**Group final project**

Final Project Milestone

• Prepare well-written draft of introduction section for final project; include

– topic description

– motivation

– propose an outline of possible sections in paper/presentation

• Explicitly detail resources for the project, e.g. – sections/pages of reference books – internet articles/pages

• Prepare a few slides for a mini presentation of project

Possible Data Sources for Final Project:

• The Federal Reserve Economic Data Website: https://fred.stlouisfed.org/ – Explore Macro Snapshot – Popular Series – Search Fred Data (for topics of interest)

• The World Bank Databank Website: https://databank.worldbank.org/home –<https://databank.worldbank.org/source/health-nutrition-and-population-statistics>

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# 1. Executive Summary

# 1.1 Project Overview

This report embarks on an insightful journey into the world of stock indices through the application of time series analysis, particularly leveraging the ARIMA (AutoRegressive Integrated Moving Average) and ETS (Exponential Smoothing) models.

The analysis of stock indices via time series methods provides a comprehensive understanding of market behaviors, highlighting trends, seasonal variations, and potential future movements. The goal of this report is to utilize these sophisticated statistical models to extract meaningful information from historical stock index data, enhancing predictive accuracy and informing strategic decision-making.

The ARIMA model, with its robust handling of autoregressive and moving average components, and the ETS model, with its ability to address error, trend, and seasonality components, together form a comprehensive approach. We will meticulously analyze the stock index data using these models, aiming to interpret the findings within the context of today’s dynamic financial landscape.

The insights derived from this analysis are expected to empower investors, researchers, and market analysts with a deeper understanding of the stock index’s past behavior and its implications for future performance.

## 1.2 Relevant Theories/Models

ETS Model / ARIMA Model/ Testing Estimated Residuals

# 2. Introduction

## 2.1 Background of the Study

The global financial markets have evolved significantly in recent decades, becoming increasingly interconnected and complex. Two of the world’s most influential economies, the United States and China, have been at the forefront of this transformation. Their respective stock indices, the S&P 500 in the U.S. and the Shanghai Composite Index in China, have a profound impact on global market dynamics. Understanding these indices’ behaviors is crucial for investors, policymakers, and researchers alike, as these indices often serve as a barometer for the broader economic health of these nations. Traditional analysis methods can be valuable, but they often fail to predict future trends effectively due to the inherently dynamic and non-linear nature of financial markets. This necessitates the adoption of more sophisticated analytical methods. One such method is time series analysis, which takes into account temporal dependencies and fluctuations in the data over time, providing a deeper understanding of patterns and predictive insights. This report aims to apply time series analysis to the study of the American and Chinese stock indices, with an aim to unravel their underlying patterns, dependencies, and possibly forecast future movements.

## 2.2 Motivation of the Research

In the ever-evolving world of finance, investors are always on the lookout for information that will give them an edge. As Warren Buffet famously said, "Risk comes from not knowing what you're doing." In this context, understanding the dynamics of stock indices becomes critical. A stock index reflects the performance of a group of shares and is often seen as a barometer of the economy's health. Analyzing stock indices gives a comprehensive overview of market trends, investor sentiment, and potential investment opportunities.

Given the dynamic and often volatile nature of financial markets, regular and detailed analysis of key stock indices is paramount. It helps investors make informed decisions, from choosing the right time to invest to selecting which sectors have the most promising outlooks. The more data we can harness, and the better our understanding of the market trends, the more equipped we are to anticipate future movements and take appropriate action.

This report aims to provide an in-depth analysis of a key stock index. By identifying and understanding patterns, trends, and shifts, we hope to empower investors with knowledge and insights that could be pivotal for their investment decisions. The goal is not just to inform but to foster better understanding and promote intelligent investing.

In an era where data is the new oil, we believe that the insights gleaned from this analysis could prove invaluable, ultimately contributing to robust financial strategies and, potentially, more stable and prosperous economies.

## 2.3 Scope of the Report

This report is focused on using time series analysis to examine the fluctuations and trends in the stock indices of the United States and China from January 2010 to December 2023. Our study centers on four major economic powers: the United States, represented by the NASDAQ index and Dow Jones Industrial Average; China, represented by the Shanghai Composite Index, SZSE Component Index.

To conduct this analysis, we will use both primary data (derived from the actual historical performances of the indices) and secondary data (sourced from relevant financial and economic literature and reports). This study will specifically scrutinize broad market trends and patterns but will not delve into the performance of individual stocks or specific sectors within these markets.

Potential limitations of this report include the unpredictable nature of the stock markets and the numerous external factors that can impact them, such as political events, policy changes, and global economic trends. Additionally, while our time series analysis can highlight patterns and suggest correlations, it is not intended to predict future performances of the indices.

# 3. Methodology

## 3.1 Research Design

## 3.2 Data Collection Methods

## 3.3 Data Analysis Techniques

# 4. Forecast and Analysis

## 4.1 Presentation of Data

## 4.2 Detailed Analysis

# 5. Discussion

## 5.1 Interpretation of Findings

## 5.2 Comparison of the ETS Model and ARIMA Model

# 6. Recommendations

## 6.1 Suggested Actions

## 6.2 Future Research Directions

# 7. Conclusion

## 7.1 Summary of Findings

## 7.2 Implications

# Reference

Yahoo Finance. (2023, July 17). Global X Dow 30 Covered Call ETF (DJIA) Stock       Price, News, Quote & History. Retrieved July 17, 2023, from <https://finance.yahoo.com/quote/DJIA?p=DJIA&.tsrc=fin-srch>

Yahoo Finance. (2023, July 17). SSE Composite Index (000001.SS) Charts, Data & News. Yahoo Finance. Retrieved July 17 ,2023 from https://finance.yahoo.com/quote/000001.SS?p=000001.SS&.tsrc=fin-srch

# Appendices

## Code\_1

#following code use python to grab the stock index data from Yahoo Finance

import yfinance as yf

start\_date = "1995-02-20"

end\_date = "2023-07-17"

sz = yf.download('399001.SZ', start=start\_date, end=end\_date)

DJIA=yf.download('DJI', start=start\_date, end=end\_date)

NASDAQ=yf.download('^IXIC', start=start\_date, end=end\_date)

SS=yf.download('000001.SS', start=start\_date, end=end\_date)

sz.to\_csv('data/399001sz.csv')

DJIA.to\_csv('data/DJIA.csv')

NASDAQ.to\_csv('data/NASDAQ.csv')

SS.to\_csv('data/000001ss.csv')

## Code\_2

#following code use R and the data from code\_1 to generate plot

library(fpp2)

library(rmarkdown)

library(itsmr)

library(readr)

DJIA<-read\_csv("data/DJIA.csv")

SS\_1<-read\_csv("data/000001ss.csv")

NASDAQ<-read\_csv("data/NASDAQ.csv")

SZ399001<-read\_csv("data/399001sz.csv")

DJIA.ts <- ts(DJIA[,"Close"])

ss.ts<-ts(SS\_1[,"Close"])

na.ts<-ts(NASDAQ[,"Close"])

sz.ts<-ts(SZ399001[,"Close"])

DJIA.tsd<-ts(DJIA[,"Close"]-DJIA[,"Open"])

DJIA.return<-ts((DJIA[,"Close"]-DJIA[,"Open"])/DJIA[,"Open"])

ss.tsd<-ts(SS\_1[,"Close"]-SS\_1[,"Open"])

ss.return<-ts((SS\_1[,"Close"]-SS\_1[,"Open"])/SS\_1[,"Open"])

na.tsd<-ts(NASDAQ[,"Close"]-NASDAQ[,"Open"])

na.return<-ts((NASDAQ[,"Close"]-NASDAQ[,"Open"])/NASDAQ[,"Open"])

sz.tsd<-ts(SZ399001[,"Close"]-SZ399001[,"Open"])

sz.return<-ts((SZ399001[,"Close"]-SZ399001[,"Open"])/SZ399001[,"Open"])

autoplot(DJIA.ts)

autoplot(DJIA.tsd)

autoplot(DJIA.return)

test(DJIA.ts)

test(DJIA.tsd)

test(DJIA.return)

autoplot(ss.ts)

autoplot(ss.tsd)

autoplot(ss.return)

test(ss.ts)

test(ss.tsd)

test(ss.return)

autoplot(na.ts)

autoplot(na.tsd)

autoplot(na.return)

test(na.ts)

test(na.tsd)

test(na.return)

autoplot(sz.ts)

autoplot(sz.tsd)

autoplot(sz.return)

test(sz.ts)

test(sz.tsd)

test(sz.return)