



**SCHOOL OF SCIENCE AND TECHNOLOGY**  
**DEPARTMENT OF DATA SCIENCE AND ANALYTICS**  
**SUMMER 2024 – ASSIGNMENT 5**

**COURSE CODE:** STA 3050A

**UNIT NAME:** TIME SERIES AND FORECASTING

**DATE:** 27<sup>TH</sup> JULY 2024

**TOTAL MARKS:** 100 MARKS

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**INSTRUCTIONS:**

For this exercise:

1. ANSWER ALL QUESTIONS
2. Do all your work in the Rmarkdown (.rmd).
3. Submissions should be in either a **`.rmd` file**
4. NO SUBMISSIONS SHOULD BE DONE VIA EMAIL

### QUESTION 1: Fitting an ARMA Model:

You are a data analyst tasked with modeling a time series using an ARMA model. Your objective is to understand the dynamics of the series and make future forecasts.

**Packages:** forecast and tseries

1. Simulate a time series dataset of length 500 from an ARMA(2,1) model with AR parameters 0.5 and 0.3, and an MA parameter 0.4. Ensure you set a seed for reproducibility
2. Plot the simulated time series data and describe any patterns or characteristics you observe
3. Plot the ACF and PACF of the simulated ARMA data. Interpret the plots
4. Fit an ARMA(2,1) model to the simulated data. Summarize the model and interpret the key output components, including parameter estimates and their significance, standard error, and model fit statistics
5. Perform the diagnostic checks on the fitted ARMA model, including residual analysis and autocorrelation checks
6. Using the fitted ARMA model, forecast the next 20 data points. Plot the forecasted values along with their confidence intervals.
7. Discuss the reliability of these forecasts based on the model diagnostics.

### QUESTION 2: Fitting an ARIMA Model:

You have another time series that appears to be non-stationary. Your task is to model this series using an ARIMA model to account for its integrated nature.

**Packages:** forecast and tseries

1. Simulate a time series dataset of length 500 from an ARIMA(1,1,1) model with AR parameters 0.65, and an MA parameter 0.4. Ensure you set a seed for reproducibility
2. Plot the simulated time series data and describe any patterns or characteristics you observe
3. Plot the ACF and PACF of the differenced simulated ARIMA data. Interpret the plots
4. Fit an ARIMA(1,1,1) model to the simulated data. Summarize the model and interpret the key output components, including parameter estimates and their significance, standard error, and model fit statistics
5. Perform the diagnostic checks on the fitted ARIMA model, including residual analysis and autocorrelation checks
6. Using the fitted ARIMA model, forecast the next 20 data points. Plot the forecasted values along with their confidence intervals.
7. Discuss the reliability of these forecasts based on the model diagnostics.