Assignment 2

Pranav Belmannu, Maithilee Kulkarni, Lea Stavoli, Swetha Vangapandu

2022-11-20

```
library(tidyverse)
library(ggplot2)
library(lubridate)
library(reshape2)
library(corrplot)
library(yfR)
library(patchwork)
```

Index of Consumer Sentiment

According to Gartner, consumer sentiment is an expression of behavior, feelings, expressions, values, and motivations of people in a particular demographic group or market. This is analyzed to understand why people feel in a particular way and how it will affect their spending behavior in the future. This information can be used to create plans to increase the number of loyal customers, improve marketing engagements, and identify future customers.

The Index of Consumer Sentiment (ICS) is derived from the Surveys of Consumers conducted by the Survey Research Center at the University of Michigan (UM). The monthly survey, conducted via telephone, contains about 50 questions, plus follow-up questions, designed to target different aspects of consumer expectations and opinions regarding personal finances, business and buying conditions. The surveyed population, at least 600 households each round, is chosen specifically to be a representative sample of contiguous US households.

The survey has five questions used to calculate the ICS. The first and second questions relate to family financial conditions and how they may have changed from the prior year and in the coming year. The third and fourth questions are about nation-wide business conditions and how they may change in the next year and next five years, particularly regarding possible unemployment and periods of recession. The fifth question is about if it is a good time to make large household purchases.

To compute the ICS, calculate the percent of positive responses minus the percent of negative responses, plus 100, for each question. Sum the five individual question scores (rounded to the nearest whole number), divide by 6.7558 (the 1966 base period total), and add 2.0 (a constant to correct for sample design changes from the 1950s). [1][2][3]

```
LS_path <- "/Volumes/My Passport/MS Business Analytics/FINC780/"

#Index of Consumer Sentiment https://data.sca.isr.umich.edu/data-archive/mine.php
index_file <- paste(LS_path,"Index_Consumer_Sentiment_2022_Nov_11.csv", sep="")

#Fed Rate https://fred.stlouisfed.org/series/FEDFUNDS
fed_rate_file <- paste(LS_path, "Federal_Funds_Effective_Rate_2014_to_2022.csv", sep=
"")

#US Bureau of Labor Statistics (following 3 files) https://data.bls.gov/cgi-bin/surve
ymost?bls
#Average hourly earnings of all employees, total private, seasonally adjusted
hourly_earnings_file <- paste(LS_path, "Avg_Hourly_Earnings_2014_to_2022.csv", sep=""
)

#Consumer Price Index, all items in U.S. city average, all urban consumers, seasonall
y adjusted
CPI_file <- paste(LS_path, "Consumer_Price_Index_2014_to_2022.csv", sep="")

#Unemployment rate
unemployment_file <- paste(LS_path, "Unemployment_Rate_2014_to_2022.csv", sep="")
```

```
#read-in consumer sentiment index file, create date column
index_df <- read.csv(index_file)
index_df <- index_df[,1:3]
index_df$Date <- my(paste(index_df$Month, "-",index_df$Year, sep = ""))
index_df <- subset(index_df, select = c(Date, Index))
```

```
#read-in fed rate file, format date column
fed_rate_df <- read.csv(fed_rate_file)
fed_rate_df$DATE <- mdy(fed_rate_df$DATE)
colnames(fed_rate_df) <- c('Date', 'Fed.Rate')
```

```
#read-in hourly earnings file, melt to long format, format date
hourly_earnings_df <- read.csv(hourly_earnings_file)
hourly_earnings_df <- melt(hourly_earnings_df, id.vars = "Year", value.name = "Hr.Rat
e")
hourly_earnings_df$Date <- my(paste(hourly_earnings_df$variable, "-",hourly_earnings_
df$Year, sep = ""))
hourly_earnings_df <- subset(hourly_earnings_df, select = c(Date, Hr.Rate))
```

```
#read-in consumer pricing index file, melt to long format, format date
CPI_df <- read.csv(CPI_file)
CPI_df <- melt(CPI_df, id.vars = "Year", value.name = "CPI")
CPI_df$Date <- my(paste(CPI_df$variable, "-",CPI_df$Year, sep = ""))
CPI_df <- subset(CPI_df, select = c(Date, CPI))
```

```
#read-in unemployment file, melt to long format, format date
unemployment_df <- read.csv(unemployment_file)
unemployment_df <- melt(unemployment_df, id.vars = "Year", value.name = "Unemp")
unemployment_df$Date <- my(paste(unemployment_df$variable, "-",unemployment_df$Year,
sep = ""))
unemployment_df <- subset(unemployment_df, select = c(Date, Unemp))
```

```
#merge Bureau of Labor Statistics dfs by index (row names), add unemployment
stats_df <- merge(hourly_earnings_df, CPI_df, by = "Date", all = TRUE)
stats_df <- merge(stats_df, unemployment_df, by = "Date", all = TRUE)

#merge stats with consumer sentiment index, add fed rate, drop rows with na values
df <- merge(index_df, stats_df, by = "Date", all = TRUE)
df <- merge(df, fed_rate_df, by = "Date", all = TRUE)
df <- df %>% drop_na()
```

Recent Trends

The ICS has had a volatile path in recent years. Although there was an overall positive climb from 2014 to 2019, early 2020 saw a steep decline likely due to the COVID pandemic that hit in December 2019. The future of financial markets looked bleak and consumers reflected similar sentiments. As the effects of the pandemic began to fade into the background, consumer sentiment began to climb again until early 2021. At that point there was a small dip in consumer sentiment and it has been falling ever since, hitting the lowest point in at least a decade in mid-2022.

Average ICS by month was plotted to see how sentiment changed during the year. The graph shows there has been lower consumer sentiment in the summer months, reaching the lowest point in August and then a sharp increase in September. The average ICS values peak in December indicating there could be many financial decisions taken during the holiday season, such as vacations and holiday shopping. This data could be skewed owing to the pandemic and the many other factors that can influence consumer sentiment.

```
#plot index
a <- ggplot(df, aes(x = Date, y = Index)) +
   geom_line(color = "blue") + ggtitle("ICS, 2014 - 2022")

#plot by month to see if consumer sentiment changes as per month
monthwise_trend <- df %>% group_by(Month = month(df$Date)) %>% summarize(Average_inde
x = mean(Index))
b <- ggplot(monthwise_trend, aes(x = Month, y = Average_index)) + geom_point(shape =
'triangle') +
   geom_line(color = 'blue') + ggtitle("Average ICS by Month")
a / b
```

ICS, 2014 - 2022

Average ICS by Month
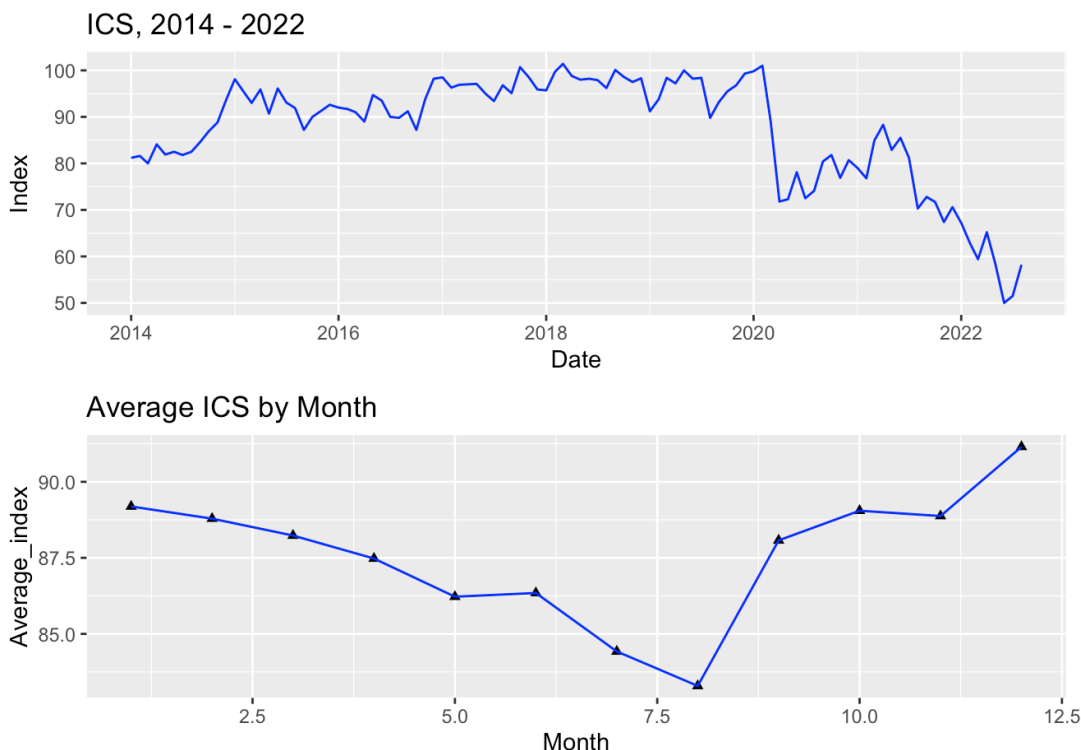
Contributing Factors

The COVID pandemic can be easily identified as a significant factor in negative consumer attitudes toward personal finances and business conditions. However there are other contributing factors that influence the ICS, such as inflation, unemployment, wages, stock market conditions, and interest rates.

To find correlated variables, we compared the ICS to the unemployment rate, federal funds effective rate, average hourly wage, Consumer Pricing Index (CPI), and the GSPC stock market. We found significant positive and negative correlation within these variables. For example, the CPI is strongly negatively correlated and the GSPC market is moderately positively correlated to the ICS.

CPI, strongly negatively correlated to the ICS, saw a significant increase due to supply chain issues without decreased demand. If we consider the CPI as one measure of inflation, it can be concluded that inflation has a very strong negative correlation to consumer sentiment. This finding is in agreement with recent news articles stating consumers believe inflation is the most significant problem facing the US.

Another very highly correlated variable is the average hourly wage, which is negatively correlated to the ICS. However, it has a strong positive correlation to the CPI. In other words, as wages increases, prices also increase. This trend can negate the impact increased wages have on consumer purchasing power and their view of the economy.

International events and circumstances play a significant role in the US economy and stock market, which in turn is reflected in the ICS. There is a moderately positive correlation between the GSPC and the ICS, meaning when the stock market sees increased returns, consumer sentiment also increases.

Beyond the limited data in this report, consumer sentiment can be swayed by the political landscape, societal discourse, global pandemic, recessions, housing market boom and collapse, wars, racial injustice, human rights violations, impact of climate change and focus on sustainable practices, etc. All of these factors, and more, contribute to consumer buying behavior, their outlook on the economy, and their future. While we cannot capture all of the factors that contribute to consumer sentiment here, we can conclude inflation is currently at the top of the list. [4][5]

```
#plot each variable with average index
df_avgCPI <- df %>% group_by(Index) %>% summarize(avg_CPI = mean(CPI))
df_avgfedrate <- df %>% group_by(Index) %>% summarize(avg_fed = mean(Fed.Rate))
df_avghrrate <- df %>% group_by(Index) %>% summarize(avg_hrrate = mean(Hr.Rate))
df_avgunemp <- df %>% group_by(Index) %>% summarise(avg_unemp = mean(Unemp))

c <- ggplot(df_avgunemp, aes(x = Index, y = avg_unemp)) + geom_line(color = 'blue') +
ggtitle("Average Unemp. Rate vs ICS")
d <- ggplot(df_avgCPI, aes(x = Index, y = avg_CPI)) + geom_line(color = 'blue') + ggt
itle("Average CPI vs ICS")
e <- ggplot(df_avgfedrate, aes(x = Index, y = avg_fed)) + geom_line(color = 'blue') +
ggtitle("Average Federal Rate vs ICS")
f <- ggplot(df_avghrrate, aes(x = Index, y = avg_hrrate)) + geom_line(color = 'blue')
+ ggtitle("Average Hourly Rate vs ICS")
(c + d) / (e + f)
```

Average Unemp. Rate vs ICS

Average CPI vs ICS

Average Federal Rate vs ICS

Average Hourly Rate vs ICS
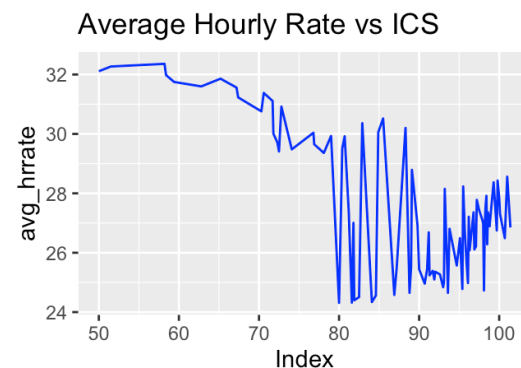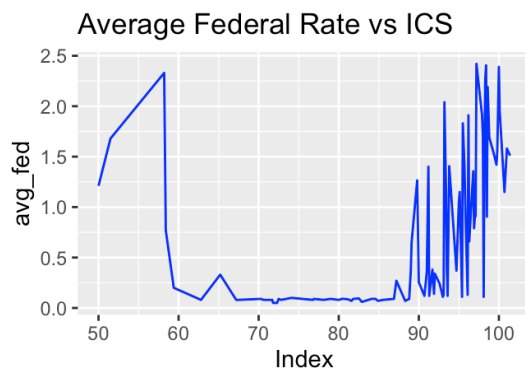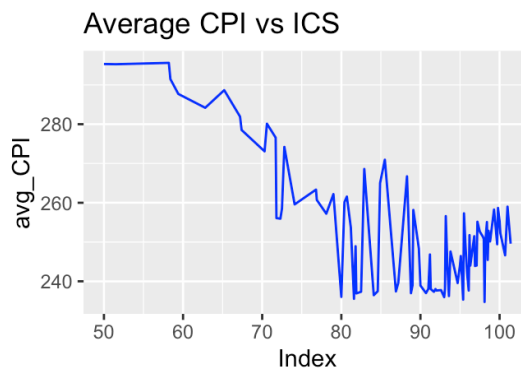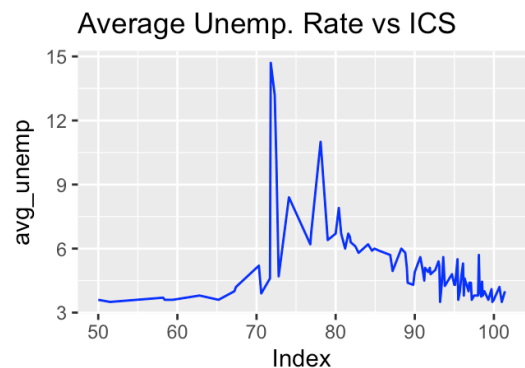
```
#GSPC stock market adjusted prices
stocks <- as.matrix(c("^GSPC"))
first_date <- ymd('20140101')
last_date <- ymd('20221031')
GSPC_df <- yf_get(tickers = stocks, first_date, last_date,
                  freq_data = 'monthly') |> mutate(freq = 'monthly')
l_wide <- yf_convert_to_wide(GSPC_df)
GSPC_df <- as.data.frame(l_wide$ret_closing_prices)
colnames(GSPC_df) <- c('Date', 'GSPC')
GSPC_df <- GSPC_df %>% drop_na()
```

```r
#summarize data by year & merge with GSPC
df$Year <- year(df$Date)
group_df <- df %>% group_by(Year) %>%
  summarize(mean_index = mean(Index), mean_hr_rate = mean(Hr.Rate),
            mean_CPI = mean(CPI), mean_unemp = mean(Unemp), mean_fed = mean(Fed.Rate)
)
group_df <- as.data.frame(group_df)

GSPC_df$Year <- year(GSPC_df$Date)
GSPC_group_df <- GSPC_df %>% group_by(Year) %>% summarize(mean_GSPC = mean(GSPC))
GSPC_group_df <- as.data.frame(GSPC_group_df)

group_stats <- merge(group_df, GSPC_group_df, by = "Year", all = TRUE)
group_stats <- group_stats %>% drop_na()
```

```r
#plot average of the variables to see the trends of each side-by-side
g <- ggplot(group_stats, aes(x = Year, y = mean_index)) + geom_line() + ggtitle("ICS"
)
h <- ggplot(group_stats, aes(x = Year, y = mean_unemp)) + geom_line() + ggtitle("Unem
ployment")
i <- ggplot(group_stats, aes(x = Year, y = mean_fed)) + geom_line() + ggtitle("Federa
l Rate")
j <- ggplot(group_stats, aes(x = Year, y = mean_hr_rate)) + geom_line() + ggtitle("Ho
urly Rate")
k <- ggplot(group_stats, aes(x = Year, y = mean_CPI)) + geom_line() + ggtitle("CPI")
l <- ggplot(group_stats, aes(x = Year, y = mean_GSPC)) + geom_line() + ggtitle("GSPC"
)
(g + h + i) / (j + k + l)
```
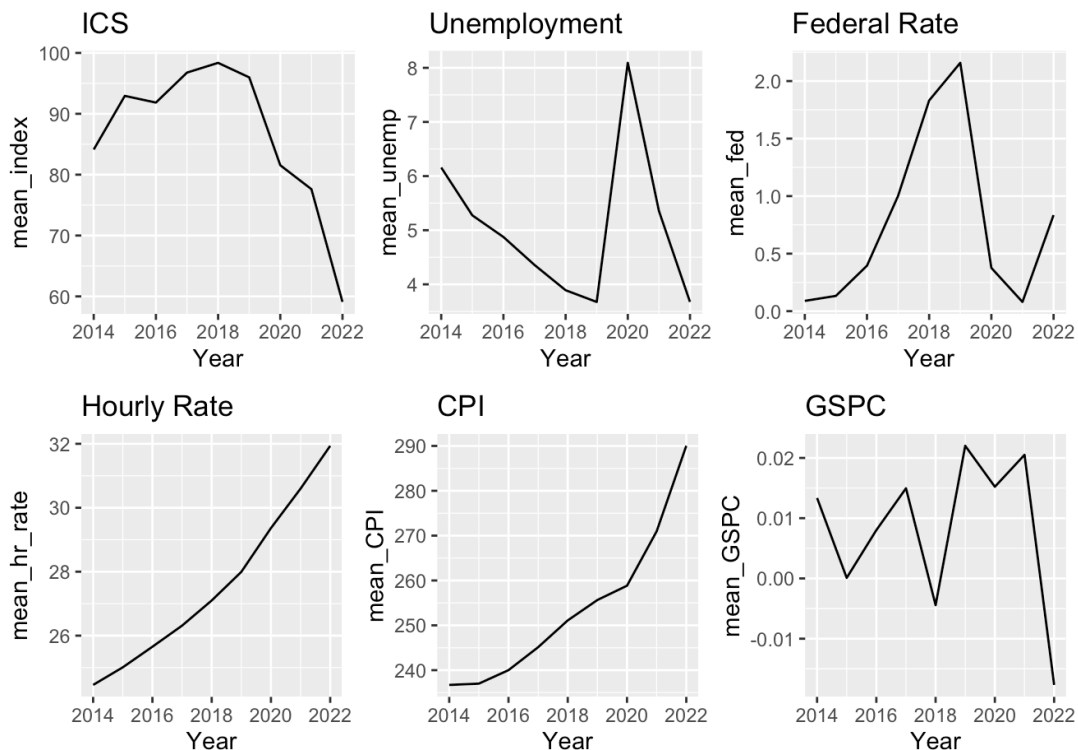
```
#plot correlation matrix
corr <- cor(group_stats[c("mean_index", "mean_hr_rate", "mean_CPI", "mean_unemp",
                          "mean_fed", "mean_GSPC")])
corrplot(corr, method = 'color', col = COL2('PRGn'), diag = FALSE, tl.cex = 0.75)
```
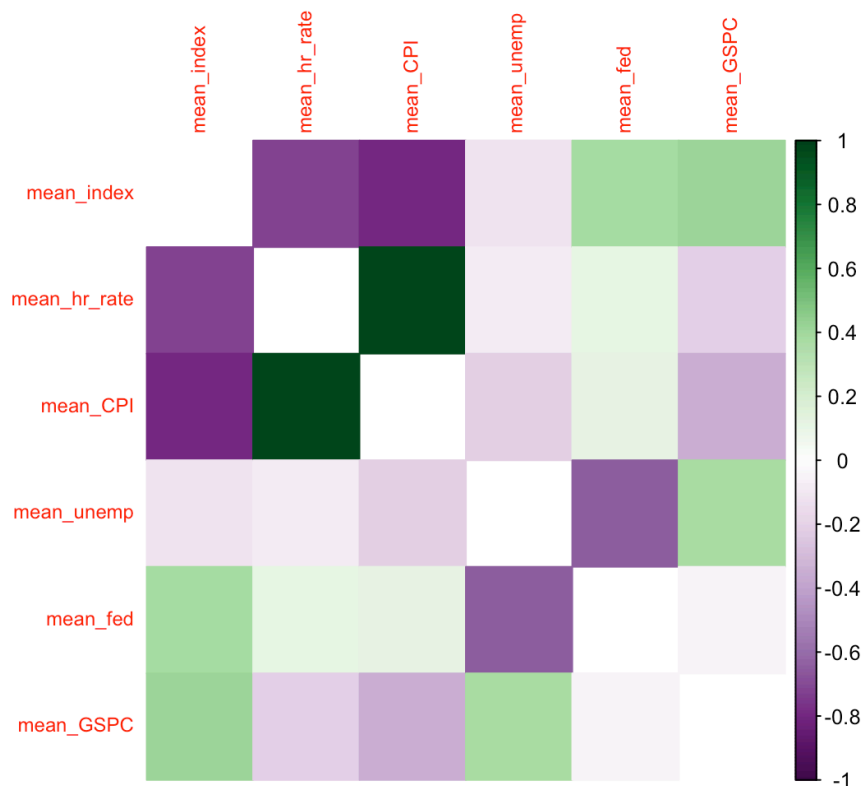
Use Cases of the Index of Consumer Sentiment

First, from the survey we can state that consumer confidence is an important component of consumer behavior. UM has described the importance of consumer confidence and economic expectations while choosing when to make discretionary purchases. Second, no one indicator can capture all the variations in the state of the economy that have an impact on consumer spending. While such stark divergences are uncommon, the Survey of Consumers provide the data required to track each of the significant variables that influence purchasing behavior independently. Third, it has been demonstrated through empirical research that consumer expectations are capable of projecting future spending patterns rather than just current expenditure. Fourth, all indices have some degree of measurement and sampling error; no index is measured accurately. Although steady rather than irregular month-to-month fluctuations have been observed in the past with the Survey of Consumers, this reduces the possibility of erroneous signals. Even the preliminary results for the middle of the month are more precise than statistical theory would predict. Finally, it hardly seems necessary to mention that while none of these ideas are novel, they are all crucial for the proper use of the consumer survey data from the University of Michigan.

Comparisons Between the United States and Russia: Consumer confidence structure research revealed that there are far more parallels than differences between the US and Russia. The findings provide significant support against the theory that the overall structures are unrelated, even while it is obvious that it cannot be accepted that the structures are identical. The analysis showed that, in some aspects, the approach produced statistical qualities that were more desirable in Russia than the US. For instance, the inter-item correlations among the five index components were stronger in the Russian data than in the cross-sectional data from the US.

The comparison of optimism and pessimism among subgroups of people based on their age and wealth revealed a startling degree of similarity between the US and Russia. The US and Russian profiles across income categories were all comparable, with the exception of the question about buying circumstances. The age groupings showed the biggest variances.

The statistics presented convey the sense that people in the US and Russia try to arrive at a coherent interpretation of the economic events that directly affect their lives, even though this analysis cannot demonstrate the existence of an economic belief system.

Consumer Economic Expectations and Persistent Partisan Differences: Following President Trump's election, there was an unprecedented party rift in economic expectations and those differences have remained constant for more than a year. Although political differences in economic forecasts are expected to exist soon following a presidential election, they have not changed as of mid-2018.

Currently, the contrasts in partisan preferences for economic policy are the most glaring. Respondents were questioned about four major problems in surveys conducted from July to October 2016 and again from February to March 2018 before and after Trump's election: trade, immigration, income inequality, and Social Security.

Differential expectancy between population groupings are consistently recorded in surveys conducted by UM. Expectations differ frequently among subgroups based on age, income, and education. According to life-cycle theory, younger workers see higher pay increases than older ones. The time-series correlation is still quite high

despite these mean variations among demographic categories. In order to create their predictions, econometric models often ignore mean differences and rely on correlations.

Political party identification would not impair the econometric models' ability to forecast outcomes if it had a similar effect, exhibiting differences in mean levels and high time-series inter-correlations. The Trump gap was higher than the historical gaps by age and income quintiles, but historically, the gaps were at their widest around previous peaks, according to data, even though the present gap is larger than those in the past. Despite the mean disparities, the time-series correlations between those socioeconomic categories remained incredibly high. Partisan divisions could exhibit the same pattern. Unfortunately, unless more data is gathered in the next years, that remains only a hypothesis. [6][7][8]

References

[1] https://www.gartner.com/en/marketing/glossary/consumer-sentiment (https://www.gartner.com/en/marketing/glossary/consumer-sentiment)

[2] https://data.sca.isr.umich.edu/fetchdoc.php?docid=24770 (https://data.sca.isr.umich.edu/fetchdoc.php?docid=24770)

[3] https://data.sca.isr.umich.edu/fetchdoc.php?docid=24774 (https://data.sca.isr.umich.edu/fetchdoc.php?docid=24774)

[4] https://www.reuters.com/world/us/us-consumer-sentiment-sours-early-january-second-lowest-level-decade-2022-01-14/ (https://www.reuters.com/world/us/us-consumer-sentiment-sours-early-january-second-lowest-level-decade-2022-01-14/)

[5] https://news.umich.edu/consumer-sentiment-sinks-to-decade-low/ (https://news.umich.edu/consumer-sentiment-sinks-to-decade-low/)

[6] Curtin, R. (September 12 - 14, 2018). Consumer Economic Expectations: Persistent Partisan Differences. 2018 Ciret Conference. Rio de Janeiro, Brazil.

[7] Curtin, R.T. (September 30, 2002). Surveys of Consumers: Theory, Methods, and Interpretation. NABE 44th Annual Meeting. Washington, DC September 30, 2002.

[8] Curtin, R.T. (n.d.). The Structure of Consumer Confidence: Comparisons Between the United States and Russia.