Time Series Analysis of Gold Price

Zakia Khanom Tisha

We will discuss:

- Gold Price Data Exploration
- Analysis of the Data
- Model Selection
- Model Fitting
- Residual Analysis
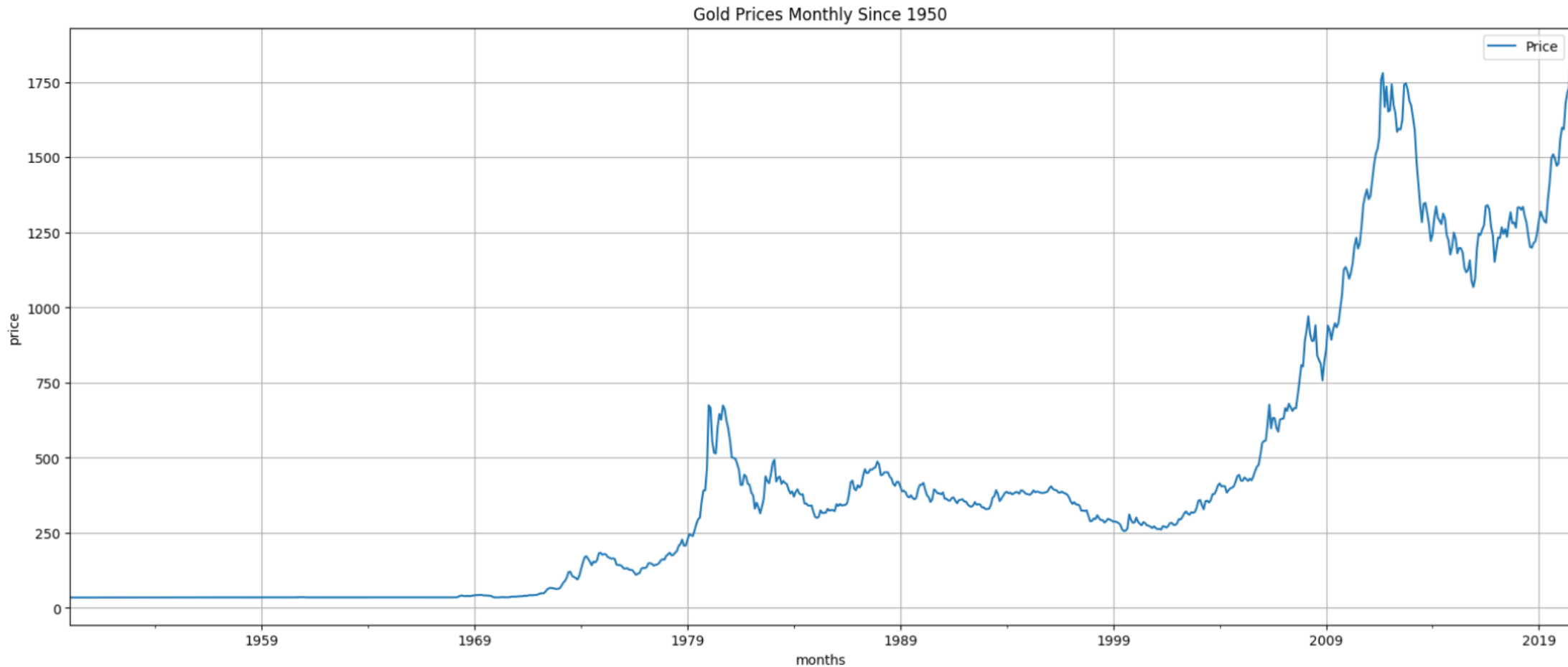- Forecasting

UPPSALA
UNIVERSITET

Why Predict Gold Price:

- Gold is safest investment
- Economic Indicators
- Reserve Management
- Optimizing Returns
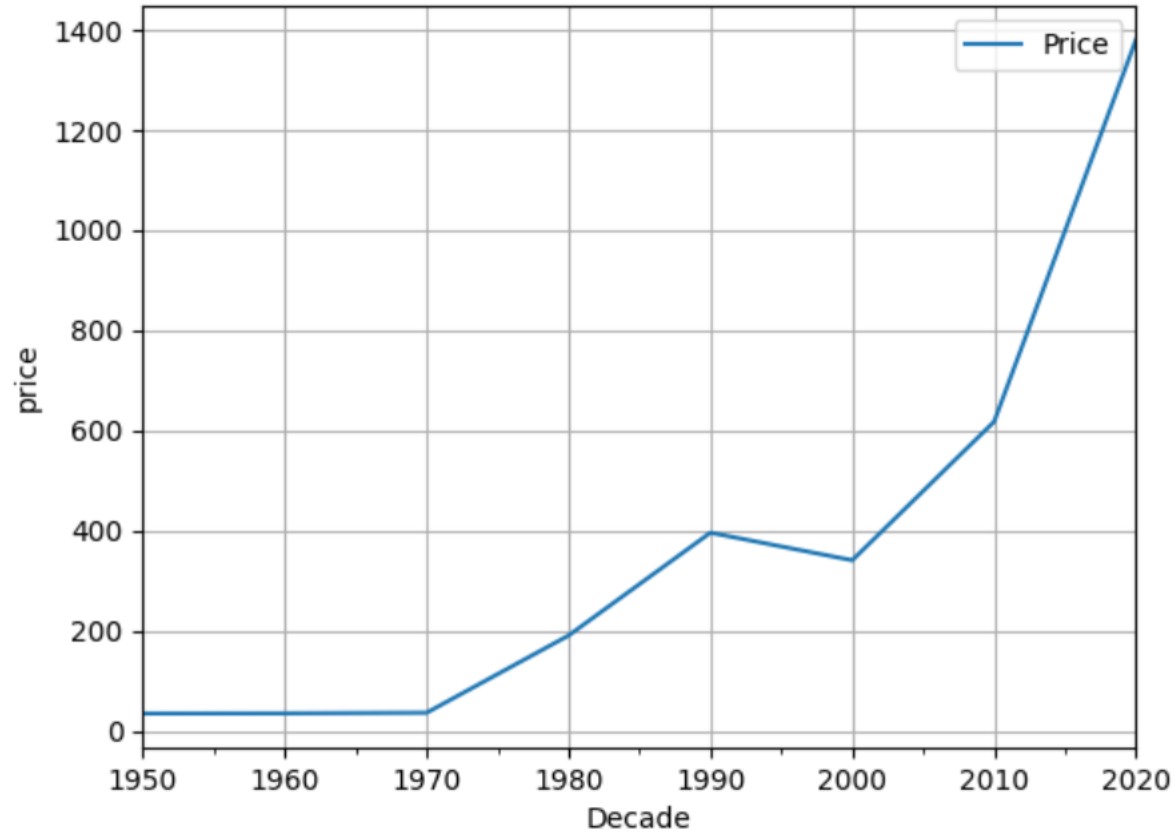- Financial Stability

Gold Data Analysis

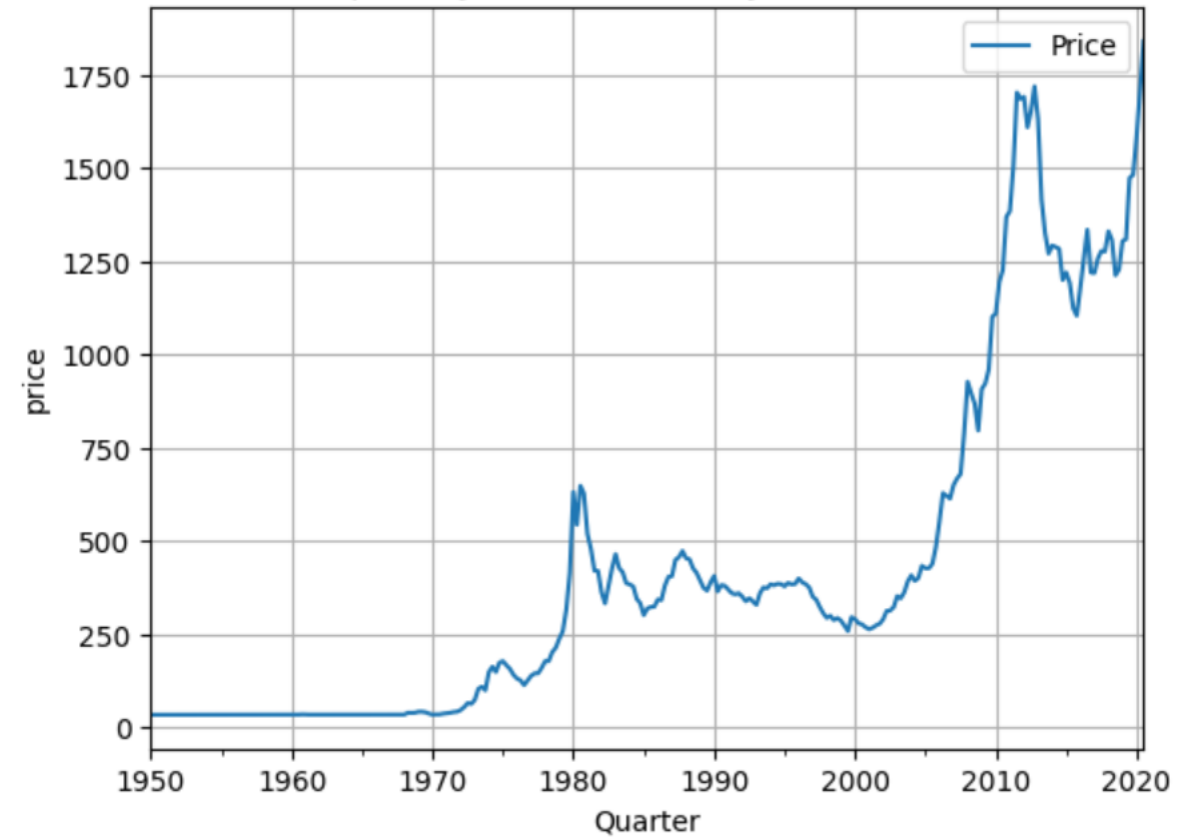**The data was taken from Business Standers Data Source from USA (1950 -2019)**

Gold Prices Monthly Since 1950

UPPSALA
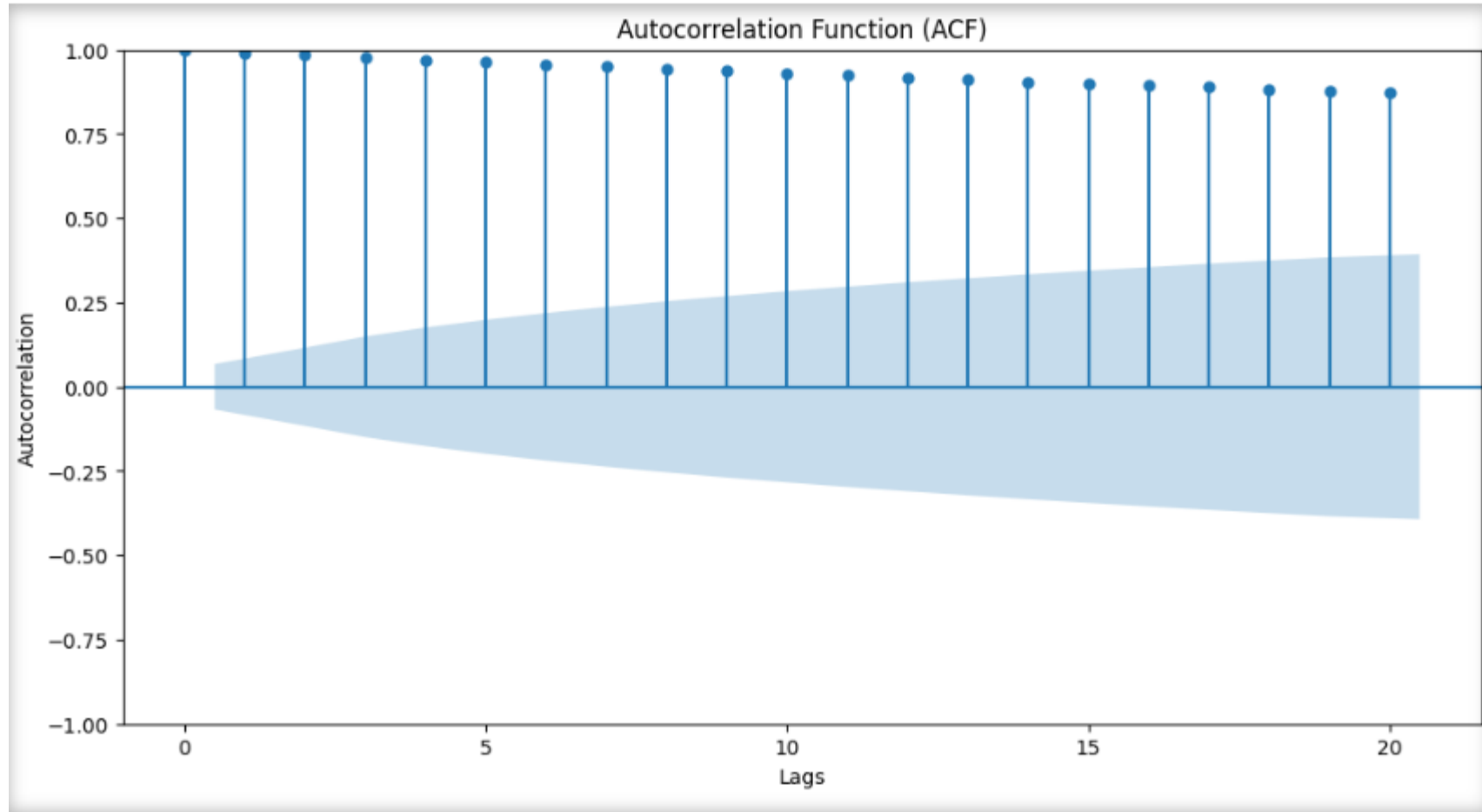UNIVERSITET

Gold Data Analysis
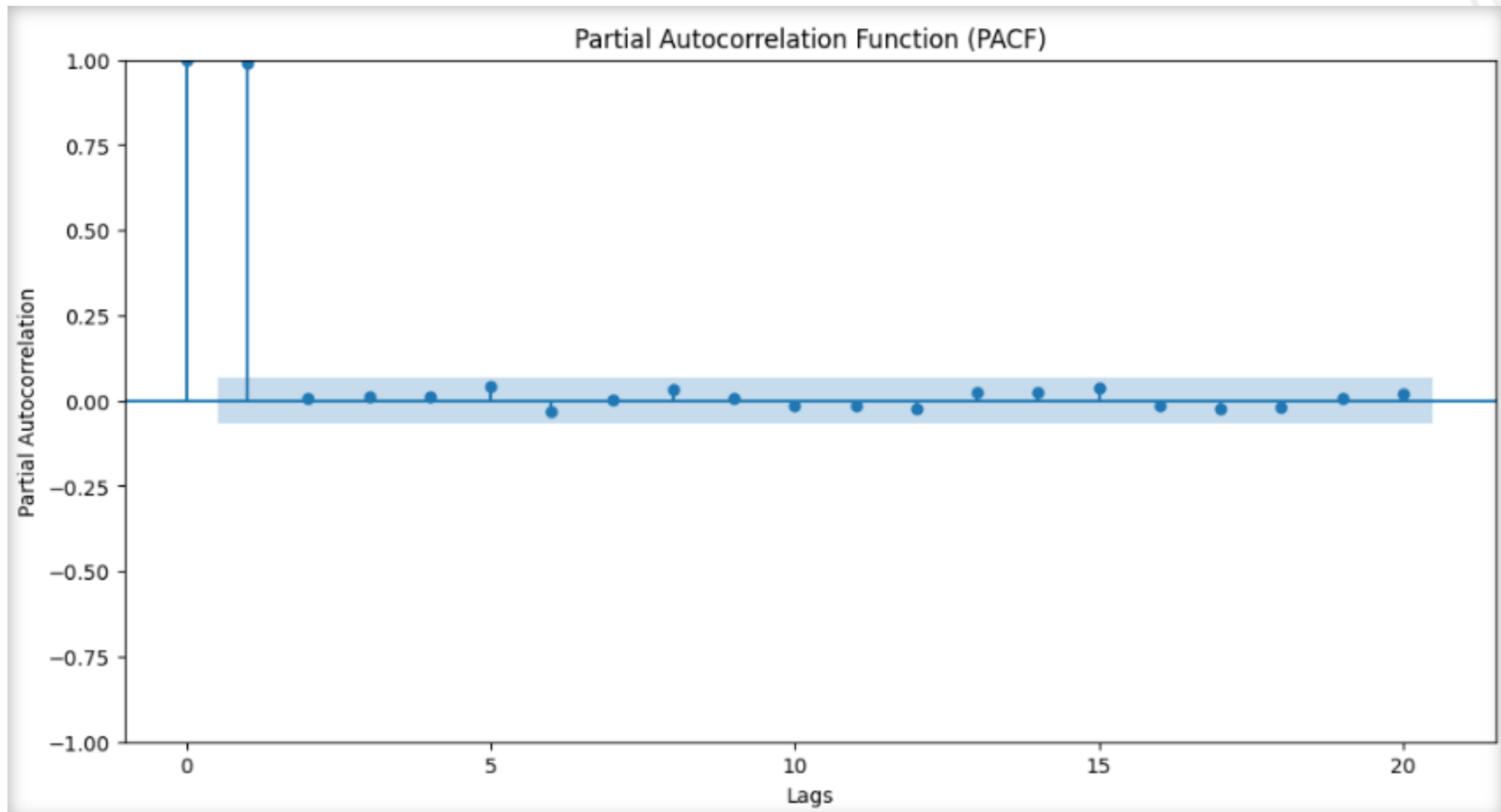

Gold Price per decade since 1950

quaterly Gold Price Yearly since 1950

ACF of Actual Data

Gold Data Analysis

Model Selection

```
Performing stepwise search to minimize aic
 ARIMA(2,2,2)(0,0,0)[0] intercept   : AIC=inf, Time=1.24 sec
 ARIMA(0,2,0)(0,0,0)[0] intercept   : AIC=8205.657, Time=0.08 sec
 ARIMA(1,2,0)(0,0,0)[0] intercept   : AIC=8108.773, Time=0.12 sec
 ARIMA(0,2,1)(0,0,0)[0] intercept   : AIC=7834.494, Time=0.31 sec
 ARIMA(0,2,0)(0,0,0)[0]             : AIC=8203.672, Time=0.08 sec
 ARIMA(1,2,1)(0,0,0)[0] intercept   : AIC=inf, Time=0.85 sec
 ARIMA(0,2,2)(0,0,0)[0] intercept   : AIC=inf, Time=0.72 sec
 ARIMA(1,2,2)(0,0,0)[0] intercept   : AIC=7788.411, Time=0.50 sec
 ARIMA(1,2,3)(0,0,0)[0] intercept   : AIC=inf, Time=1.20 sec
 ARIMA(0,2,3)(0,0,0)[0] intercept   : AIC=inf, Time=1.00 sec
 ARIMA(2,2,1)(0,0,0)[0] intercept   : AIC=inf, Time=0.79 sec
 ARIMA(2,2,3)(0,0,0)[0] intercept   : AIC=inf, Time=1.39 sec
 ARIMA(1,2,2)(0,0,0)[0]             : AIC=7786.785, Time=0.30 sec
 ARIMA(0,2,2)(0,0,0)[0]             : AIC=inf, Time=0.32 sec
 ARIMA(1,2,1)(0,0,0)[0]             : AIC=inf, Time=0.22 sec
 ARIMA(2,2,2)(0,0,0)[0]             : AIC=inf, Time=0.52 sec
 ARIMA(1,2,3)(0,0,0)[0]             : AIC=inf, Time=0.94 sec
 ARIMA(0,2,1)(0,0,0)[0]             : AIC=7832.826, Time=0.13 sec
 ARIMA(0,2,3)(0,0,0)[0]             : AIC=7793.301, Time=0.25 sec
 ARIMA(2,2,1)(0,0,0)[0]             : AIC=7796.870, Time=0.37 sec
 ARIMA(2,2,3)(0,0,0)[0]             : AIC=inf, Time=0.68 sec

Best model:  ARIMA(1,2,2)(0,0,0)[0]
Total fit time: 12.010 seconds
Optimal order for ARIMA model: (1, 2, 2)
```

UPPSALA
UNIVERSITET

Model Selection

- To Select Optimal Model Python Libraries are Used
- auto_arima function from pmdarima library used to find optimal ARIMA model
- Tested different combinations of ARIMA parameters (p, d, q)
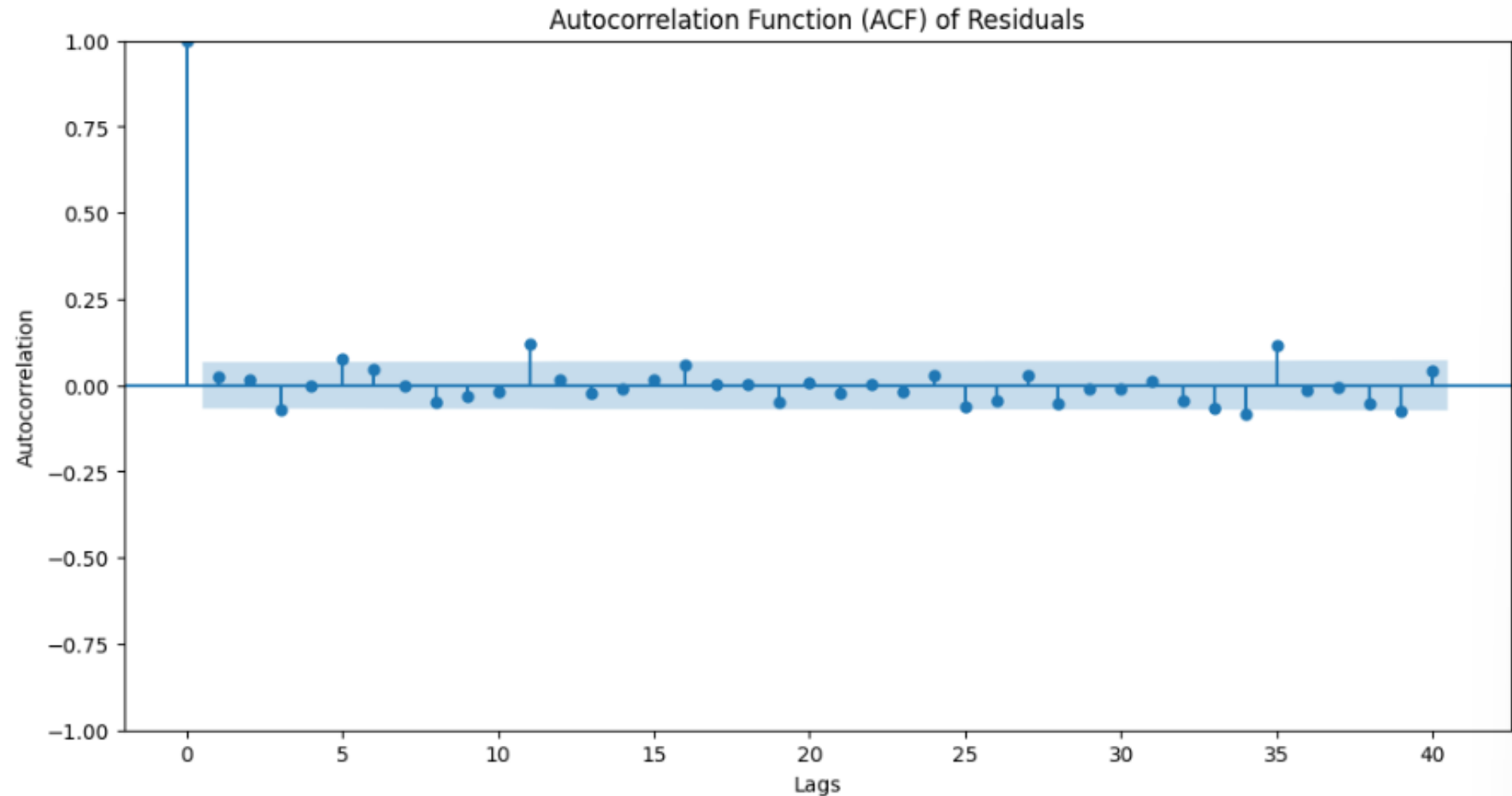- Optimal model was ARIMA (1,2,2)

Model Fitting and Residual Analysis
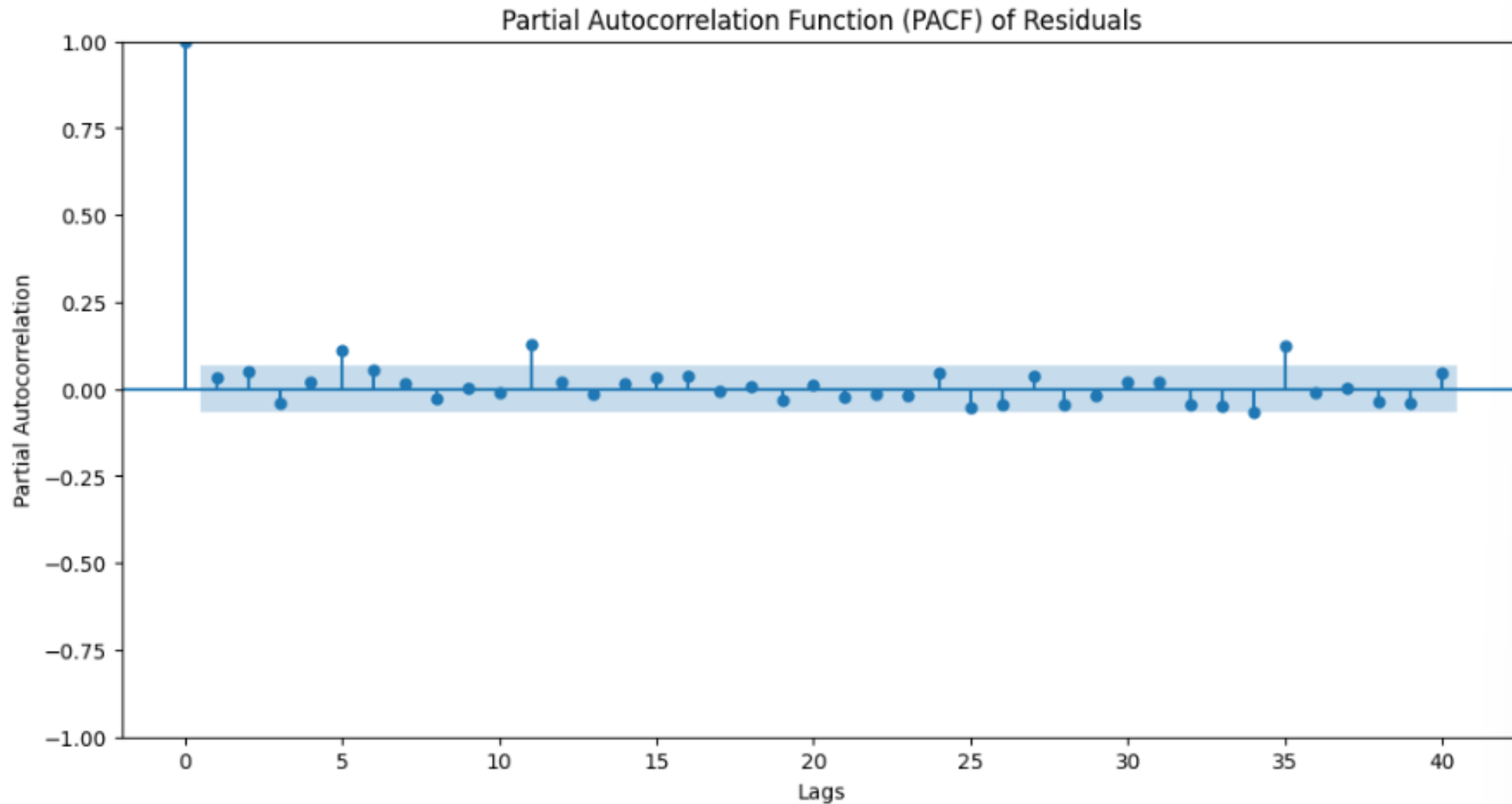
- ARIMA (1,2,2) was fitted to Gold Data
- Residuals behave like white noise

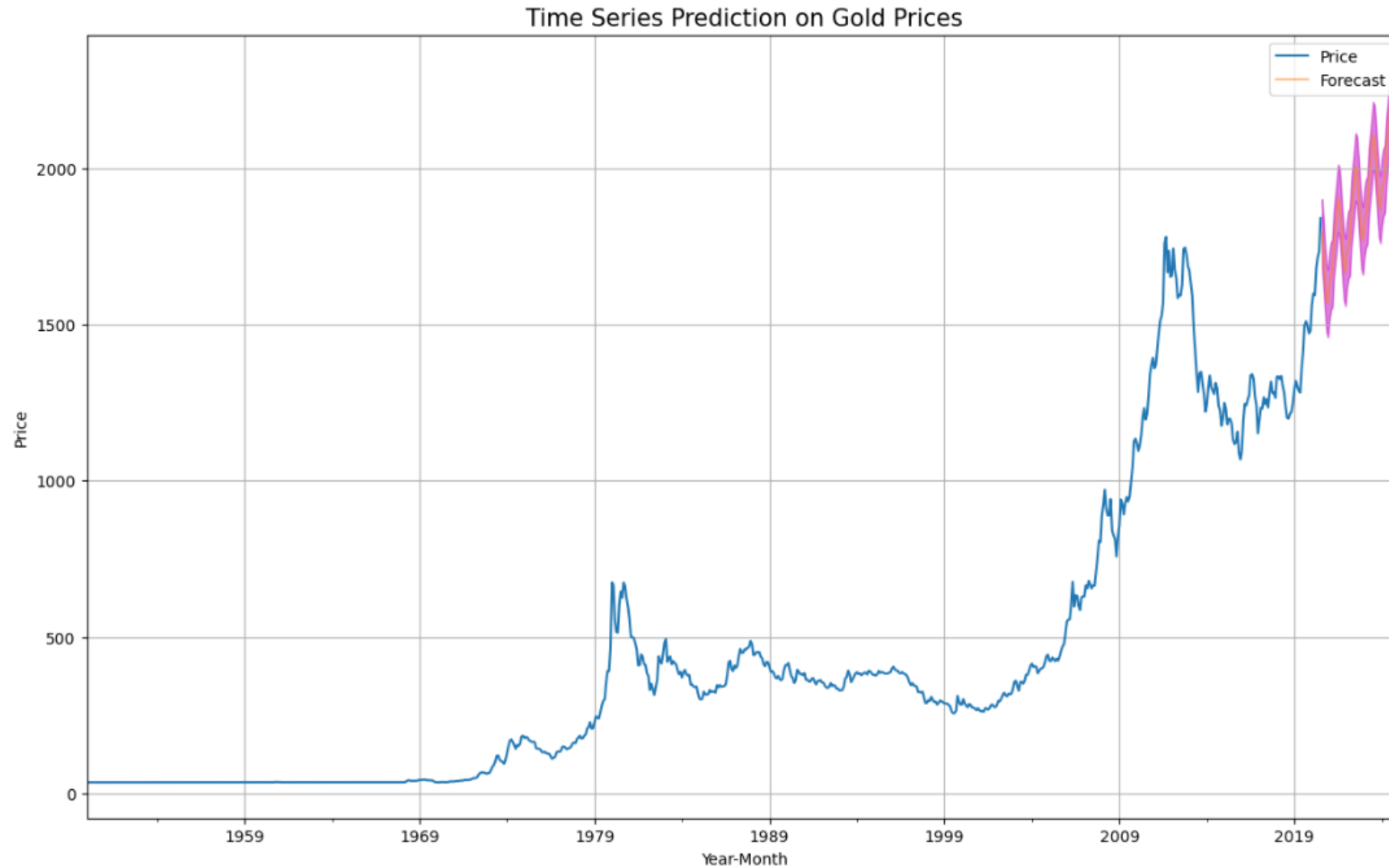Residuals from ARIMA Model

Residuals Analysis And Model Fitting

Autocorrelation Function (ACF) of Residuals
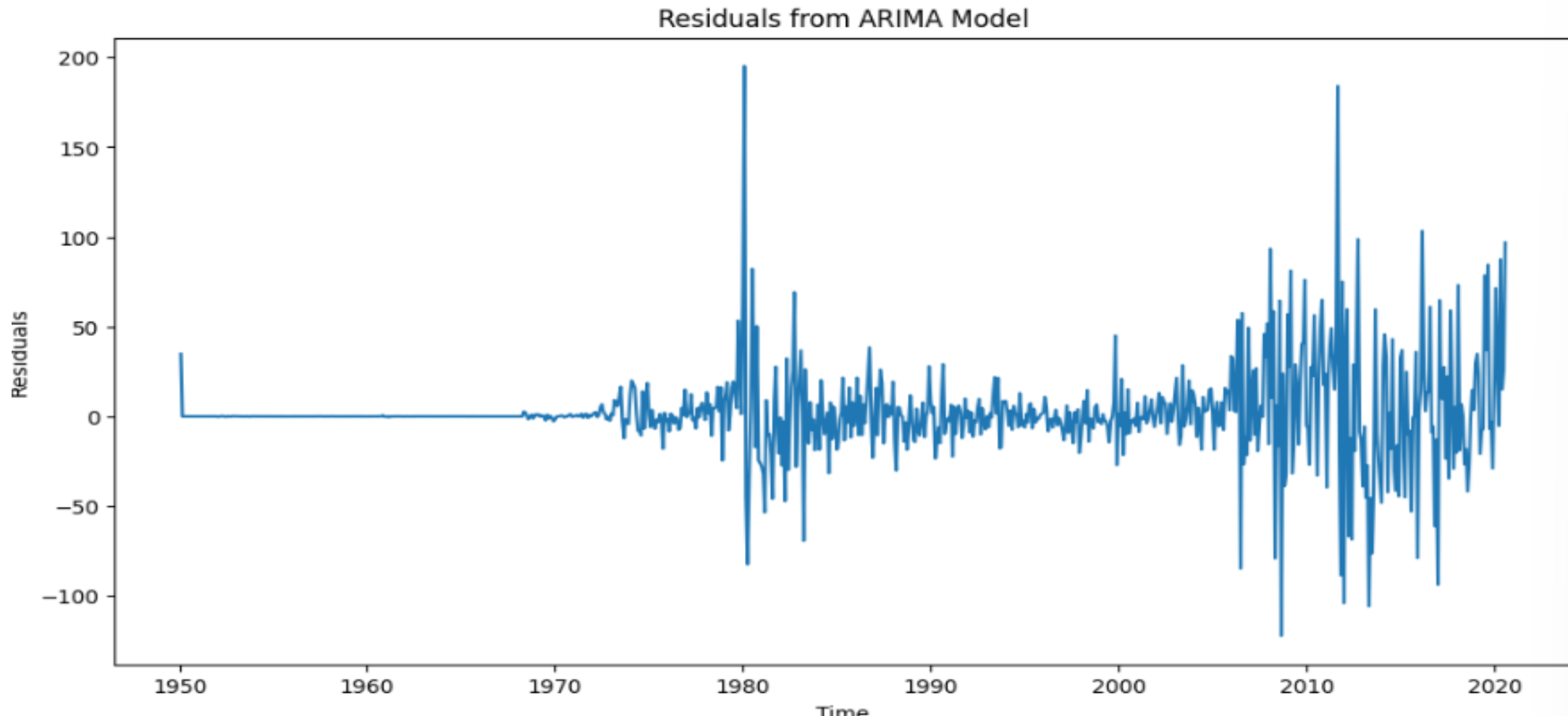
Residuals Analysis And Model Fitting

Residuals Analysis And Model Fitting

```
                             SARIMAX Results
==============================================================================
Dep. Variable:                  Price   No. Observations:                  847
Model:                 ARIMA(1, 2, 2)   Log Likelihood               -3889.393
Date:                Tue, 14 May 2024   AIC                           7786.785
Time:                        10:55:35   BIC                           7805.743
Sample:                    01-31-1950   HQIC                          7794.049
                         - 07-31-2020
Covariance Type:                  opg
==============================================================================
                 coef    std err          z      P>|z|      [0.025      0.975]
------------------------------------------------------------------------------
ar.L1         -0.6018      0.041    -14.786      0.000      -0.682      -0.522
ma.L1         -0.1598      0.031     -5.173      0.000      -0.220      -0.099
ma.L2         -0.7731      0.028    -27.501      0.000      -0.828      -0.718
sigma2       581.0090     10.903     53.287      0.000     559.639     602.379
===================================================================================
Ljung-Box (L1) (Q):                   0.57   Jarque-Bera (JB):              5297.12
Prob(Q):                              0.45   Prob(JB):                         0.00
Heteroskedasticity (H):             445.42   Skew:                             0.49
Prob(H) (two-sided):                  0.00   Kurtosis:                        15.23
===================================================================================
```

Forecasting

Time Series Prediction on Gold Prices

Conclusion

The ARIMA(1,2,2) model was identified as the optimal model for forecasting gold prices, successfully addressing both trend and autocorrelation in the data. Future work could focus on incorporating exogenous variables and testing seasonal ARIMA models to further enhance forecasting accuracy

Thank you!