Financial Strain and Mental Health

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Set-up your environment

```r
require(tidyverse)
```

```
## Loading required package: tidyverse
```

```
## -- Attaching core tidyverse packages ----------------------- tidyverse 2.0.0 --
## v dplyr     1.1.4      v readr     2.1.5
## v forcats   1.0.0      v stringr   1.5.1
## v ggplot2   3.5.2      v tibble    3.3.0
## v lubridate 1.9.4      v tidyr     1.3.1
## v purrr     1.0.4
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
## i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors
```

```r
require(rmarkdown)
```

```
## Loading required package: rmarkdown
```

```r
require(yaml)
```

```
## Loading required package: yaml
```

```r
require(lubridate)
require(sf)
```

```
## Loading required package: sf
## Linking to GEOS 3.13.0, GDAL 3.10.1, PROJ 9.5.1; sf_use_s2() is TRUE
```

```r
require(tmap)
```

```
## Loading required package: tmap
```

```
library(tinytex)
```

Money Problems and Mental Health

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Tutorial 3; Chantal Schouwenaar

Part 1 - Identify a Social Problem

The relationship between income and mental health represents a significant social issue with consequences for individuals, families, and communities. People facing financial difficulties are more likely to experience mental health problems, while mental health issues can in turn reduce a person's ability to work or maintain income stability. This creates a reinforcing cycle of disadvantage (World Health Organization, 2025).

Research has shown that individuals with lower incomes tend to suffer more from psychological stress, have less access to mental health services, and face living conditions that increase the risk of mental illness. Michael Marmot (2005) highlights how reduced control, limited resources, and chronic stress contribute to health inequalities among socioeconomically disadvantaged groups. Similarly, Pickett and Wilkinson (2001) found that mental health problems are more common in low-income communities due to factors like social isolation and resource scarcity.

Although this connection is well documented at the national and international levels, it remains unclear how income and mental health interact within cities. In this project, we investigate the extent to which these patterns appear across neighborhoods in Amsterdam, using local statistics and basic data analysis in R.

1.1 Describe the Social Problem

This issue is relevant because it highlights how economic inequality can lead to unequal mental health outcomes within the same city. If poorer neighborhoods in Amsterdam consistently show higher levels of mental health problems, this may reflect deeper structural inequalities in the distribution of public health resources and economic opportunity. Understanding these local patterns allows policymakers to target interventions more effectively, especially in the areas most in need (Thomson et al., 2023).

By analyzing neighborhood-level data from Amsterdam and applying simple coding techniques in RStudio, this project contributes to a better understanding of how income and mental health are related in an urban setting. Our findings may help support future decisions about healthcare access, social support, and economic policy.

Part 2 - Data Sourcing

2.1 Load in the data

The data for this project was downloaded from the RIVM StatLine, a public health platform that provides neighborhood-level statistics across the Netherlands.

We use two sets of data, zooming in specifically on the city of Amsterdam:

- **Moeite met rondkomen (Trouble making ends meet)**

- **Hoog risico op angst of depressie (High risk of anxiety or depression)**

Additionally, we use a combined dataset that includes both the 'moeite met rondkomen' (difficulty making ends meet) and 'Hoog risico op angst of depressie' (High risk of anxiety or depression) variables. This combined dataset was exported for four reference years (2012, 2016, 2020, and 2022) and split into three age categories: 18 years and older, 18 to 65 years, and 65 years and older. This results in a total of 12 data files. All files were downloaded from the shared group folder, in line with the assignment instructions.

```
# Load the datasets
Gezondheid_per_wijk_en_buurt__2012_18_of_ouder <- read.csv2("https://raw.githubusercontent.com/Adhamarti
Gezondheid_per_wijk_en_buurt__2016_18_of_ouder <- read.csv2("https://raw.githubusercontent.com/Adhamarti
Gezondheid_per_wijk_en_buurt__2020_18_of_ouder <- read.csv2("https://raw.githubusercontent.com/Adhamarti
Gezondheid_per_wijk_en_buurt__2022_18_of_ouder <- read.csv2("https://raw.githubusercontent.com/Adhamarti
Gezondheid_per_wijk_en_buurt__2012_18_tot_65 <- read.csv2("https://raw.githubusercontent.com/Adhamartim
Gezondheid_per_wijk_en_buurt__2016_18_tot_65 <- read.csv2("https://raw.githubusercontent.com/Adhamartim
Gezondheid_per_wijk_en_buurt__2020_18_tot_65 <- read.csv2("https://raw.githubusercontent.com/Adhamartim
Gezondheid_per_wijk_en_buurt__2022_18_tot_65 <- read.csv2("https://raw.githubusercontent.com/Adhamartim
Gezondheid_per_wijk_en_buurt__2012_65_of_ouder <- read.csv2("https://raw.githubusercontent.com/Adhamarti
Gezondheid_per_wijk_en_buurt__2016_65_of_ouder <- read.csv2("https://raw.githubusercontent.com/Adhamarti
Gezondheid_per_wijk_en_buurt__2020_65_of_ouder <- read.csv2("https://raw.githubusercontent.com/Adhamarti
Gezondheid_per_wijk_en_buurt__2022_65_of_ouder <- read.csv2("https://raw.githubusercontent.com/Adhamarti
```

2.2 Provide a short summary of the dataset(s)

We use datasets from the RIVM StatLine (Rijksinstituut voor Volksgezondheid en Milieu), which provide neighborhood-level statistics related to health and socioeconomic well-being in the Netherlands. Since all 12 datasets we use are identical in the number of observations and variables—differing only by year & age group—we provide a short summary of one representative dataset.

```
# Let's have a quick glance of the dataset using the glimpse (via dplyr) & head function
glimpse(Gezondheid_per_wijk_en_buurt__2012_18_of_ouder)
```

```
## Rows: 579
## Columns: 9
## $ Leeftijd                              <chr> "18 jaar of ouder", "18 jaa~
## $ Marges                                <chr> "Waarde", "Waarde", "Waarde~
## $ Perioden                              <int> 2012, 2012, 2012, 2012, 201~
## $ Wijken.en.buurten                     <chr> "Amsterdam", "Burgwallen-Ou~
## $ Regioaanduiding.Gemeentenaam..naam.   <chr> "Amsterdam            ~
## $ Regioaanduiding.Soort.regio..omschrijving. <chr> "Gemeente  ", "Wijk      ",~
## $ Regioaanduiding.Codering..code.       <chr> "GM0363            ", "WK~
## $ Hoog.risico.op.angst.of.depressie....  <chr> "     8.6", "     6.2", "  ~
## $ Moeite.met.rondkomen....               <chr> "    34.5", "    32.5", "  ~
```

```
head(Gezondheid_per_wijk_en_buurt__2012_18_of_ouder)
```

```
##            Leeftijd Marges Perioden    Wijken.en.buurten
## 1 18 jaar of ouder Waarde     2012            Amsterdam
## 2 18 jaar of ouder Waarde     2012 Burgwallen-Oude Zijde
## 3 18 jaar of ouder Waarde     2012           Kop Zeedijk
## 4 18 jaar of ouder Waarde     2012         Oude Kerk e.o.
```

```
## 5 18 jaar of ouder Waarde    2012        Burgwallen Oost
## 6 18 jaar of ouder Waarde    2012             Nes e.o.
##         Regioaanduiding.Gemeentenaam..naam.
## 1 Amsterdam
## 2 Amsterdam
## 3 Amsterdam
## 4 Amsterdam
## 5 Amsterdam
## 6 Amsterdam
##   Regioaanduiding.Soort.regio..omschrijving. Regioaanduiding.Codering..code.
## 1                                   Gemeente                          GM0363
## 2                                       Wijk                        WK036300
## 3                                      Buurt                      BU03630000
## 4                                      Buurt                      BU03630001
## 5                                      Buurt                      BU03630002
## 6                                      Buurt                      BU03630003
##   Hoog.risico.op.angst.of.depressie.... Moeite.met.rondkomen....
## 1                                   8.6                     34.5
## 2                                   6.2                     32.5
## 3                                   6.1                     31.6
## 4                                   6.8                     36.1
## 5                                   6.3                     32.8
## 6                                   6.0                     31.2
```

This dataset contains 579 rows and 9 variables. Each row represents a specific neighborhood or district, and the variables include the year of data collection (Perioden), age group (Leeftijd), and values like the percentage of people at high risk for anxiety or depression and the percentage of people reporting difficulty making ends meet. These indicators are relevant for our research question, as they help us explore whether there is a possible relationship between financial difficulty and mental health at the neighborhood level.

2.3 Describe the type of variables included The variables in our

dataset represent both health-related and socioeconomic indicators:

- The **Moeite met Rondkomen** variable reflects socioeconomic stress (SES), measured by the percentage of individuals who report difficulty making ends meet.

- The **Hoog Risico op Angst of Depressie** variable reflects mental health vulnerability, measured by the percentage of individuals estimated to be at high risk for anxiety or depression.

These two variables are the focus of our analysis, as they relate directly to our research question about the connection between financial strain and mental health.

All variables are expressed as percentages (%) of individuals within defined age groups (18+, 18–65, or 65+) at the neighborhood (wijk/buurt) level.

In addition to the two main variables, the dataset includes structural variables such as:

- Wijken.en.buurten: the name of the neighborhood or district,
- Perioden: the year of data collection,
- Leeftijd: the age group,
- RegioS: the statistical code for the neighborhood or district.

4

According to the metadata available at RIVM Statline, the health-related indicators are based on national surveys combined with model-based estimates.

These variables provide the structure and context necessary to filter and analyze the data by location, year, and age group. This helps us focus on relevant subpopulations and make meaningful comparisons across Amsterdam's neighborhoods.

Part 3 - Quantifying

3.1 Data cleaning

We cleaned each dataset by removing unnecessary rows and rows with aggregate totals (such as "Gemeente: Amsterdam"). We then renamed columns to make them more interpretable. In step 5, we converted the SES and mental health variables to numeric format so they can be used in analysis. In step 6, we converted the Perioden variable to a date format to ensure consistent handling of time across datasets.

###Remove missing and aggregate rows

```
amsterdam_gezondheid_merged <- rbind(Gezondheid_per_wijk_en_buurt__2012_18_of_ouder, Gezondheid_per_wij
```

```
amsterdam_gezondheid_clean <- amsterdam_gezondheid_merged |>
  select(-Marges) |>
  select(-Regioaanduiding.Gemeentenaam..naam.)
```

```
amsterdam_gezondheid <- amsterdam_gezondheid_clean |>
  filter(Wijken.en.buurten != "Amsterdam")
```

```
amsterdam_gezondheid  <- amsterdam_gezondheid |>
  rename(
     wijken_en_buurten = Wijken.en.buurten,
    Type_regio = Regioaanduiding.Soort.regio..omschrijving.,
    regio_code = Regioaanduiding.Codering..code.,
    risico_depressie = Hoog.risico.op.angst.of.depressie....,
    moeite_met_rondkomen = Moeite.met.rondkomen....
  )
```

```
amsterdam_gezondheid$risico_depressie = as.numeric(amsterdam_gezondheid$risico_depressie, na.rm = TRUE)
```

```
amsterdam_gezondheid$moeite_met_rondkomen = as.numeric(amsterdam_gezondheid$moeite_met_rondkomen, na.rm
```

```
amsterdam_gezondheid$Perioden = ymd(amsterdam_gezondheid$Perioden, truncated = 2L)
```

3.2 Generate necessary variables

Variable 1

```
amsterdam_gezondheid <- amsterdam_gezondheid |>
  group_by(Perioden, Leeftijd) |>
  mutate(
    avg_risico_depressie = mean(risico_depressie, na.rm = TRUE),
    avg_moeite_rondkomen = mean(moeite_met_rondkomen, na.rm = TRUE)
  )
```

Variable 2

```r
# First, calculate the percentiles (1-5) for "moeite met rondkomen" (financial stress). We assign each
amsterdam_gezondheid <- amsterdam_gezondheid |>
  mutate(
    rondkomen_percentile = ntile(moeite_met_rondkomen, 5),
    rondkomen_group = case_when(
      rondkomen_percentile == 1 ~ "Very Low",
      rondkomen_percentile == 2 ~ "Low",
      rondkomen_percentile == 3 ~ "Moderate",
      rondkomen_percentile == 4 ~ "High",
      rondkomen_percentile == 5 ~ "Very High",
      TRUE ~ NA_character_
    )
  )


# We reepeat the same logic for "risico op depressie" (mental health complaints)
amsterdam_gezondheid <- amsterdam_gezondheid |>
  mutate(
    depressie_percentile = ntile(risico_depressie, 5),
    depressie_group = case_when(
      depressie_percentile == 1 ~ "Very Low",
      depressie_percentile == 2 ~ "Low",
      depressie_percentile == 3 ~ "Moderate",
      depressie_percentile == 4 ~ "High",
      depressie_percentile == 5 ~ "Very High",
      TRUE ~ NA_character_
    )
  )


# Let's view the first few lines of the new groupings
amsterdam_gezondheid |>
  select(wijken_en_buurten, moeite_met_rondkomen, rondkomen_group,
         risico_depressie, depressie_group) |>
  head(10)
```

```
## Adding missing grouping variables: 'Perioden', 'Leeftijd'

## # A tibble: 10 x 7
## # Groups:   Perioden, Leeftijd [1]
##    Perioden   Leeftijd    wijken_en_buurten moeite_met_rondkomen rondkomen_group
##    <date>     <chr>       <chr>                            <dbl> <chr>
##  1 2012-01-01 18 jaar of~ Burgwallen-Oude ~                 32.5 Moderate
##  2 2012-01-01 18 jaar of~ Kop Zeedijk                       31.6 Moderate
##  3 2012-01-01 18 jaar of~ Oude Kerk e.o.                    36.1 High
##  4 2012-01-01 18 jaar of~ Burgwallen Oost                   32.8 Moderate
##  5 2012-01-01 18 jaar of~ Nes e.o.                          31.2 Moderate
##  6 2012-01-01 18 jaar of~ BG-terrein e.o.                   30.9 Moderate
##  7 2012-01-01 18 jaar of~ Burgwallen-Nieuw~                 31.8 Moderate
##  8 2012-01-01 18 jaar of~ Stationsplein e.~                 NA   <NA>
##  9 2012-01-01 18 jaar of~ Hemelrijk                         31.7 Moderate
## 10 2012-01-01 18 jaar of~ Nieuwendijk Noord                 36.3 High
## # i 2 more variables: risico_depressie <dbl>, depressie_group <chr>
```
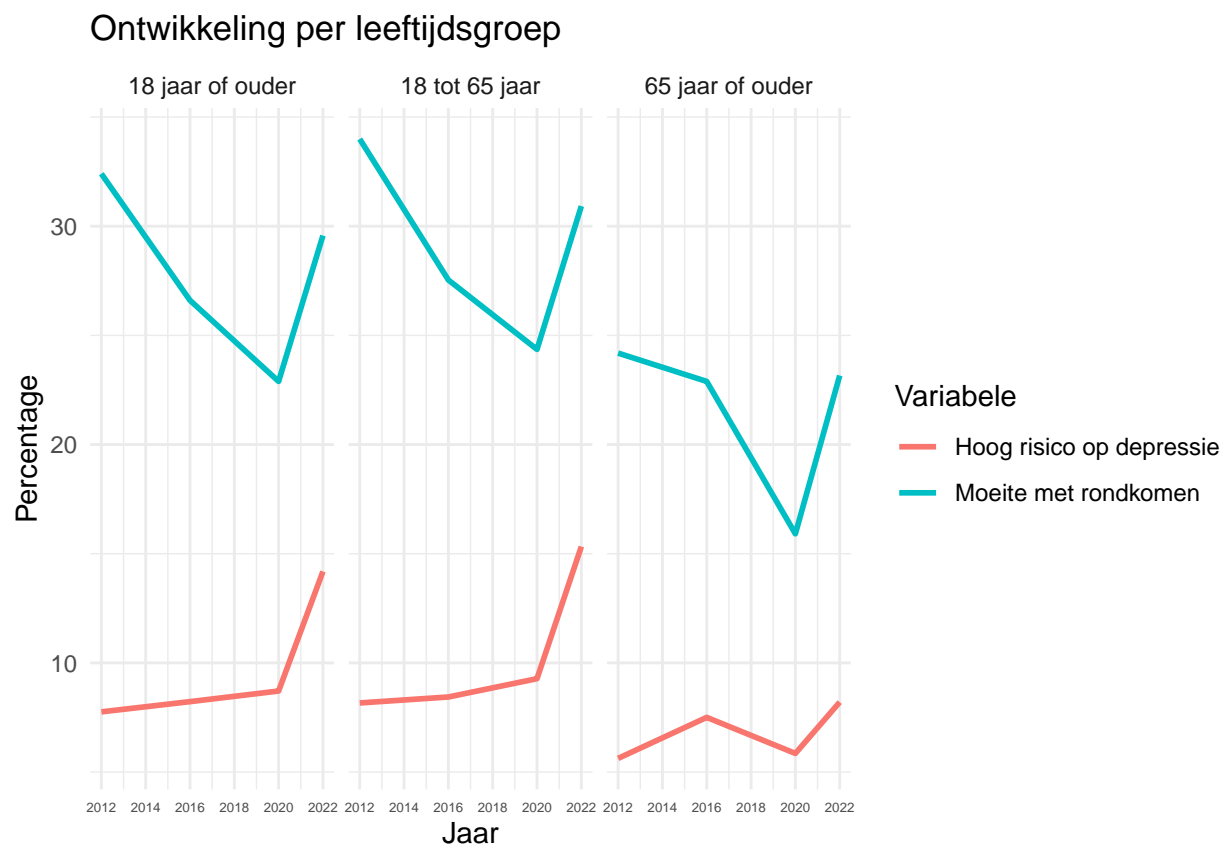
Variable 3

```r
amsterdam_gezondheid <- amsterdam_gezondheid |>
  mutate(verschil_score = moeite_met_rondkomen - risico_depressie)
```

3.3 Visualize temporal variation

```r
ggplot(amsterdam_gezondheid, aes(x = Perioden)) +
  geom_line(aes(y = avg_risico_depressie, color = "Hoog risico op depressie"), size = 1) +
  geom_line(aes(y = avg_moeite_rondkomen, color = "Moeite met rondkomen"), size = 1) +
  facet_wrap(~Leeftijd) +
  labs(title = "Ontwikkeling per leeftijdsgroep", x = "Jaar", y = "Percentage", color = "Variabele") +
  theme_minimal() +
  theme(axis.text.x = element_text(size = 5))
```


The graph shows the development of two variables, financial strain and depression risk, across three age groups in Amsterdam from 2012 to 2022. Before 2020 we observe an counterintuitive trend; financial strain is in a declining trend across all age groups while depression risk is gradually rising. This suggests that despite improvements in the ability to make ends meet, psychological complaints continued to rise. This could be for various reasons; rising loneliness in cities, underlying mental health trends unrelated to income or rising loneliness could be among the possibilities. From 2020 to 2022 this pattern breaks, financial strain and depression risk both spike in parallel, especially among working-age adults. This shift suggests that there is a stronger link between financial and mental health pressures during and after the pandemic. Unlike the previous trend, worsening economic conditions now coincide with the rise in mental health problems.

The aftermath of this social and economic shock indicates a clear connection between material insecurity and mental well-being.

3.4 Visualize spatial variation

```
# Load spatial data
geo_data <- st_read("C:/Users/AdhamArtimi/OneDrive/Bureaublad/wijkenbuurten_2022_v3.gpkg", layer = "buu
```

```
## Reading layer 'buurten' from data source
##   'C:\Users\AdhamArtimi\OneDrive\Bureaublad\wijkenbuurten_2022_v3.gpkg'
##   using driver 'GPKG'
## Simple feature collection with 14412 features and 209 fields
## Geometry type: MULTIPOLYGON
## Dimension:     XY
## Bounding box:  xmin: 10425.16 ymin: 306846.2 xmax: 278026.1 ymax: 621876.3
## Projected CRS: Amersfoort / RD New
```

```
# Filter for Amsterdam only
amsterdam_map <- geo_data |>
  filter(gemeentenaam == "Amsterdam") |>
  select(buurtcode, buurtnaam)

# Clean and filter your health dataset to match buurtcodes only. Here we remove extra spaces in column
amsterdam_gezondheid <- amsterdam_gezondheid |>
  mutate(regio_code = toupper(trimws(regio_code))) |>
  filter(str_starts(regio_code, "BU"))

# Merge spatial and health data by buurtcode
amsterdam_merged <- left_join(amsterdam_map, amsterdam_gezondheid, by = c("buurtcode" = "regio_code"))

# Filter to only 2022 data
latest_year <- amsterdam_merged |>
  filter(format(Perioden, "%Y") == "2022")

# Use static mode for PDF
tmap_mode("plot")
```

```
## i tmap mode set to "plot".
```

```
# Map 1: Mental health complaints
map1 <- tm_shape(latest_year) +
  tm_polygons("risico_depressie",
              palette = "PuBuGn",
              title = "High risk on depression (%)") +
  tm_layout(legend.outside = TRUE)
```

```
##
## -- tmap v3 code detected -----------------------------------------------------
## [v3->v4] 'tm_tm_polygons()': migrate the argument(s) related to the scale of
## the visual variable 'fill' namely 'palette' (rename to 'values') to fill.scale
## = tm_scale(<HERE>).[v3->v4] 'tm_polygons()': migrate the argument(s) related to the legend of the
## visual variable 'fill' namely 'title' to 'fill.legend = tm_legend(<HERE>)'
```

```
# Map 2: Financial difficulty
map2 <- tm_shape(latest_year) +
  tm_polygons("moeite_met_rondkomen",
              palette = "YlOrRd",
              title = "Financial Strain (%)") +
  tm_layout(legend.outside = TRUE)
```

```
## [v3->v4] 'tm_polygons()': migrate the argument(s) related to the legend of the
## visual variable 'fill' namely 'title' to 'fill.legend = tm_legend(<HERE>)'
```

```
# Combine maps
tmap_arrange(map1, map2)
```

```
## [cols4all] color palettes: use palettes from the R package cols4all. Run
## 'cols4all::c4a_gui()' to explore them. The old palette name "PuBuGn" is named
## "brewer.pu_bu_gn"
## Multiple palettes called "pu_bu_gn" found: "brewer.pu_bu_gn", "matplotlib.pu_bu_gn". The first one,
##
## [cols4all] color palettes: use palettes from the R package cols4all. Run
## 'cols4all::c4a_gui()' to explore them. The old palette name "YlOrRd" is named
## "brewer.yl_or_rd"
## Multiple palettes called "yl_or_rd" found: "brewer.yl_or_rd", "matplotlib.yl_or_rd". The first one,
```
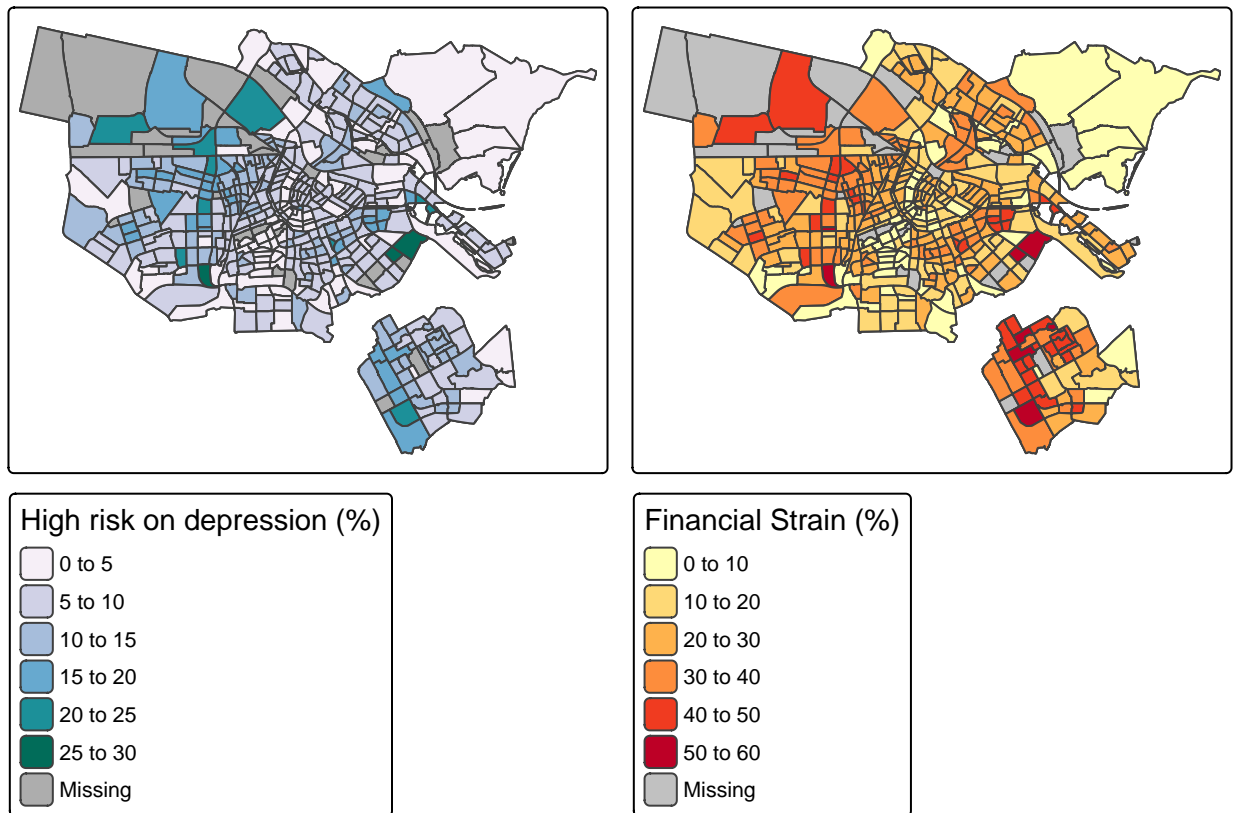

The map above offers a spatial visualisation of the correlation between the percentage of residents experiencing high risk of depression (left) and financial strain (right) at the neighbourhood level within Amsterdam.

9

These two indicators reflect the central focus of our project: the relationship between income and mental health.

The visual evidence supports previous findings from the literature (Marmot, 2005; Pickett & Wilkinson, 2015; Thomson et al., 2023), which suggest a strong link between socioeconomic status and psychological well-being. Neighbourhoods in the southern and southeastern parts of Amsterdam, which show elevated levels of financial strain (in darker red tones), also correspond to areas with a higher estimated risk of depression (in darker blue/green tones). Conversely, wealthier districts, especially in the city's central and northern areas—show both lower financial strain and lower depression risk. This geographical overlap reinforces the relevance of our topic: income inequality is not evenly distributed within a city, and it may be a key driver of mental health disparities.

While the plot strengthens our main argument; financial stress is linked to mental health problems, the strength of this link depends on neighbourhood level factors. By recognizing this, one moves away from possible policy solutions that cater to the entire city towards more targeted policies. The spread in the age groups magnifies these clear differences.

3.5 Visualize sub-population variation

What is the poverty rate by state?

```r
ggplot(subset(amsterdam_gezondheid, format(Perioden, "%Y") =="2022"), aes(x = Leeftijd, y = verschil_sc
  geom_boxplot(fill = "lightblue", color = "darkblue") +
  labs(
    title = "Difference in score between Financial Strain and Depression Risk",
    x = "Age Group",
    y = "Difference in score",
    caption = "Reference year: 2022"
  ) +
  theme_minimal() +
  theme(plot.title = element_text(size = 12))
```

Difference in score between Financial Strain and Depression Risk

Reference year: 2022
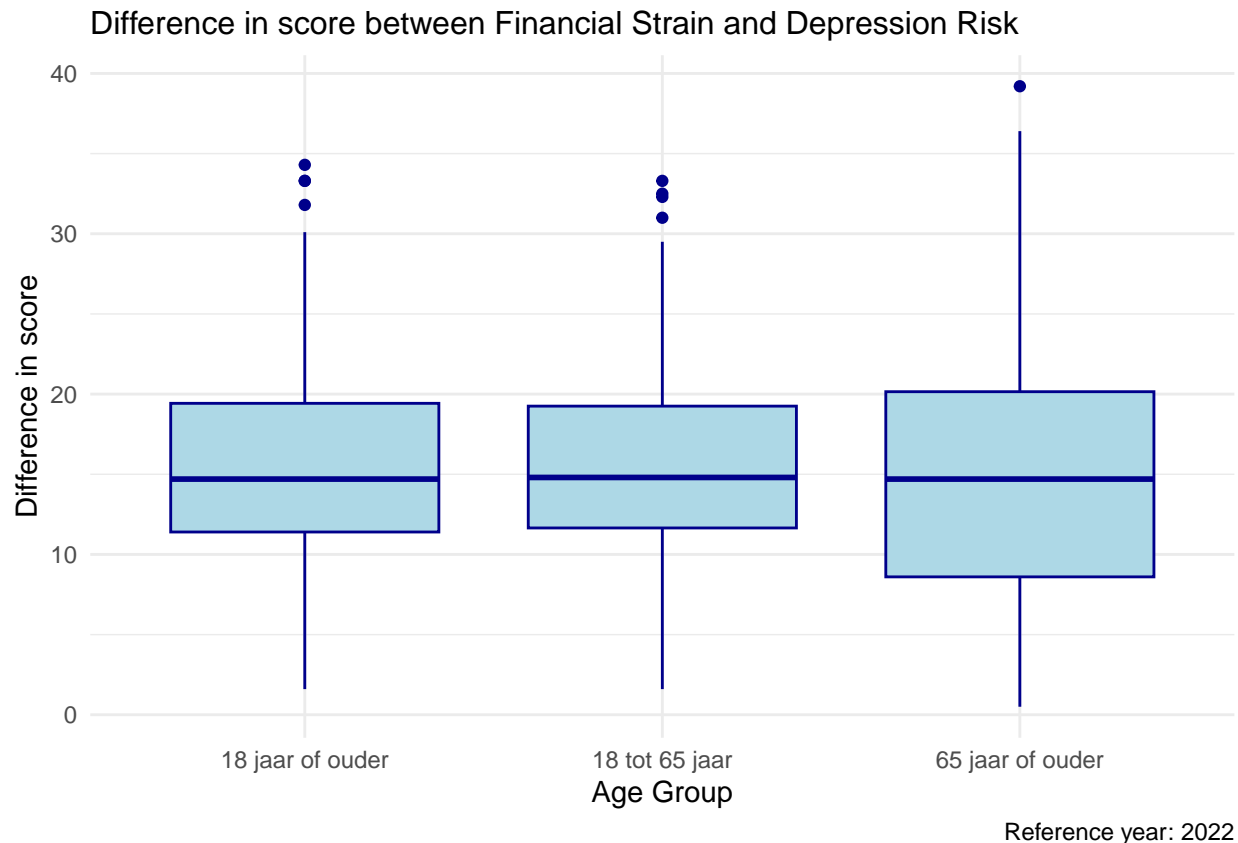
The boxplot shows the spread of the difference between financial strain and depression risk at the neighborhood level, across three age groups in Amsterdam. We plotted the following value: Difference = % experiencing financial difficulty - % depression risk

The boxplot shows that there is a variation within each age group in how financial strain and mental health complaints align. The difference is positive in every age group on average, which means that financial stress percentages are higher than depression risk in general. The spread in the interquartile range shows that the difference varies widely between neighborhoods however.

3.6 Event analysis

In this section, we analyze the relationship between financial difficulty (rondkomen) and mental health problems (depressie) over time. We use 'extra variable 1' generated in part 3.1, that consists of the average financial stress across all age categories and the average risk of depression for each year. This way we are able to observe citywide trends in contrast to age-specific fluctuations. We are focusing specifically on the potential impact of the COVID crisis in 2020, as this specific point in time provides us with a critical event horizon that likely disrupted both economic and psychological conditions across Amsterdam. We expect that both financial stress and psychological complaints would increase following the COVID crisis, mainly due to job insecurity, social isolation and economic uncertainty. With our visualization of the trends before and after 2020, our goal is to look into whether this event correlates with a significant shift in our variables.

```
ggplot(amsterdam_gezondheid, aes(x = Perioden)) +
  geom_line(aes(y = avg_risico_depressie,  color = "Depressie"), size = 1,) +
  geom_line(aes(y = avg_moeite_rondkomen, color = "Rondkomen"), size = 1) +
  geom_vline(aes(xintercept = as.Date("2020-03-01"), colour = "COVID-19"), linetype = "dashed") +
  labs(title = "Event studie 'COVID-19 2020'", x = "Jaar", y = "Gemiddelde score", color = "Variabele",
```

```
theme_minimal() +
theme(axis.text.x = element_text(size = 6)) +
scale_color_manual(name = "Variabele",
                   values = c("Depressie" = "Darksalmon", "Rondkomen" = "Darkcyan", "COVID-19" = "Bla
```

Event studie 'COVID–19 2020'

Source: Rijksoverheid
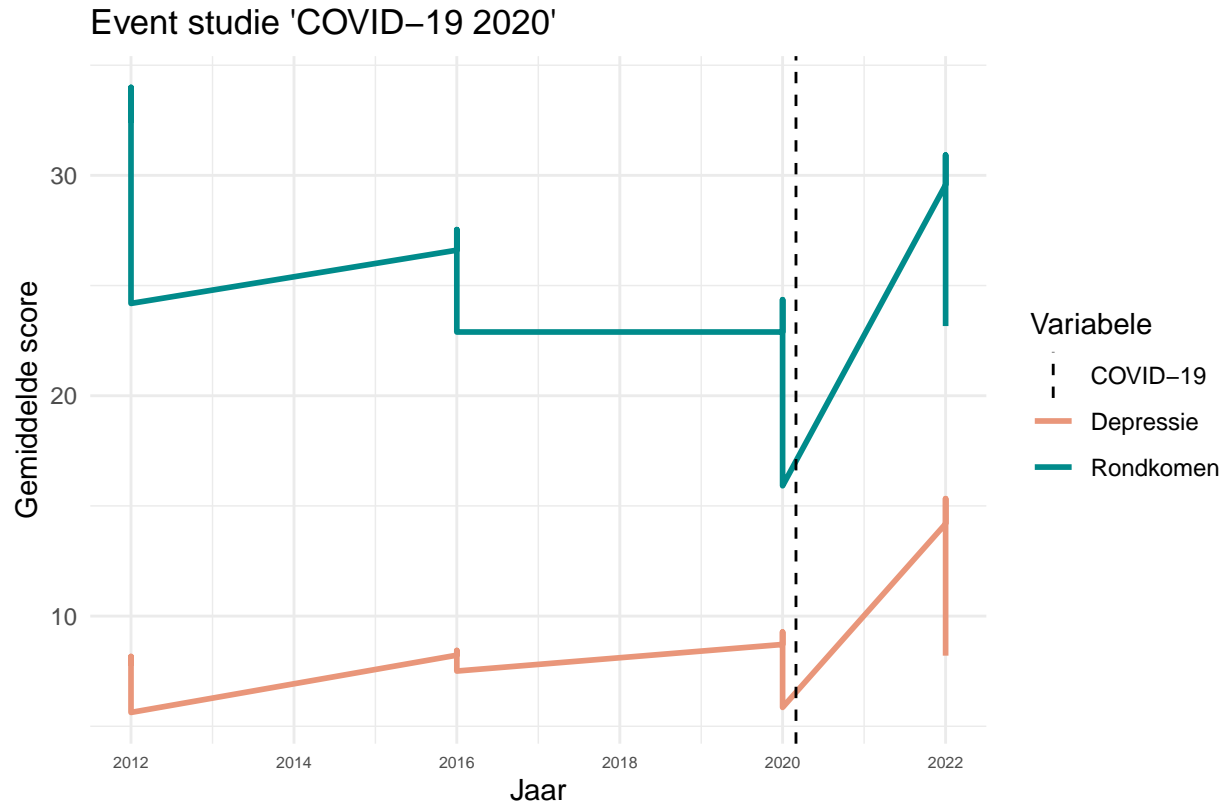
The plot above confirms our expectations. By relying on our generated 'extra variable 1' wee are able to observe a clear post-COVID increase in both financial difficulty and depression, Between 2020 and 2022 the average percentage of people who suffered severe mental health problems rises sharply and so does the average percentage of people who face financial strain. The timing of the increase, it coincides with the pandemic, suggests that external shock can magnify underlying social problems, especially for already vulnerable groups.

Part 4 - Discussion

4.1 Discuss your findings

Our findings reveal a concerning pattern; areas with higher levels of financial difficulty tend to report elevated rates of psychological complaints. This aligns with the existing literature concerning the relationship between socioeconomic status and mental health. Financial insecurity can therefore be seen as a strong indicator for mental health risks (Marmot, 2005; Pickett& Wilkinson, 2001)

The choropleth maps provide a visual evidence for the spatial disparaties in financial hardship and psychological stress. Several neighbourhoods in Amsterdam, especially those located further from the city center or with historically lower average incomes, show higher levels in both variable consistently.

Sub-group analysis shows that working age aduls (18-65) consitently report the highest levels of both psychological complaints and financial stress. A conclusion could therefore be drawn that economic and mental health pressures are more severe for those in the labour force.

Finally, the event study confirms the strong correlation between financial and psychological strains, following the linear regression line. This supports the idea that economic hardship is closely linked to mental health problems.

These findings align with the public health research and might indicate that addressing financial difficulties locally could be a more effective way to reduce mental health problems across the city.

Part 5 - Reproducibility

5.1 Github repository link

Provide the link to your PUBLIC repository here: https://github.com/Adhamartimi/ProgrammingForEcon-Tutorial-3-group-4

5.2 Reference list

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