NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY

FACULTY OF HEALTH AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS AND STATISTICS

QUALIFICATION: Bachelor of science ; Bachelor of science in Applied Mathematics and Statistics	
QUALIFICATION CODE: 07BAMS	**LEVEL: 7**
COURSE CODE: TSA701S	**COURSE NAME:** TIME SERIES ANALYSIS
SESSION: JULY 2019	**PAPER:** THEORY
DURATION: 3 HOURS	**MARKS: 100**

SECOND OPPORTUNITY EXAMINATION QUESTION PAPER	
EXAMINER	Dr CR. KIKAWA
MODERATOR:	DR LILLIAN PAZVAKAWAMBWA

INSTRUCTIONS

1. Answer ALL the questions in the booklet provided.
2. Show clearly all the steps used in the calculations.
3. All written work must be done in blue or black ink and sketches must be done in pencil.

PERMISSIBLE MATERIALS

1. Non-programmable calculator without a cover.

THIS QUESTION PAPER CONSISTS OF 6 PAGES (Including this front page)

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TIME SERIES ANALYSIS: TSA701S

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Time-3 Hrs **Attempt all Questions** **Maximum Marks - 100**

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1. Questions

   (a) Adjacent observations in time series data (excluding white noise) are independent and identically distributed (IID), discuss the validity of this statement. **(4 marks)**

   (b) A Smoothing parameter close to one gives more weight or influence to recent observations over the forecast. Students that were required to explain the validity of the statement, all stated that it was `true`. You are required to give a motivation to their response. **(4 marks)**

   (c) Discuss the four components of time series. Be as relevant as possible in each case **(8 marks)**

   (d) Describe what is meant by autocovariance and mention the condition for weakly stationary time series. **(4 marks)**

2. Questions

(a) Suppose, you are a data scientist at NUST Analytics. And you observed that the number of students at the university canteen is always high during the months of Jan-Mar. Whereas the students numbers decrease during June-July. Explain the analysts' observation in line with one specific and appropriate component of time series. **(2 marks)**

(b) Compute the 3-month simple moving average for February 2017, given that the demand is 100 during October 2016, 200 in November 2016, 300 in December 2016, 400 in January 2017. **(3 marks)**

(c) State any three smoothing techniques of a time series. **(3 marks)**

(d) Stationarity is a desirable property for a time series process, which conditions should hold for this concept to be realised in a time series? **(3 marks)**

(e) The data below represent the values of precipitations recorded at a weather station in the Karas region in Namibia. **(9 marks)**

23.32, 32.33, 32.88, 28.98, 33.16, 26.33, 29.88, 32.69, 18.98, 21.23, 26.66, 29.89

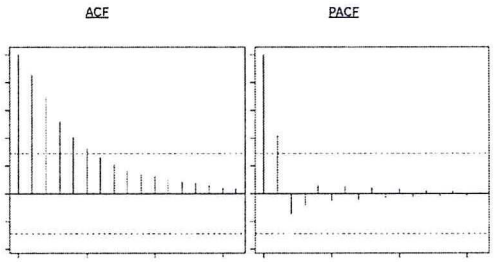
You are required to compute the first difference of the precipitation and the lag-one sample autocorrelation of the time series (given values).

3. Question

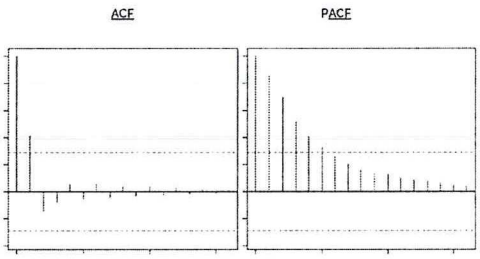
(a) Describe the construction and forecasting approach of auto-regressive processes in time series. Illustrate with a process of order p. (point out the independent variables of the model) **(8 marks)**

(b) Explain the terms **Autocorrelation function** and **partial autocorrelation function** as used in time series modeling with respect to their plots. **(4 marks)**

(c) Discuss the number of AR and MA terms that should be included for the time series by looking at the ACF and PACF plots in Figures 1a and 1b? **(8 marks)**



(a) Figure 1a



(b) Figure 1b

Figure 1: Autocorrelation charts for a stationary time series.

4. Questions

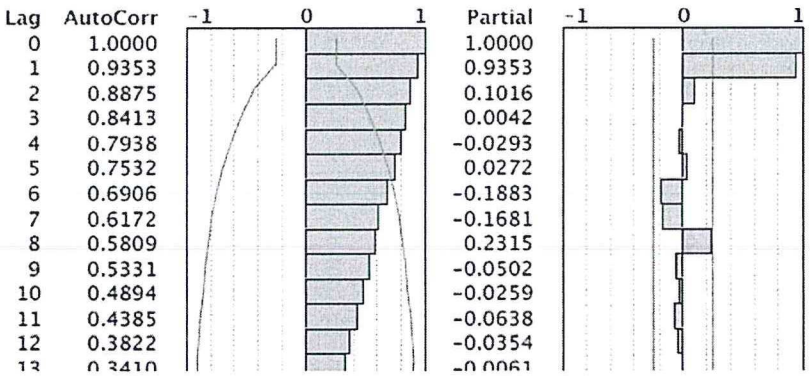
(a) Describe the characteristics of a white noise process. **(4 marks)**

(b) Consider the following AR(1) model with the disturbances having zero mean and unit variance. $y_t = 0.4 + 0.2y_{t-1} + u_t$ Estimate the (unconditional) variance of y. **(3 marks)**

(c) Required to fill the given Table which describes the behavior of ACF and PACF of ARMA models. **(5 marks)**

	AR(p)	MA(q)	ARMA(p,q)
ACF	Decay exponentially		
PACF			

(d) Figure d indicates the estimated autocorrelation and partial autocorrelation of a time series of $n = 60$ observations. Based on the plots, discuss what should be done in order to make the series stationary. **(4 marks)**



(e) In model assessment BIC penalizes complicated models more strongly than the AIC. Explain the validity of the statement. **(4 marks)**

5. Questions

(a) For a realized stationary time series $X_t =$, $t = 1, 2, ..., 16$,
That is, $X_t = 1.6, 0.8, 1.2, 0.5, 0.9, 1.1, 1.1, 0.6, 1.5, 0.8, 0.9, 1.2, 0.5, 1.3, 0.8, 1.2$. You are required to determine whether the series' second order population autocorrelation is zero using the 95% confidence interval. **(10 marks)**

(b) Outline the least squares iteration procedure for identifying the ARMA (p,q) processes using ARMA (1,1) as an example. **(10 marks)**

END