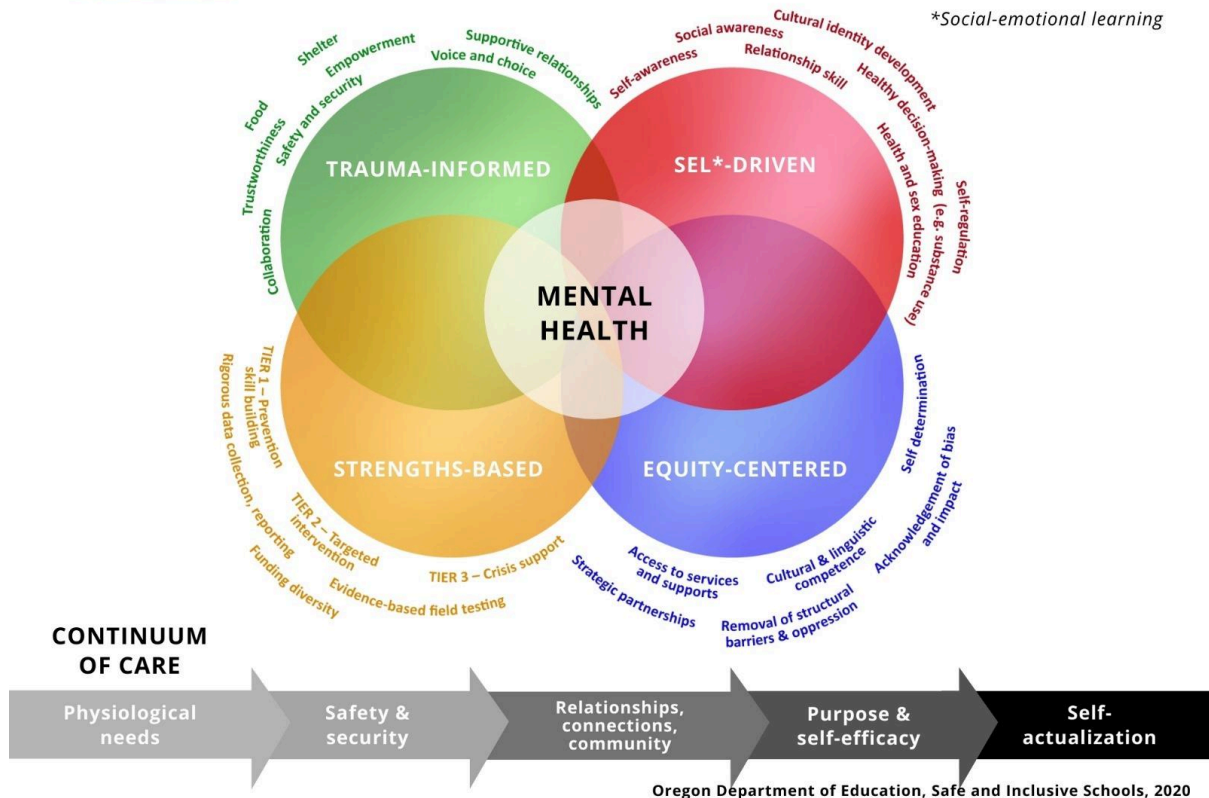
5. **Solving the problem**
   Research shows that there is an increase in depression and anxiety worldwide, particularly after the COVID-19 pandemic, and a need for a holistic approach to addressing mental health struggles. The Oregon Department of Education has proposed an integrated model of mental health which focuses on addressing physiological, psychological, cultural, relational, and personal needs. This approach is more focused on prevention and health promotion, as opposed to typical mental health services which focus more on management and cure after a mental illness develops.

Integrated Model of Mental Health

Mental health emphasizes strengths, resilience, and enhancing social-emotional abilities

*Social-emotional learning

OREGON DEPARTMENT OF EDUCATION
Oregon achieves . . . together!

TRAUMA-INFORMED
SEL*-DRIVEN
STRENGTHS-BASED
EQUITY-CENTERED

MENTAL HEALTH

Food
Shelter
Empowerment
Supportive relationships
Voice and choice
Trustworthiness
Safety and security
Collaboration
Social awareness
Cultural identity development
Self-awareness
Relationship skill
Healthy decision-making (e.g. substance use)
Health and sex education
Self-regulation
Self determination
Acknowledgement of bias and impact
Cultural & linguistic competence
Access to services and supports
Strategic partnerships
Removal of structural barriers & oppression
TIER 1 – Prevention skill building
Rigorous data collection, reporting
TIER 2 – Targeted intervention
Funding diversity
Evidence-based field testing
TIER 3 – Crisis support

CONTINUUM OF CARE

Physiological needs → Safety & security → Relationships, connections, community → Purpose & self-efficacy → Self-actualization

Oregon Department of Education, Safe and Inclusive Schools, 2020

The data visualization produced at the end of this report shows the trends of the prevalence of depressive disorders in Germany and neighbouring countries from 1990 to 2019. Although showing a slight decline from 2017 to 2019, more recent studies show that anxiety and depression rates rose significantly during the COVID-19 pandemic and have continued to remain high thereafter.

Trends in years preceding and leading up to the pandemic are themselves a call to action for stakeholders at every level of society to work collaboratively towards reducing the incidence, prevalence and severity of depression and other mental illnesses. Efforts should focus on creating awareness to help demystify mental illness and fight the stigma which prevents people from seeking help when they need it. Psychosocial support should be provided at institutions of learning and workplaces as a strategy in both the prevention and management of mental illnesses. Mental health services should also be included as part of primary healthcare to increase financial access through insurance coverage and to reduce out-of-pocket spending for individuals in need.

The Implementation Process

This section has three parts beginning with a summarized outline of the main tasks performed, followed by the code generated throughout the process. The sections with the code show the more detailed steps followed in the implementation process (preceded by the # sign) leading to the publication of the data visualization on Shiny found in the following link: https://sogugu80.shinyapps.io/DigiHproject/.

Part One

1. Downloading and installing RStudio and R.
2. Selecting a suitable data set on "Mental Health" from Kaggle and downloading them onto a desktop folder.
3. Unzipping the files and importing the data sets into RStudio.
4. Setting a working directory to the desktop folder containing the data sets.
5. Installing different packages and loading them using the *library* function.
6. Reading in the data.
7. Interacting with data functions and packages to create data frames.
8. Creating plots - a line plot and tables

```
getwd()

# loading packages -----
library(tidyverse)
library(here)
library(skimr)
library(janitor)
library(shinyalert)

#reading in data -----
dep_symptoms <- read_csv("depression_symptoms.csv")
dep_prevalence <- read_csv("depression_prevalence.csv")
mi_prevalence <- read_csv("mental_illness_prevalence.csv")
cpri_data <- read_csv("countries_primary_data.csv")

# exploring data -----
View(dep_symptoms)
dim(dep_symptoms)
str(dep_symptoms)
glimpse(dep_symptoms)
head(dep_symptoms)
tail(dep_symptoms)
summary(dep_symptoms)
skim(dep_symptoms)
```

```r
# editing columns
# renaming columns
library(dplyr)
# applying the pipe function to rename columns in different data frames
dep_symptoms <- dep_symptoms %>%
  rename(Symptom = Entity)
View(dep_symptoms)

cpri_data <- cpri_data %>%
  rename(Disorders = Entity)
View(cpri_data)

dep_prevalence <- dep_prevalence %>%
  rename(Region = Entity)
View(dep_prevalence)

mi_prevalence <- mi_prevalence %>%
  rename(Country = Entity)
View(mi_prevalence)

# replace lengthy column name to shorter one, before summarizing data ----
colnames(mi_prevalence)[colnames(mi_prevalence) == "Depressive disorders (share of
population) - Sex: Both - Age: Age-standardized"] <- "Depressive_disorders"

# filter all mental illness data for the year 2019 ----
data_2019 <- mi_prevalence %>% filter(Year == 2019)


# group data by country -----
# create summaries - calculate max, median, and min prevalence for depressive disorders ----
summary_Depressive_disorders <- data_2019 %>%
  group_by(Country) %>%
  summarise(Max_Depressive_disorders = max(Depressive_disorders, na.rm = TRUE),
        Median_Depressive_disorders = median(Depressive_disorders, na.rm = TRUE),
        Min_Depressive_disorders = min(Depressive_disorders, na.rm = TRUE))


# comparing trends depressive disorder trends for Germany from 1990 to 2019 ----

# load necessary libraries
library(tidyverse)
library(ggplot2)
```

```
# load data
mi_prevalence <- read.csv("mental_illness_prevalence.csv")

# filter for Germany -----
germany_data <- subset(mi_prevalence, Country == "Germany")
# select Depressive disorders column -------
depression_column <- "Depressive_disorders"
# plot the trends
# run ggplot package
library(ggplot2)

## convert the column to numeric if necessary
germany_data$Depressive.disorders <-
as.numeric(germany_data$Depressive.disorders..share.of.population....Sex..Both...Age..Age.s
tandardized)

# create a line plot
ggplot(germany_data, aes(x = Year, y =
Depressive.disorders..share.of.population....Sex..Both...Age..Age.standardized)) +
  geom_line() +
  labs(title = "Trends in Prevalence of Depressive Disorders in Germany (1990-2019)",
    x = "Year",
    y = "Prevalence of Depressive_disorders") +
  theme_minimal()
```

Trends in Prevalence of Depressive
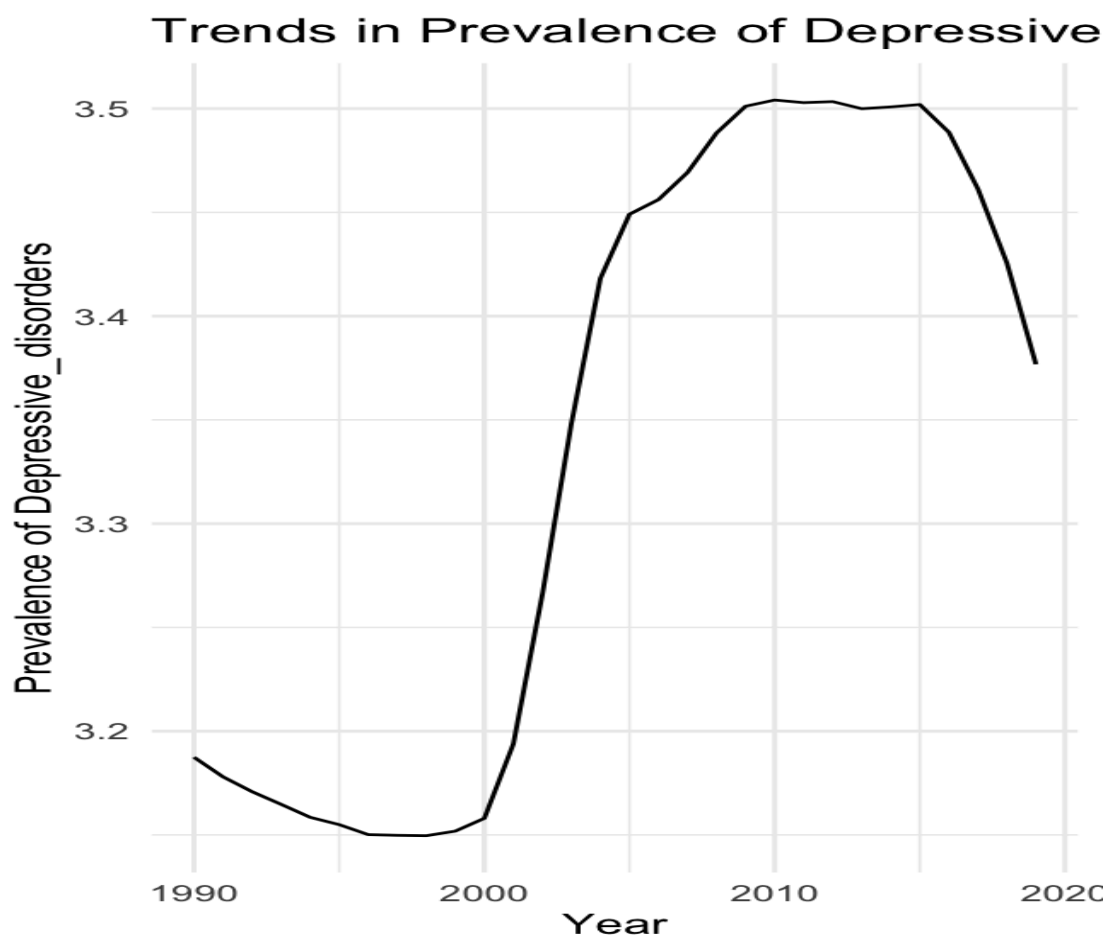
```
# plotting a data frame as a table
library(knitr)
kable(dep_symptoms)
kable(dep_prevalence)

table(dep_symptoms)

tabyl(dep_symptoms)
library(janitor)
tabyl(dep_symptoms)
tabyl(dep_prevalence)
tabyl(cpri_data)

library(grid)
table(dep_prevalence)
table(dep_symptoms)

install.packages("gridExtra")
library(gridExtra)
plot(tableGrob(dep_symptoms))
plot(tableGrob(dep_prevalence))
```

Symptom	Code	Year	Nearly every day	More than half the days	Several days	N
Appetite change	NA	2014	4.6	5.1	15.5	
rage across symptoms	NA	2014	4.4	4.3	15.0	
Depressed mood	NA	2014	3.6	3.9	16.8	
fficulty concentrating	NA	2014	3.5	3.6	10.9	
Loss of interest	NA	2014	4.4	5.4	16.3	
Low energy	NA	2014	9.0	7.8	34.0	
Low self-esteem	NA	2014	3.0	2.9	11.5	
sychomotor agitation	NA	2014	1.9	2.5	6.8	
Sleep problems	NA	2014	9.2	6.5	20.9	
Suicidal ideation	NA	2014	0.6	0.6	2.3	

The above table shows depression symptom scores based on the Patient Health Questionnaire (PHQ), a tool commonly used as an assessment for depression.

Part Two
1. Applying different functions to exclude columns in a data frame.
2. Using ChatGPT to resolve errors in the code, such as conflicts in differing data types.
3. Reshaping data in preparation for plotting a graph.
4. Plotting a bar graph for depression symptoms using the *plotly* package in R.

```r
# Load libraries
library(tidyverse)
library(plotly)

# Read data
depression_data <- read_csv("depression_symptoms.csv")

# Exclude "Code" and "Year" columns
depression_data <- depression_data[, !(colnames(depression_data) %in% c("Code", "Year"))]

# Convert "Entity" column to character type
depression_data$Entity <- as.character(depression_data$Entity)

# Convert numeric columns to character
depression_data[, c("Nearly every day", "More than half the days", "Several days", "Not at all")] <-
  lapply(depression_data[, c("Nearly every day", "More than half the days", "Several days", "Not at all")], as.character)

# Check the unique values in the "Entity" column
unique_entities <- unique(depression_data$Entity)

# Create a factor variable for "Entity" column
depression_data$Entity <- factor(depression_data$Entity, levels = unique_entities)

# Reshape the data for plotting
melted_data <- melt(depression_data, id.vars = "Entity", variable.name = "Frequency", value.name = "Score")

# Plot the bar graph using plot_ly
plot_ly(melted_data, x = ~Entity, y = ~Score, color = ~Frequency, type = "bar") %>%
  layout(title = "Depression Symptoms",
       xaxis = list(title = "Entity"),
       yaxis = list(title = "Score"),
       barmode = "group")
```
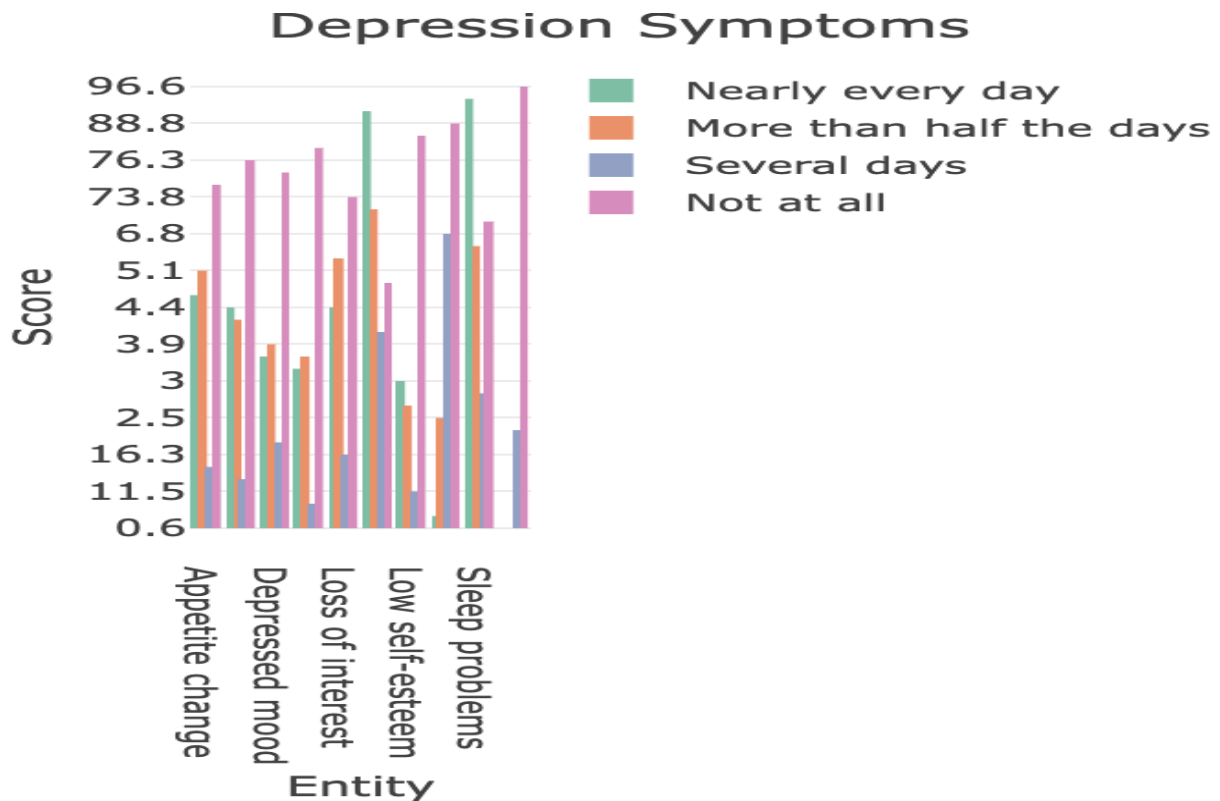
Depression Symptoms

Legend:
- Nearly every day
- More than half the days
- Several days
- Not at all

Y-axis: Score — 96.6, 88.8, 76.3, 73.8, 6.8, 5.1, 4.4, 3.9, 3, 2.5, 16.3, 11.5, 0.6

X-axis (Entity): Appetite change, Depressed mood, Loss of interest, Low self-esteem, Sleep problems

Part Three

1. Creating an account on Shiny.io and linking it to Rstudio.
2. Creating a Shiny web application file on RStudio and saving it on the desktop folder with the original csv files from Kaggle.
3. Loading the relevant packages including the *shiny* package.
4. Preparing data to plot a graph.
5. Defining the UI for the Shiny application.
6. Defining the server logic.
7. Rendering a comparative line plot showing depression prevalence trends for Germany and neighbouring countries from 1990 to 2019.
8. Running the application.
9. Publishing the app.R code in the script file to Shiny.
10. Testing the link generated in the Shiny application to check that it opens on the browser.
11. Using ChatGPT to resolve any errors which may appear while performing any of the above tasks.

```r
# Load packages
library(shiny)
library(tidyverse)
library(plotly)
library(RColorBrewer)

# Read data
mi_prevalence <- read.csv("mental_illness_prevalence.csv")

# Rename dataset column
mi_prevalence <- mi_prevalence %>%
  rename(Country = Entity)

# Filter for Germany
germany_data <- subset(mi_prevalence, Country == "Germany")

# Filter for selected countries
selected_countries <- c("Austria", "Belgium", "Poland", "Denmark", "Czechia", "France",
"Netherlands")
selected_data <- mi_prevalence %>% filter(Country %in% selected_countries)

# Convert the column to numeric if necessary
selected_data$Depressive.disorders <-
as.numeric(selected_data$Depressive.disorders..share.of.population....Sex..Both...Age..Age.st
andardized)

# Define UI for Shiny app
ui <- fluidPage(
  titlePanel("Depression Trends in Germany and Neighbouring Countries (1990-2019)"),
  plotlyOutput("linePlot")
)

# Define server logic
server <- function(input, output) {

  # Render the line plot
  output$linePlot <- renderPlotly({

    color_palette <- colorRampPalette(brewer.pal(8, "Set1"))(length(selected_countries))

    plot_ly() %>%
      add_trace(
        data = germany_data,
```

```r
  x = ~Year, y =
~Depressive.disorders..share.of.population....Sex..Both...Age..Age.standardized,
    type = 'scatter', mode = 'lines', name = 'Germany', line = list(color = color_palette[1])
  ) %>%
  add_trace(
    data = selected_data,
    x = ~Year, y =
~Depressive.disorders..share.of.population....Sex..Both...Age..Age.standardized,
    type = 'scatter', mode = 'lines', name = selected_countries[1],
    line = list(color = color_palette[2])
  ) %>%
  add_trace(
    data = selected_data %>% filter(Country == selected_countries[2]),
    x = ~Year, y =
~Depressive.disorders..share.of.population....Sex..Both...Age..Age.standardized,
    type = 'scatter', mode = 'lines', name = selected_countries[2],
    line = list(color = color_palette[3])
  ) %>%
  add_trace(
    data = selected_data %>% filter(Country == selected_countries[3]),
    x = ~Year, y =
~Depressive.disorders..share.of.population....Sex..Both...Age..Age.standardized,
    type = 'scatter', mode = 'lines', name = selected_countries[3],
    line = list(color = color_palette[4])
  ) %>%
  add_trace(
    data = selected_data %>% filter(Country == selected_countries[4]),
    x = ~Year, y =
~Depressive.disorders..share.of.population....Sex..Both...Age..Age.standardized,
    type = 'scatter', mode = 'lines', name = selected_countries[4],
    line = list(color = color_palette[5])
  ) %>%
  add_trace(
    data = selected_data %>% filter(Country == selected_countries[5]),
    x = ~Year, y =
~Depressive.disorders..share.of.population....Sex..Both...Age..Age.standardized,
    type = 'scatter', mode = 'lines', name = selected_countries[5],
    line = list(color = color_palette[6])
  ) %>%
  add_trace(
    data = selected_data %>% filter(Country == selected_countries[6]),
    x = ~Year, y =
~Depressive.disorders..share.of.population....Sex..Both...Age..Age.standardized,
    type = 'scatter', mode = 'lines', name = selected_countries[6],
```

```r
      line = list(color = color_palette[7])
    ) %>%
    add_trace(
      data = selected_data %>% filter(Country == selected_countries[7]),
      x = ~Year, y =
~Depressive.disorders..share.of.population....Sex..Both...Age..Age.standardized,
      type = 'scatter', mode = 'lines', name = selected_countries[7],
      line = list(color = color_palette[8])
    ) %>%
    # Repeat the add_trace block for each additional country in selected_countries

    layout(
      title = list(
        text = "The World Health Organization (WHO) reported almost 1 billion people
worldwide had a mental disorder in 2019.
        In 2019, 970 million people around the world were living with anxiety and depressive
disorders.
        Mental disorders are the leading cause of disability globally, resulting in 1 to 5 years
lived with disability.",
        font = list(size = 10)  # Adjust the font size as needed
      ),
      xaxis = list(title = "Year"),
      yaxis = list(title = "Depression Scores"),

      legend = list(x = 1, y = 0.5, xanchor = "left", yanchor = "middle")
    )
  })
}

# Run the Shiny app
shinyApp(ui, server)
```

References

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