Tutorial letter 101/3/2018

Forecasting II

STA2604

Semesters 1 & 2

Department of Statistics

IMPORTANT INFORMATION:

This tutorial letter contains important information about your module and includes the assignment questions for both semesters.

Define tomorrow.

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CONTENTS

2

1 INTRODUCTION

1.1 Welcome message

Dear Student,

Welcome to the module Forecasting II. We hope that you will find it both interesting and rewarding. We will do our best to make your study of this module successful and interesting. You have one semester to complete the work and write the examination. You will be well on your way to success if you start studying early in the semester and resolve to do your assignments properly. You will receive a number of tutorial letters during the semester. A tutorial letter is our way of communicating with you about teaching, learning and assessment.

This Tutorial Letter 101 contains important information about the scheme of work, resources and assignments for this module. We urge you to read it carefully and to keep it at hand when working through the study material, preparing the assignments, addressing questions to your lecturer and preparing for the examination.

This tutorial letter also provides all the information you need with regard to the prescribed study material and other resources and how to obtain them. Please study this information carefully and make sure that you obtain the prescribed material as soon as possible.

We have also included certain general and administrative information about this module. Please study this section of the tutorial letter carefully.

Right from the start we would like to point out that you must read all the tutorial letters you receive during the semester immediately and carefully, as they always contain important and, sometimes, urgent information.

1.2 Tutorial matter

Shortly after registration the Department of Despatch should supply you with the following tutorial matter for this module:

- **Tutorial letters 101**. Read it and save it as it contains important information *as well as your assignments for the semester.*

- **A study guide** written by one of previous lecturers to guide you through the relevant sections in the prescribed book. Use it together with the textbook as the guide indicates the relevant prescribed sections, explaining some basic concepts, giving some examples and exercises, etc. However, the prescribed book is the main document for this module. Therefore, you should have it at hand.

- Other tutorial letters to further assist you with your studies, will be dispatched to you throughout the semester.

If you have access to the Internet, you can view the study guide and tutorial letters for the modules for which you are registered on the University's online campus, myUnisa, at http://my.unisa.ac.za. There are two types of tutorial letters:

- The 100-series (e.g. Tutorial letter 101, 102, 103, etc.) containing general information, assignment questions, information about your lecturer, study notes, the trial examination paper, etc.

- The 200-series (e.g. Tutorial letter 201, 202, 203, etc.) containing the solutions to the assignments and to the trial paper.

Some of this tutorial matter may not be available when you register. Tutorial matter that is not available when you register will be posted to you as soon as possible, but is also available on myUnisa.

2 PURPOSE OF AND OUTCOMES FOR THE MODULE

2.1 Purpose

The purpose of this module is to make you capable of building models useful for forecasting, validate these models, interpret concepts in forecasting and comprehend the relevant methodologies and to develop the forecasts, among others. Therefore, as student enrolled for this module you will be expected to apply forecasting concepts and methodologies to real-world problems. The module cultivates the skill to interpret and communicate the results of forecasting problems. It is an applied module which exposes students to a wide variety of realistic yet tractable examples that expose to the work of actual statisticians.
The module exposes you to the concept of forecasting in a scientific context. It shows the use of some descriptive measures and statistics topics in model building for forecasting. You will know how to develop models for forecasting, test and compare them and select the best for use in different contexts. It will also help you obtain the knowledge to develop the ultimate forecast using the model developed. Many of the topics learned at earlier course/modules will become handy, and you will hopefully appreciate their use since past uses were in other contexts and not forecasting.

2.2 Outcomes

Qualifying students will be able to:

- understand issues regarding choice of forecasting methods based on error analysis.

- build a forecasting model.

- understand Time series regression.

- understand Exponential smoothing.

- understand Decomposition methods.

3 LECTURER(S) AND CONTACT DETAILS

3.1 Lecturer(s)

Your lecturer is Dr Gaëtan Kabera. Please do not hesitate to contact the lecturer if you have any questions or problems.

- You can send an e-mail to: kaberg@unisa.ac.za, or use the contact link from the module web page.

- The lecturer's telephone number is 011 670 9062. (If the lecturer is not in the office when you phone, please phone the Statistics Department's secretary at 011 670 9255. She will be able to tell you when the lecturer will be available; or you can leave your contact number with the secretary and the lecturer will call you back as soon as possible.

- You are most welcome to come see the lecturer in person, but please contact him in advance to make sure that he will be available to help you. The office details are GJ Gerwel Building (C-Block), Floor 6, Office C6-07, on the UNISA Science (Florida) campus in Roodepoort.

All queries that are not of a purely administrative nature but are about the content of this module should be directed to the lecturer. Please have your study material with you when you contact the lecturer.

PLEASE NOTE: Letters to lecturers should not be enclosed with or inserted into assignments.

3.2 Department

The departmental secretary can be contacted at (011) 670 9255 for other queries.

3.3 University

If you need to contact the University about matters not related to the content of this module, please consult the publication *My Studies @ Unisa* that you received with your study material. This brochure contains information on how to contact the University (e.g. to whom you can write for different queries, important telephone and fax numbers, addresses and details of the times certain facilities are open).

Always have your student number at hand when you contact the University.

4 MODULE RELATED RESOURCES

4.1 Prescribed books

The prescribed book for this module is

Forecasting, Time Series and Regression by
Bowerman~O'Connell~Koehler (2005), 4th edition.

You have to buy this book. Please consult the list of official booksellers and their addresses listed in my Studies @ Unisa. Prescribed books can be obtained from the University's official booksellers. If you have difficulty locating your book(s) at these booksellers, please contact the Prescribed Books Section at 012 429 4152 or e-mail vospresc@unisa.ac.za.

4.2 Recommended books

There are no recommended books for this module.

4.3   Software

No statistical software is recommended, but you must have access to Excel "Analysis ToolPak". If not directly seen on your computer, please install it as follows (e.g. with Microsoft Excel 2010):
File $\longrightarrow$ Options $\longrightarrow$ Add-Ins $\longrightarrow$ Analysis ToolPak $\longrightarrow$ Go.
In principle, the toolPak will appear in the top right-corner of your computer.

4.4   Electronic Reserves (e-Reserves)

There are no e-Reserves for this module.

4.5   Library services and resources information

For brief information go to : http://www.unisa.ac.za/contents/studies/docs/myStudies-at-Unisa2017-brochure.pdf
For more detailed information, go to the Unisa website: http://www.unisa.ac.za/, click on Library
For research support and services of Personal Librarians, go to:
http://www.unisa.ac.za/Default.asp?Cmd=ViewContent&ContentID=7102
The Library has compiled numerous library guides:

- find recommended reading in the print collection and e-reserves
  -http://libguides.unisa.ac.za/request/undergrad

- request material - http://libguides.unisa.ac.za/request/request

- postgraduate information services - http://libguides.unisa.ac.za/request/postgrad

- finding, obtaining and using library resources and tools to assist in doing research
  http://libguides.unisa.ac.za/Research_Skills

- how to contact the Library/find us on social media/frequently asked questions -
  http://libguides.unisa.ac.za/ask

5   STUDENT SUPPORT SERVICES FOR THE MODULE

For information on the various student support systems and services available at Unisa (e.g. student counseling, tutorial classes, language support), please consult the publication *my Studies @ Unisa* that you received with your study material.

5.1   Contact with Fellow Students

5.1.1 Study Groups

It is advisable to have contact with fellow students. One way to do this is to form study groups. **Please consult the publication *my Studies@Unisa* to find out how to obtain the addresses of students in your region.**

5.1.2 myUnisa

If you have access to a computer that is linked to the internet, you can quickly access resources and information at the University. The *myUnisa* learning management system is Unisa's online campus that will help you to communicate with your lecturers, with other students and with the administrative departments of Unisa - all through the computer and the internet.

To go to the *myUnisa* website, start at the main Unisa website, http://www.unisa.ac.za, and then click on the "Login to *myUnisa*" link on the right-hand side of the screen. This should take you to the *myUnisa* website. You can also go there directly by typing in http://my.unisa.ac.za.

Please consult the publication *my Studies @ Unisa* which you received with your study material for more information on *myUnisa*.

5.1.3 Discussion classes

There are no discussion classes offered in this module. Should the need for discussion classes arise in future, students will be informed well in advance about actual dates and venues.

5.2   Free computer and internet access

Unisa has entered into partnerships with establishments (referred to as Telecentres) in various locations across South Africa to enable you (as a Unisa student) free access to computers and the Internet. This access enables you to conduct the following academic related activities: registration, online submission of assignments, engaging in e-tutoring activities and signature courses, etc. Please note that any other activity outside of these are for your own costing e.g. printing, photocopying, etc. For more information on the Telecentre nearest to you, please visit www.unisa.ac.za/telecentres.

6   MODULE-SPECIFIC STUDY PLAN

SEMESTER 1	Study units for preparing your assignments Bowerman and Study Guide:	From	To
Assignment 1	Chapter 1, 4, 5 and 6. Study Guide: Unit 1, 2 & 3. Start writing your assignment	Registration 11 March 2018	10 March 2018 20 March 2018
Assignment 2	Chapter 6, 7 and 8. Study Guide: Study unit 3, 4 & 5. Start writing your assignment	20 March 2018 09 April 2018	08 April 2018 16 April 2018

SEMESTER 2	Study units for preparing your assignments Bowerman and Study Guide:	From	To
Assignment 1	Chapter 1, 4, 5 and 6. Study Guide: Unit 1, 2 & 3. Start writing your assignment	Registration 09 August 2018	08 August 2018 17 August 2018
Assignment 2	Chapter 6, 7 and 8. Study Guide: Study unit 3, 4 & 5. Start writing your assignment	17 August 2018 09 September 2018	08 September 2018 18 September 2018

7   MODULE PRACTICAL WORK AND WORK-INTEGRATED LEARNING

There are no practicals for this module.

8   ASSESSMENT

8.1   Introduction

8.1.1 Assessment criteria

The outcomes of this module are given in Section 2.2 of this tutorial letter. These outcomes describe what you should be able to do in order to successfully pass this module. Assignments and examinations are the ways we use to assess whether you have reached the outcomes.
The criteria we use to assess your work can be summarised as follows:

- You must apply the correct and appropriate formulas, presentations, methods, rules, laws, values from tables, and so on, as required in the question. Proofs may also be asked, mainly in exams.

- Applying of formulas, methods etc. must be done correctly.

- Results, tests, computer printouts etc. should be interpreted correctly, when you are asked to do so.

- Calculations must be correct and accurate.

The following general comments are valid to all modules.

8.1.2 Written assignment and examination questions

Please keep the following in mind when answering questions.

- Read the question carefully – you will get zero marks if you end up answering what was not asked for!

- Give full calculations, marks will usually not be given for the end results only.

- Present your solutions clearly. A collection of disjointed formulas and numbers is not the right way to answer questions. Please use words to explain what you are doing and why. Use correct mathematical notations and remember that lines of mathematical equations must always be linked to each other – for example with the = sign if they are a series of continuing calculations, or otherwise maybe by the signs for "equals" or "therefore". See your textbooks and/or study guides for examples.

8.2   Assessment plan

The assessment in this module consists of two assignments and an examination.

Your final mark for the module is determined from your semester mark and your examination mark. The semester mark forms 20% and the examination mark 80% of the final mark. The semester mark is the average of the marks you receive for assignments 1 and 2. An assignment submitted late or not at all will give you 0%. If you do well in your assignments you have a good semester mark and that can make all the difference between a pass or fail or between a distinction or simply a pass!

The two assignments prescribed for this module must be seen as part of the learning process. The typical assignment question is a reflection of a typical examination question. However, modifications may be made in the scope of the module. There are fixed submission dates for the assignments and each assignment is based on specific chapters in the prescribed book. You have to adhere to these dates as assignments are only marked if they are received on or before the due dates.

You will only get examination admission if you submit the first assignment by its due date. You should complete both assignments as well as you can, since

- they are the sole contributors towards your semester mark,

- they form an integral part of the learning process and indicate the form and nature of the questions you can expect in the examination.

8.3   Assignments and Learning

Assignments are seen as part of the learning material for this module. As you do the assignment, study the reading texts, consult other resources, discuss the work with fellow students or tutors or do research, you are actively engaged in learning. Looking at the assessment criteria given for each assignment, and the feedback you receive in your marked assignment, will help you to understand what is required of you more clearly.

8.4   General assignment numbers

The two assignments are numbered 01 and 02 for each semester.

8.4.1 Unique assignment numbers

Please note that each assignment has its unique six-digit assignment number which has to be written on the cover of your assignment upon submission. The unique numbers are given later on in this tutorial letter; you will find them in the heading of each set of assignment questions.

8.4.2 Due dates for assignments

The closing dates for the submission of the assignments are:

Assignment for SEMESTER 1	Sections from the following chapters are covered	Due Date	Unique nr.
1	Chapter 1, 4, 5 and 6	20 March 2018	876682
2	Chapter 6, 7 and 8	16 April 2018	751919

Assignment for SEMESTER 2	Sections from the following chapters are covered	Due Date	Unique nr.
1	Chapter 1, 4, 5 and 6	17 August 2018	524604
2	Chapter 6, 7 and 8	18 September 2018	536944

8.5 Submission of assignments

For detailed information on assignments, please refer to the *my Studies @ Unisa* brochure, which you received with your study package.

To submit an assignment via myUnisa:

- Go to myUnisa.

- Log in with your student number and password.

- Select the module.

- Click on assignments in the menu on the left-hand side of the screen.

- Click on the assignment number you wish to submit.

- Follow the instructions.

For general information and requirements as far as assignments are concerned, see the brochure *my Studies @ Unisa* which you received with your study material.

8.6 Assignments

This tutorial letter 101 contains the assignments for both semesters, so select the semester you are enrolled for and do the set of assignments for that semester only. The assignments for Semester 1 are in Section 13. The assignments for Semester 2 are in Section 14.
Solutions to the assignments will be posted a while after the closing date only to students who will have submitted their work. Solutions will also be available to ALL students on *myUnisa* just a few days before the exams.

9 EXAMINATION

9.1 Examination Admission

You need to have a final mark of 50% to pass this module and 75% to obtain a distinction.

In this module a maximum of 20 marks is added to your examination mark (out of 80) to form your final mark. This 20% contribution comes from the marks you obtained for the two assignments and is called your semester mark. If you do well in your assignments you have a good semester mark and that can make all the difference between a pass or fail or between a distinction or simply a pass!

Currently admission to the examination is only based on the proof that you are actively involved in your studies. This proof is based on the **submission of your first assignment** before a fixed given date. Admission therefore does not rest with the department and if you do not submit that particular assignment in time, we can do nothing to give you admission. Although you are most probably a part time student with many other responsibilities, work circumstances will not be taken into consideration for exemption from assignments or the eventual admission to the examination.

No concession will be made to students who do not qualify for the examination.

9.2 Examination Period

This module is offered in a semester period of fifteen weeks. This means that

- if you are registered for the first semester, you will write the examination in May/June 2017 and should you fail and qualify for a supplementary examination, that supplementary examination will be written in October/November 2017.

- if you are registered for the second semester, you will write the examination in October/November 2017 and should you fail and qualify for a supplementary examination, that supplementary examination will be written in May/June 2018.

The examination section will provide you with information regarding the examination in general, examination venues, examination dates and examination times. Eventually, your results will also be processed by them and sent to you.

9.3 Examination Paper

Your examination will be a **2 hour examination.** The questions will be similar to the assignment questions, but there will also be questions on theory. Should you have a final mark of less than 50%, it implies that you failed the module STA2604. However, should your results be within a specified percentage (usually from 40% to 49%), you will be given a second chance in the form of a *supplementary* examination on the dates as specified in Section 9.2. Please note that the semester mark does not apply in the case of a supplementary examination. The final mark after a supplementary examination is simply the mark you achieved in that examination, expressed as a percentage

9.4 Previous Examination Papers

Some previous examination papers are available to students. These may give you an idea of question papers, but remember that lecturers do not assess in the same way, and a lecturer may change the assessment style throughout the years or semesters. A *trial* paper will be given towards

the end of the semester. This may be a new or past paper that you can use as an indication of typical examination questions. Solutions to this trial paper is also sent out in a follow-up tutorial letter. Remember that the examples, exercises, activities in the guide as well as your assignment questions are also indicators of typical examination questions.

9.5 Tutorial Letter with Information on the Examination

As mentioned before, you will receive a tutorial letter containing a trial paper. Should the lecturer want to discuss any matter about the examination, it will be included in this tutorial letter. In the study guide you are given clear indications of the sections in the textbook that you have to know and can be tested on in the examination. Remember that you have to work continuously and do not treat statistics as any other subject, where it may be possible to study only selected sections of the work. All the topics are interlinked and you will definitely run into trouble if you skip sections! We really advise you to be very familiar with your textbook, not only with the study guide.

You are automatically admitted to the exam on the submission of Assignment 01 by a specific date – see Section 8.1. Please note that lecturers are not responsible for exam admission, and ALL enquiries about exam admission should be directed by e-mail to exams@unisa.ac.za.

10 OTHER ASSESSMENT METHODS

There are no other assessment methods for this module.

11 FREQUENTLY ASKED QUESTIONS

The my Studies @ Unisa brochure contains an A-Z guide of the most relevant study information. Please refer to this brochure for any other questions.

12 CONCLUSION

Remember that there are no "short cuts" to studying and understanding statistics. You need to be dedicated, work consistently and practise, practise and practise some more! We trust that you will find a depth of knowledge in STA2604 that you can apply in many aspects of your life. Be positive, determined and eager to learn and you will be successful!

Dr G Kabera

13 FIRST SEMESTER ASSIGNMENTS

13.1 Assignment 01

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ONLY FOR SEMESTER 1 STUDENTS
ASSIGNMENT 01
Unique Nr.: 876682
Fixed closing date: 20 MARCH 2018
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QUESTION 1

(1.1) Define the term forecasting and cite five domains, not taken from your study material, in which forecasting may be applied for planning. **[5]**

(1.2) Give the four components of a time series and explain their meaning in own words. **[4]**

(1.3) Give the difference between time series data and cross-sectional data. **[3]**

(1.4) The table below presents the actual and predicted daily customers during work days at a small shop in a given week.

(1.4.1) Calculate the forecast error for each day. **[3]**

(1.4.2) Calculate the MAD. **[3]**

(1.4.3) Calculate the MSE. **[3]**

(1.4.4) Compare the results in questions (1.4.2) and (1.4.3). Which measure of precision would you recommend and why? **[3]**

Day	Actual customers	Predicted customers
Monday	100	125
Tuesday	120	110
Wednesday	130	140
Thursday	123	136
Friday	150	155

[24]

QUESTION 2

The past twenty monthly sales (y) for a new type of watch are given in the following table:

Month	Sales	Month	Sales
1	298	11	356
2	300	12	370
3	300	13	400
4	350	14	390
5	340	15	420
6	360	16	410
7	400	17	460
8	350	18	458
9	360	19	470
10	346	20	480

Assume that the model applicable to these data is given by the equation $y_t = \beta_0 + \beta_1 t + \epsilon_t$ where t indicates time (here month) with $t = 1, 2, \ldots, 20$.

(2.1) Use the method of least squares to estimate β_0 and β_1, then write down the fitted model. **[8]**

(2.2) Calculate the point forecasts and 95% prediction interval for watch sales in month 21. **[6]**

(2.3) Test for positive autocorrelation by using the Durbin-Watson statistic with $\alpha = 0.05$. **[6]**

(2.4) Calculate the coefficient of determination and the adjusted coefficient of determination R_{adj}^2.

[4]

(2.5) Calculate the variance inflation factor VIF. **[2]**

[26]

QUESTION 3

A real estate agency collected the data concerning
y = sales price of a house (in thousands of dollars)
x_1 = home size (in hundreds of square meters)
x_2 = rating (an overall "niceness rating" for the house expressed on a scale from 1 (worst) to 10 (best)).
The data is given in the table below:

y	x_1	x_2
180	23	5
98.1	11	2
173.1	20	9
136.5	17	3
141	15	8
165.9	21	4
193.5	24	7
127.8	13	6
163.5	19	7
172.5	25	2

The agency wishes to develop a regression model that can be used to predict the sales prices of future houses it will list. Consider relating y to x_1 and x_2 by using the model

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \epsilon \qquad (E_1)$$

(3.1) Plot price versus size and then price versus rating. **[6]**

(3.2) Why the data plots indicate that model (E_1) is reasonable? **[2]**

(3.3) Fit model (E_1), and write down the predictive equation. Use Excel. **[6]**

(3.4) Calculate the residuals and plots them against the fitted values. Give a table using Excel. **[6]**

(3.5) Does the results in question (3.4) confirm the conclusion in question (3.2)? Explain in only one sentence. **[2]**

(3.6) Is the assumption of normality satisfied? Explain. **[4]**

(3.7) Calculate the variance inflation factor (VIF). What do you conclude? **[2]**

[28]

QUESTION 4

The quarterly sales (y_t), where t denotes time, of a product are given in the following table:

Year	Quarter	y_t
1	1	10
	2	30
	3	40
	4	20
2	1	12
	2	32
	3	45
	4	18
3	1	14
	2	35
	3	50
	4	20
4	1	15
	2	38
	3	50
	4	22

Assume that the model that fits the data is given by equation

$$y_t = \beta_0 + \beta_1 t + \beta_2 Q_2 + \beta_3 Q_3 + \beta_4 Q_4 + \epsilon_t \qquad (E_2)$$

where Q_2, Q_3, and Q_4 are the appropriately defined dummy variables for quarters 2, 3 and 4. Some of the questions below need the use of Excel. Statistical softwares may give similar results, but here only use excel.

(4.1) Write down the definitions of the dummy variables Q_2, Q_3 and Q_4. **[4]**

(4.2) Plot y_t versus t. **[4]**

(4.3) What type of seasonal variation appears to exist? **[2]**

(4.4) Fit model (E_2), then write down the prediction model. **[6]**

(4.5) Use the results in Question (4.4) to calculate $\widehat{y}_{17}$ and its 95% confidence interval. **[6]**

[22]

Total: [100]

13.2 Assignment 02

QUESTION 1

The data in the following table give quarterly sales of the popular game Oligopoly at J-Mart variety store. Consider using the multiplicative decomposition method to forecast Oligopoly sales for year 4. Use of a spreadsheet (Excel) is recommended for all the questions below. However, it is also easy to obtain the results using hand calculations.

Year	Quarter	y_t
1	1	20
	2	25
	3	35
	4	44
2	1	28
	2	29
	3	43
	4	48
3	1	24
	2	37
	3	39
	4	56

(1.1) Plot the Oligopoly sales versus time and explain the type of trend that appears.   **[4]**

(1.2) Compute appropriate four-point moving averages for these data.   **[4]**

(1.3) Compute centered moving averages for these data.   **[3]**

(1.4) Calculate $sn_t \times ir_t$ values for these data.   **[4]**

(1.5) Calculate estimates of the seasonal factors for quarterly Oligopoly sales (that is, compute sn_t values for these data).   **[4]**

(1.6) Compute the deseasonalised observations for these data.   **[4]**

(1.7) Plot the deseasonalised observations versus time. From the data plot, what kind of trend appears to exists?   **[3]**

(1.8) Assuming that a linear trend $TR_t = \beta_0 + \beta_1 t$ describes the deasonalised observations, compute least squares point estimates of β_0 and β_1.   **[6]**

(1.9) Compute $cl_t \times ir_t$ values for the Oligopoly data.   **[4]**

(1.10) Compute estimates of the cyclical factors for the Oligopoly data (that is, compute cl_t values for these data). **[4]**

(1.11) Compute estimates of the irregular factors for the Oligopoly data (that is, compute ir_t values for these data). **[4]**

(1.12) Do the cl_t values determine any well-defined cycle? Explain your answer in only one sentence. **[3]**

(1.13) Using estimated trend and seasonal factors, compute point forecasts of Oligopoly sales for each quarter of year 4. **[4]**

(1.14) Using estimated trend and seasonal factors, compute approximate 95% prediction interval forecasts of Oligopoly sales for each quarter of year 4. **[4]**

[55]

QUESTION 2

Consider the Oligopoly data presented in the previous question.

(2.1) Repeat all parts of the question using the additive decomposition method. **[55]**

(2.2) Does this additive decomposition method seem more appropriate for these data than the multiplicative decomposition method? Briefly explain. **[2]**

[57]

QUESTION 3

Consider the Oligopoly data presented in the previous question.

(3.1) Fit the linear regression $y_t = \beta_0 + \beta_1 t + \epsilon_t$ to the data. Use Excel. **[4]**

(3.2) Use simple exponential smoothing with $\alpha = 0.1$ to determine the smoothed levels corresponding to the data. **[5]**

(3.3) Compute the forecasts made last period. **[4]**

(3.4) Compute the forecast errors. **[4]**

(3.5) Compute the squared forecast errors. **[4]**

(3.6) Compute the mean squared forecast error (MSFE). **[2]**

[23]
Total: [135]

14 SECOND SEMESTER ASSIGNMENTS

14.1 Assignment 01

<div style="border:1px solid;">

ONLY FOR SEMESTER 2 STUDENTS
ASSIGNMENT 01
Unique Nr.: 524604
Fixed closing date: 17 AUGUST 2018

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QUESTION 1

1.1 What is usefulness of forecasting? Give two examples, not drawn from your textbook.   **(3)**

1.2 Explain the meaning of the four components of a time series.   **(4)**

(1.3) Consider the cost of a certain product during five consecutive weeks

Week	Actual cost	Predicted cost
1	75	73.3
2	89.7	86.5
3	123.6	129.4
4	102	99.7
5	139	142

Calculate:

(1.3.1) the forecast error for each week.   **(2)**

(1.3.2) the MAD.   **(4)**

(1.3.4) the MSE.   **(4)**

(1.3.5) the MAPE.   **(4)**

[21]

QUESTION 2

The past eighteen weekly sales (y) for a product are given in the following table:

Month	Sales	Month	Sales
1	98	9	156
2	100	10	170
3	110	11	200
4	150	12	190
5	140	13	220
6	160	14	210
7	200	15	260
8	150	16	258

Assume that the model applicable to these data is given by the equation $y_t = \beta_0 + \beta_1 t + \epsilon_t$ where t indicates time (here week) with $t = 1, 2, \ldots, 16$.

(2.1) Use the method of least squares to estimate β_0 and β_1, then write down the fitted model. **[8]**

(2.2) Calculate the point forecasts and 95% prediction interval for product sale in week 17. **[6]**

(2.3) Test for positive autocorrelation by using the Durbin-Watson statistic with $\alpha = 0.05$. **[6]**

(2.4) Calculate the coefficient of determination and the adjusted coefficient of determination R^2_{adj}.

[4]

(2.5) Calculate the variance inflation factor VIF. **[2]**

[26]

QUESTION 3

The data in the table below come from the comparison of the growth rates for bacteria types A and B. The growth y recorded at five equally spaced (and coded) points of time is show in the table.

| Bacteria type | Time | | | | |
	-2	-1	0	1	2
A	8.0	9.0	9.1	10.2	10.4
B	10.0	10.3	12.2	12.6	13.9

(3.1) Fit the linear model

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_1 x_2 + \epsilon$$

where $x_1 = 1$ refers to bacteria type B and $x_1 = 0$ refers to bacteria type A, and x_2 refers to the coded time. Use Excel. **[6]**

(3.2) Predict the of type A bacteria at time $x_2 = 0$ and compare the answer with the observed value.

[3]

(3.3) Calculate the residuals and plots them against the fitted values. Give a table using Excel. **[6]**

(3.4) Calculate a 90% confidence interval for the expected growth for type B at time $x_2 = 1$. **[4]**

(3.5) Calculate a 90% prediction interval for the expected growth for type B at time $x_2 = 1$. **[4]**

(3.6) Compare the results in questions (3.4) and (3.5). **[2]**

[25]

QUESTION 4

The quarterly sales (y_t) on five years, where t denotes time, of a product are given in the following table:

Year	Quarter	y_t
1	1	12
	2	31
	3	42
	4	21
2	1	13
	2	33
	3	45
	4	19
3	1	15
	2	36
	3	52
	4	21
4	1	15
	2	37
	3	52
	4	22
5	1	24
	2	40
	3	50
	4	23

Assume that the model that fits the data is given by equation

$$y_t = \beta_0 + \beta_1 t + \beta_2 Q_2 + \beta_3 Q_3 + \beta_4 Q_4 + \epsilon_t \qquad (E)$$

where Q_2, Q_3, and Q_4 are the appropriately defined dummy variables for quarters 2, 3 and 4. Some of the questions below need the use of Excel. Statistical softwares may give similar results, but here only use excel.

(4.1) Write down the definitions of the dummy variables Q_2, Q_3 and Q_4. **[6]**

(4.2) Plot y_t against t. **[4]**

(4.3) What type of seasonal variation appears to exist? **[3]**

(4.4) Fit model (E), then write down the prediction model. **[8]**

(4.5) Use the results in Question (4.4) to calculate $\widehat{y}_{17}$ and its 95% confidence interval. **[7]**

[28]

Total: [100]

14.2 Assignment 02

> # ONLY FOR SEMESTER 2 STUDENTS
> ### ASSIGNMENT 02
> ### Unique Nr.: 536944
> ### Fixed closing date: 18 SEPTEMBER 2018

QUESTION 1

The quarterly sales (y_t) on three years, where t denotes time, of a product are given in the following table:

Year	Quarter	y_t
1	1	10
	2	29
	3	40
	4	20
2	1	12
	2	33
	3	45
	4	19
3	1	15
	2	38
	3	52
	4	21

(1.1) Plot the sales versus time and explain the type of trend that appears. **[4]**

(1.2) Compute appropriate four-point moving averages for these data. **[4]**

(1.3) Compute centered moving averages for these data. **[3]**

(1.4) Calculate $sn_t \times ir_t$ values for these data. **[4]**

(1.5) Calculate estimates of the seasonal factors for quarterly sales (that is, compute sn_t values for these data). **[4]**

(1.5) Compute the deseasonalised observations for these data. **[4]**

(1.7) Plot the deseasonalised observations versus time. From the data plot, what kind of trend appears to exists? **[3]**

(1.8) Assuming that a linear trend $TR_t = \beta_0 + \beta_1 t$ describes the deseasonalised observations, compute least squares point estimates of β_0 and β_1. **[6]**

(1.9) Compute $cl_t \times ir_t$ values for the sales data. **[4]**

(1.10) Compute estimates of the cyclical factors for the sales data (that is, compute cl_t values for these data). **[4]**

(1.11) Compute estimates of the irregular factors for the sales data (that is, compute ir_t values for these data). **[4]**

(1.12) Do the cl_t values determine any well-defined cycle? Explain your answer in only one sentence. **[3]**

(1.13) Using estimated trend and seasonal factors, compute point forecasts of sales for each quarter of year 4. **[4]**

(1.14) Using estimated trend and seasonal factors, compute approximate 95% prediction interval forecasts of sales for each quarter of year 4. **[4]**

[55]

QUESTION 2

Consider the data presented in the previous question.

(2.1) Repeat all parts of the question using the additive decomposition method. **[55]**

(2.2) Does this additive decomposition method seem more appropriate for these data than the multiplicative decomposition method? Briefly explain. **[2]**

[57]

QUESTION 3

Consider again the data presented in Question 1

(3.1) Fit the linear regression $y_t = \beta_0 + \beta_1 t + \epsilon_t$ to the data. Use Excel. **[4]**

(3.2) Use the Holt's trend corrected exponential smoothing with $\alpha = 0.15$ and $\gamma = 0.1$ to determine the smoothed levels corresponding to the data. **[4]**

(3.3) Compute the growth rates. **[2]**

(3.4) Compute the forecasts made last period. **[4]**

(3.5) Compute the forecast errors. **[3]**

(3.6) Calculate the squared forecast errors. **[4]**

(3.7) Compute the mean squared forecast error (MSFE). **[2]**

[23]
Total: [135]