

Tutorial letter 101/3/2017

Distribution Theory I

STA1503

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.

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1 INTRODUCTION

Dear Student

Welcome to this module. We trust your studies will be rewarding and successful!

The focus in this module is on the theory behind statistical inference, namely probability theory and distribution theory. You will learn to work with different distributions and with probability theory. This is the start of a process to provide every statistician with a solid undergraduate foundation in statistical theory underlying problems encountered in the work situation. The module is titled **Distribution theory I**, indicating that the emphasis will be on theoretical mathematical statistics. Without distribution theory there will be no legal basis for our statistical inference. The “one” in the name indicates a vertical level jump starting at first level with STA1503, followed by STA2603 (Distribution theory II) at second level and finally to STA3703 (Distribution theory III) at third level.

The prerequisites for STA1503 are such that at the stage of enrolment you should have completed the modules STA1501 and STA1502 and also have a thorough knowledge of first-level calculus. There is therefore an assumption of pre-knowledge of basic statistics and a solid grasp of important mathematical techniques. STA1503 is the third of the three compulsory first-level modules that form the basis for a degree with a major in Statistics.

We trust that you will enjoy this module and work seriously and continuously. We wish you all the best in your studies!

1.1 Tutorial matter

The Department of Despatch will supply you with the following study material for this module:

- A study guide, written by a lecturer 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 difficult concepts in more detail, giving additional examples and exercises, etc.
- This tutorial letter (Tutorial letter 101), as well as others which will be sent out during the semester (numbered 102, 103,... or 201, 202, ... and so on).

The Department of Despatch should have supplied to you the tutorial letter 101 and the study guide shortly after your registration. The other tutorial letters will be sent to you throughout the semester. Follow the instructions in the brochure entitled *my Studies @ Unisa* if you have not received some of the material that should have been sent to you.

Note that if you have access to the Internet, you can view, download and print the study guide and all the tutorial letters for the modules for which you are registered on the University's online campus, myUnisa, at <http://my.unisa.ac.za>.

Take note that every tutorial letter you will receive is important and you should read them all immediately and carefully. Some information contained in these tutorial letters may be urgent, while others may, for example, contain examination information. So, it is wise to keep them all in a file!

2 PURPOSE OF AND OUTCOMES FOR THE MODULE

2.1 Purpose

Qualifying students will have a solid fundamental knowledge of statistical theory and have a clear understanding of the nature of mathematical statistics in terms of its objective, namely statistical inference. These skills or competencies include knowledge of different theoretical distributions for populations, using probability theory, to progress to statistical inference in an accurate mathematical manner. In this process, distribution theory models will be applied in specific discrete and continuous random variables. This module will support further studies and applications in the sector of statistical theory in the field Statistics, as part of the Bachelor of Science and Bachelor of Commerce qualifications. This module will be an illustration of Mathematical Statistics as a theory of information to contribute to the development of communities and of research in Southern Africa, Africa or globally, utilizing mathematics extensively, but only as a tool.

2.2 Outcomes

Qualifying students will be able to:

- Apply basic mathematical methods and rules of probability using set theory.
- Present the probability distribution for a discrete random variable.
- Utilize probability models for continuous random variables.
- Determine distributions of functions of random variables.
- Determine moment-generating functions, expectations, and joint distributions of random variables.

3 LECTURER(S) AND CONTACT DETAILS

3.1 Lecturer(s)

The details of the lecturer for this module will be sent in a separate tutorial letter, and will also be made available on the myUnisa web site of the module at the beginning of the semester. You can also call the departmental secretary at 011 670 9255 and ask to be put through to the module lecturer for STA1503.

Please do not include your enquiries with your assignments as this will cause unnecessary delays.

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

Wackerley, Dennis D; Mendenhall, William III and Scheaffer, Richard L;
Mathematical statistics with applications (2008), 7th ed.

You have to buy this book. Please consult the list of official booksellers and their addresses listed in my Studies @ Unisa. For shorter reference, we use **WM&S** when we need to draw your attention to the prescribed book. If you have any difficulties in obtaining books from these bookshops, please contact UNISA.

4.2 Recommended books

There are no recommended books for this module.

4.3 Electronic Reserves (e-Reserves)

There are no e-Reserves for this module.

4.4 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 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 internet.

Joining *myUnisa* will offer you the following benefits:

- You have access to the additional resources on this module.
- You will be able to immediately download all your study material from this site, in electronic format.
- You can use the discussion forum to communicate with your fellow students.
- You can contact your lecturer through the e-mail link of your *myUnisa* module page.

For this module, the lecturer will add various resources onto the myUnisa web site during the semester. An announcement will be sent to your myLife email address whenever a new resource is uploaded, so do make sure that your email address is activated.

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 will take you to the *myUnisa* website. You can also go there directly by typing in <http://my.unisa.ac.za>. On the website you will find general Unisa related information, plus a module site for each module you are registered for. 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

The semester during which you study at UNISA consists of 15 weeks between the last day of registration and the beginning of the examination period, during which time you need to study and understand the contents of the module, complete and submit the assignments, and then prepare for the examination. Therefore it is important that you create a timetable for planning your studies for this module, and all the other modules you take this semester or year.

Please start studying as soon as you receive your study material. Note that if you are registered for Semester 1, then all your assignments need to be submitted by end of April and you will write your examination in May-June; and if you are registered for Semester 2, then your assignments need to be submitted by early October and you will write your examination in October-November.

6.1 Suggested time table

The following time tables are provided as a starting point for your personal schedule.

| SEMESTER 1 | Study units for preparing your assignments WM&S and Study Guide: | From | To |
|---------------------|---|--------------------------|----------------------|
| Assignment 1 | Chapter 2.3 to Chapter 3, Chapter 4 Start writing your assignment | Registration 10 March | 10 March 15 March |
| Assignment 2 | Chapter 5 and 6 and Study Guide: Study unit 5 and 6 Start writing your assignment | 15 March 7 April | 7 April 12 April |
| Assignment 3 | Questionnaire | | 28 April |
| Exam | Prepare for the examination | 12 April | Exam |

| SEMESTER 2 | Study units for preparing your assignments WM&S and Study Guide: | From | To |
|---------------------|---|---------------------------|-----------------------------|
| Assignment 1 | Chapter 2.3 to Chapter 3, Chapter 4 Start writing your assignment | Registration 13 August | 13 August 18 August |
| Assignment 2 | Chapter 5 and 6 and Study Guide: Study unit 5 and 6 Start writing your assignment | 18 August 9 September | 9 September 14 September |
| Assignment 3 | Questionnaire | | 6 October |
| Exam | Prepare for the examination | 13 September | Exam |

6.2 How to study this module

6.2.1 An overview of the module

The outcomes of the module are listed in Section 2.2 of this tutorial letter. To pass this module, you must achieve these outcomes.

To do this, you will need to study and work through the material in the study guide and the prescribed textbook, until you are able to understand and apply the concepts and principles involved. The study guide contains activities and problems, which are there to help you ensure that you have mastered the material. Another way to find out how you are doing is through the assignments that you are supposed to submit throughout the semester. The lecturer will mark your work and give individual feedback to you.

For even more help in case you need it, please join myUnisa — on the module web page at myUnisa, there will be more resources available. These will be explained on the web page.

The final decision on whether you have mastered the module outcomes well enough comes from your final mark for the module, which is calculated from your semester mark and the examination mark. (How exactly this is done is explained later on.)

Note that the examination date is fixed, and it is your duty to make sure that you are ready to write the examination when it comes! In Statistics, it is often very hard to catch up again with the work if you fall behind, since you need to understand previous material thoroughly before learning new things.

Although you do need to take responsibility for your studies, remember that you are not alone. Your lecturer is there to help you, and you can also contact your fellow students and use Unisa's student support systems. Details of all of these are listed elsewhere in this tutorial letter!

6.2.2 Guidelines for studying this module

Guidelines of what you should do while studying for this module are therefore as follows:

- There is quite a bit of work to be done in the 15 weeks of study time. Make a timetable for yourself, to make sure you know what amount of work you need to do by what time to keep up to date with the work.
- Work through the textbook and the study guide. This includes doing the activities, and working on more exercises from the textbook if you feel you need more practice.
- You will need to use a calculator for this module. Make sure you know how to use your calculator! You will be allowed to bring a non-programmable calculator to the examination.
- Submit the assignments by their due dates. The due dates of the assignments are chosen in such a way that you will need to work steadily through the semester. When you receive back your marked assignments, make note and take advantage of the lecturer's feedback on your work.
- Prepare well for the examination.

7 MODULE PRACTICAL WORK AND WORK-INTEGRATED LEARNING

There are no practicals for this module.

8 ASSESSMENT

8.1 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, examinations, and in some modules projects and portfolios 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.
- 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 our modules. In some cases the lecturers will give further instructions to keep in mind when completing your work; these will be given in the tutorial letters for that particular module.

8.1.1 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 notation 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.

8.1.2 Multiple choice questions

- Only one of the given answers is correct. If you believe several to be correct, check your work again!
- We suggest you keep copies of your calculations, so that when you get the results, you can check where you went wrong.

8.2 Assessment plan

Assessment is the process where the lecturer assesses your work by comparing it to the module outcomes and the related assessment criteria. The assessment in this module consists of formative assessment and summative assessment.

Formative assessment means assessment of your work while you are still studying. This is particularly important in distance learning since it might sometimes be the only way you can get feedback on how you are doing, while you can still benefit from it. In this module, formative assessment is through the assignments. The lecturer marks your work and gives you individual feedback on how you are doing, as well as suggestions for improvement. Make sure to take advantage of the lecturer's feedback! In addition to your marked assignment, all students will also receive the solutions to the assignment questions as well as comments on the assignment in a tutorial letter sent out after the closing date of each assignment.

Summative assessment refers to the final mark you receive for this module. In this module, your final mark is calculated from your examination mark (which counts for 80%) and from your semester mark (which counts for 20%). The semester mark is determined by how well you did in your assignments. Details of how this works are given in the following.

The semester mark and the final mark

Your **final mark** will be calculated from your **semester mark** and the **examination mark**.

- The **semester mark** is calculated from your assignment results (the percentages you receive for the assignments). The weights of the different assignments differ: Assignment 1 and Assignment 2 count for 45% each, and Assignment 3 for 10%. That is, the semester mark is calculated as

$$\text{semester mark} = \frac{1}{100} * (45 \cdot A_1 + 45 \cdot A_2 + 10 \cdot A_3)$$

where A_1 to A_3 are the percentages you received in assignments 1 to 3, respectively. Assignments not submitted, or submitted late, will give you 0%.

- The **examination mark** is the percentage mark you get in the examination.
- The examination mark contributes 80% to the final mark, and the semester mark contributes 20%. That is, your **final mark** is calculated as

$$\text{final mark} = 0.8 * (\text{examination mark}) + 0.2 * (\text{semester mark}).$$

You pass the module if your final mark is ≥ 50 , and you pass it with distinction if your final mark is ≥ 75 . There is also a subminimum rule, which says that you must get at least 40% in the examination to pass the module.

IMPORTANT: Please note that a poor semester mark will lower your final mark! It is therefore important that you try to complete all the assignments as well as you can – if your year mark is

zero, you must get 63% in the exam to pass the module! Also, you must make sure that you submit all the assignments on time, since if we receive your assignment too late, we have to give you 0% for it.

8.3 The assessments

There are three assignments in this module.

- Assignments 1 and 2 are written assignments. They will help you work through the module and will give you an idea on which topics you understand correctly, and where you are struggling. Please do view these assignments as a chance for you to get feedback from your lecturer! These assignments each count for 45% towards the semester mark, so these two assignments together make up 90% of the semester mark. Assignment 1 is compulsory; you will only get examination admission if you submit it by its due date.
- Assignment number 3 is a survey questionnaire, seeking your opinions on this module. The questionnaire will be sent out to all students later in the semester, and any student who fills it in and submits it gets 10% for the semester mark – which means 2 percentage points in the final mark, absolutely free!

You should complete all assignments as well as you can: To get admission to the examination; and because of the semester mark system which means that how well you do your assignments will also have a direct effect on the final mark you get for this module; and most importantly, because submitting the assignments gives you a chance to find out how well you have mastered the course contents, and for us to give you feedback on your progress!

Marking of the Assignments

Written assignments (Assignments 1 and 2)

After you have submitted your assignment, we will mark it, give you a percentage mark for it (a number between 0% and 100%), and send it back to you. The percentage mark you received will be indicated in your marked assignment. Your marked assignment will contain detailed feedback on your work. This feedback is very important, so make sure to read through the comments when you receive your assignment back.

The survey questionnaire (Assignment 3)

The survey questionnaire will be sent to you later in the semester; you should submit it in the assignment covers, as usual, and as soon as we receive it, you will get 100% for it.

Feedback to assignments

Comments and the answers to the questions in each assignment will be automatically sent out to all students a week or so after the closing date of the assignment, and therefore we have to give 0% for assignments which reach us too late. If you are struggling to meet the closing dates, please contact your lecturer before the closing date!

However, even if we receive your assignment too late, we will try to mark it and provide you feedback for it. So, it will still be a good idea to submit your assignment even if you know it might be too late for you to receive a percentage mark for it.

If you are genuinely unable to submit an assignment at all, please try to answer the questions in it anyway by yourself, before looking at the solutions. You will learn much more in this way than by simply reading through the correct solutions we send to you.

8.4 General assignment numbers

The three assignments are numbered 01, 02 and 03 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 in the table in the next section; you will also find them in the heading of each set of assignment questions.

8.4.2 Due dates for assignments

For each assignment there is a **FIXED CLOSING DATE**, which is the date by which the assignment **must reach** the university. The closing dates for submission of the assignments are given in the following table. We also give the contribution of each assignment to the semester mark.

| Assignment for SEMESTER 1 | Sections covered | Due Date | Unique number | Sem. mark contribution |
|---------------------------|--|---------------|---------------|------------------------|
| 1 | Chapters 2, 3 and 4; Study units 2, 3 and 4 | 15 March 2017 | 794575 | 45% |
| 2 | Chapters 5 and 6; Study units 5 and 6 | 12 April 2017 | 897232 | 45% |
| 3 | Questionnaire | 28 April 2017 | 822366 | 10% |

| Assignment for SEMESTER 2 | Sections covered | Due Date | Unique number | Sem. mark contribution |
|---------------------------|--|----------------|---------------|------------------------|
| 1 | Chapters 2, 3 and 4; Study units 2, 3 and 4 | 18 August 2017 | 656067 | 45% |
| 2 | Chapters 5 and 6; Study units 5 and 6 | 14 Sept 2017 | 853238 | 45% |
| 3 | Questionnaire | 6 October 2017 | 827335 | 10% |

8.5 Submission of assignments

Enquiries about assignments, such as whether they have been received by the university, what mark you obtained, when they were returned to you, etc., should be addressed to the Assignments section. For detailed information and requirements as far as assignments are concerned, see *my Studies @ Unisa*, which you received with your study package.

We strongly recommend that you submit your written assignments through myUnisa, since then the turnaround time for your assignment to get back to you will be shorter, and your assignment can never get lost. For most of the statistics modules we only accept file submissions in the PDF format. You can scan your hand-written assignment into a PDF file; or alternatively you can use a word-processing program with an equation editor (e.g. MSWord) or you can use special mathematical

typesetting programs such as LaTeX, and at the end convert your assignment to PDF. Please note that for typed assignments, you must still use all the correct mathematical notations, and include all necessary graphs, diagrams, and so on, just as if you were submitting a hand-written assignment!

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.

Please note: Although students may work together when preparing assignments, each student must write and submit his or her own individual assignment. It is unacceptable for students to submit identical assignments on the basis that they worked together. That is copying (a form of plagiarism) and none of these assignments will be marked. Furthermore, in such cases students may be penalised or subjected to disciplinary proceedings by the University.

8.6 Assignments

This tutorial letter 101 contains the assignments for both semesters, so make sure to select the semester you are enrolled for and do the set of assignments for that semester only. The assignments for Semester 1 are in Appendix A, pages 17–21. The assignments for Semester 2 are in Appendix B, pages 22–26. Solutions to the assignments will be posted to ALL students registered for this module after the closing date of the relevant assignment. Solutions will also be available on *myUnisa*.

9 OTHER ASSESSMENT METHODS

All the other assessment methods in this module are by self-assessment. To find out whether you are on the right track, you can: Do the activities in the study guide and compare your answers with the feedback; and do exercises in the text book and compare your answers with the given ones.

10 EXAMINATION

10.1 Examination Admission

To be admitted to the examination you must submit the compulsory assignment, i.e. Assignment 01, by its due date. Note that 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.

10.2 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.

10.3 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 STA1503. However, should your results be within a specified percentage (from 40% to 49%), you will be given a second chance in the form of a *supplementary* examination on the dates as specified in above. If you fail the examination with less than 40%, the year mark will not count to help you pass.

10.4 Previous Examination Papers

Previous examination papers are available to students on myUnisa. In addition, you will receive a *trial* paper towards the end of the semester that you can use as an indication of typical examination questions. Solutions to this trial paper is also included. Remember that the examples, exercises, activities in the guide as well as your assignment questions are also indicators of typical examination questions.

10.5 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 any.

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 SOURCES CONSULTED

No books other than the prescribed book was consulted in preparing this tutorial letter.

13 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 STA1503 that you can apply in many aspects of your life. Be positive, determined and eager to learn and you will be successful!

Your STA1503 lecturers

ADDENDUM A: FIRST SEMESTER ASSIGNMENTS**A.1 Assignment 01****ONLY FOR SEMESTER 1 STUDENTS****ASSIGNMENT 01****Unique Nr.: 794575****Fixed closing date: 15 MARCH 2017****QUESTION 1****[Total 15 marks]**

If A and B are events with $P(A) = 0.30$, $P(B) = 0.60$ and $P(A \cup B) = 0.70$, find:

- (a) $P(A \cap B)$ (3)
- (b) $P(\bar{A} \cup \bar{B})$ (3)
- (c) $P(\bar{A} \cap B)$ (4)
- (d) $P(B | A)$ (3)
- (e) Are the two events A and B independent? Justify your answer! (2)

QUESTION 2**[Total 15 marks]**

Assume that a randomly chosen Unisa student who is writing an examination at a certain centre is writing an economics module with probability $1/2$, a statistics module with probability $1/4$ and a law module with probability $1/4$. If the student is doing an economics module, she is repeating the module with probability $1/8$; for a statistics module she is repeating the module with probability $1/4$ and for a law module the student is repeating the module with probability $1/2$. Assuming that repeating students pass the module with probability $1/4$ and first-time writing students with probability $3/4$ in all three subjects, find the following probabilities:

- (a) The probability that the student passes the module. (5)
- (b) The probability that the student wrote a law module, given that the student passes. (5)
- (c) The probability that the student is repeating a statistics module, given that the student passes. (5)

QUESTION 3**[Total 20 marks]**

An urn contains 5 white balls, 4 blue balls, and 4 red balls.

- (a) If 4 balls are selected from the urn at random without replacement, find the probability that exactly 2 blue balls are selected. (5)
- (b) If 4 balls are selected from the urn at random with replacement, find the probability that exactly 2 blue balls are selected. (5)
- (c) If balls are selected one by one from the urn at random with replacement, find the probability it takes at least 2 tries to get a blue ball. (5)
- (d) If 6 balls are selected from the urn at random with replacement, find the probability that 2 white, 2 blue, and 2 red balls are selected. (5)

QUESTION 4**[Total 15 marks]**

Assume that the number of phone calls arriving at an office has the Poisson distribution, with an average of 2 calls per hour.

- (a) Find the probability that exactly 1 phone call arrives between 9:00 and 10:00. (5)
- (b) Given that it is known that three phone calls arrived between 9:00 and 12:00, find the probability that two of those phone calls arrived between 9:00 and 10:00. (5)
- (c) Let X denote the number of phone calls arriving during a working day of 8 hours. Find the expected value and variance of X . (5)

QUESTION 5**[Total 25 marks]**

Let Y be a random variable with $p(y)$ given in the table below.

| | | | | |
|--------|-----|-----|-----|-----|
| y | -1 | 0 | 1 | 3 |
| $p(y)$ | 0.2 | 0.3 | 0.2 | 0.3 |

Calculate the following:

- (a) $P(Y \leq 0)$ (3)
- (b) $P(Y \geq 0)$ (3)
- (c) $E(Y)$ (5)
- (d) $Var(Y)$ (6)
- (e) The moment generating function $m(t)$ of Y (8)

QUESTION 6**[Total 30 marks]**

Let Y be a continuous random variable with probability density function.

$$f(y) = \begin{cases} c(y+1) & \text{for } -1 \leq y \leq 1 \\ 0 & \text{otherwise.} \end{cases}$$

- (a) Find the value of c that makes $f(y)$ a probability density function. (5)
- (b) Find the cumulative distribution function, $F(y)$. (5)
- (c) Find $P(Y \leq 0)$. (5)
- (d) Find $P(Y > 1/2 \mid Y > 0)$. (5)
- (e) Find $E(Y)$ and $Var(Y)$. (5)
- (f) Find the moment generating function, $m(t)$, of Y . (5)

QUESTION 7**[Total 20 marks]**

- (a) Assume that the income of a newly appointed intern statistician is uniformly distributed between 5000 and 10 000 per month. Find the following:
- (i) The probability that the salary is between 6000 and 8000. (5)
- (ii) The expected salary per month. (5)
- (b) An automatic machine filling water bottles at a factory can be set to fill bottles such that the actual amount in each bottle has the normal distribution with an average on 750 milliliters (ml) and standard deviation σ .
- (i) How should σ be chosen if we want to make sure that the actual amount in each bottle is more than 750 ml at least 95% of the time? (5)
- (ii) How should σ be chosen if we want to make sure that the actual amount in each bottle is between 745 ml and 755 ml at least 99% of the time? (5)

Total: [140]

A.2 Assignment 02

ONLY FOR SEMESTER 1 STUDENTS

ASSIGNMENT 02

Unique Nr.: 897232

Fixed closing date: 12 APRIL 2017

QUESTION 1

[Total 46 marks]

Assume that the joint density function of two random variables Y_1 and Y_2 is given by

$$f(y_1, y_2) = \begin{cases} c(y_1 + y_2^2), & 0 < y_1 < 1, 0 < y_2 < 2 \\ 0 & \text{elsewhere.} \end{cases}$$

- (a) Find c . (6)
- (b) Find the marginal density functions $f_1(y_1)$ and $f_2(y_2)$ of the random variables Y_1 and Y_2 . (8)
- (c) Find $P(Y_1 < 1/2, Y_2 < 1)$. (6)
- (d) Find $P(Y_1 < 1/2 | Y_2 < 1)$. (8)
- (e) Find $P(Y_1 < 1/2 | Y_2 = 1)$. (8)
- (f) Find $Cov(Y_1, Y_2)$. (6)
- (g) Prove that Y_1 and Y_2 are not independent. (4)

QUESTION 2

[Total 18 marks]

Let Y_1 have the exponential distribution with expected value $1/2$, and let Y_2 have the exponential distribution with expected value $1/3$. Assume that Y_1 and Y_2 are independent of each other.

- (a) Find the joint density function of Y_1 and Y_2 . (6)
- (b) Find $P(Y_1 > 1, Y_2 > 1)$. (6)
- (c) Find $E(Y_1 Y_2)$. (6)

QUESTION 3**[Total 16 marks]**

Let Y be a continuous random variable with the density function.

$$f(y) = \begin{cases} \frac{3}{2}y^2 & \text{for } -1 \leq y \leq 1 \\ 0 & \text{otherwise.} \end{cases}$$

- (a) Find the density function of the random variable $U = 2 - 3Y$ using the method of distribution functions. (8)
- (b) Find the density function of the random variable $U = 2 - 3Y$ using the method of transformations. (8)

QUESTION 4**[Total 42 marks]**

Assume that a joint density function of random variables Y_1 and Y_2 is given by

$$f(y_1, y_2) = \begin{cases} c, & 0 < y_1 < y_2 < 2 \\ 0 & \text{elsewhere.} \end{cases}$$

- (a) Draw a sketch of the area where $f(y_1, y_2)$ is not zero. (5)
- (b) Find c . (10)
- (c) Find the marginal density functions $f_1(y_1)$ and $f_2(y_2)$ of the random variables Y_1 and Y_2 . (10)
- (d) Find $P(Y_2 < 1)$. (9)
- (e) Find $E(Y_1Y_2)$. (8)

Total: [122]**A.3 Assignment 03**

ONLY FOR SEMESTER 1 STUDENTS

ASSIGNMENT 03

Unique Nr.: 822366

Fixed closing date: 28 APRIL 2017

The questionnaire will be sent out to you later in the semester. Fill it in, and submit it in the assignment covers or through myUnisa by the due date, to get 100% for this assignment.

ADDENDUM B: SECOND SEMESTER ASSIGNMENTS

B.1 Assignment 01

ONLY FOR SEMESTER 2 STUDENTS

ASSIGNMENT 01

Unique Nr.: 656067

Fixed closing date: 18 AUGUST 2017

QUESTION 1

[Total 14 marks]

If A and B are independent events with $P(A) = 0.20$, $P(B) = 0.80$, find:

- (a) $P(A \cap B)$ (3)
- (b) $P(A \cup B)$ (3)
- (c) $P(A \cap \bar{B})$ (4)
- (d) $P(\bar{A} \cap \bar{B})$ (4)

QUESTION 2

[Total 14 marks]

In a population of voters, 30% favour an election issue, and 70% do not favour it. In a survey it is found that 40% of those who favour the issue vote for the ruling party, while 80% of those who do not favour the issue vote for the ruling party.

- (a) What is the probability that a randomly chosen person votes for the ruling party? (6)
- (b) A person chosen at random is found to be from the ruling party. What is the probability that the chosen person does not favour the election issue? (8)

QUESTION 3

[Total 20 marks]

An urn contains 3 white balls, 4 blue balls, and 5 red balls.

- (a) If I select 3 balls at random without replacement, find the probability that I get no red balls. (5)
- (b) If I select 5 balls at random with replacement, find the probability that I get exactly 3 white balls. (5)
- (c) If I select balls at random with replacement, find the probability it takes me at least 4 tries to get two blue balls. (5)
- (d) If I select 6 socks at random with replacement, find the probability that I get 2 white, 2 blue, and 2 red balls. (5)

QUESTION 4**[Total 25 marks]**

Assume that the daily mail delivery arrives at a house at a time X which is uniformly distributed in the time interval between 10:00 and 14:00.

- (a) Find the probability that the delivery arrives between 13:45 and 14:00. (5)
- (b) Find the probability that the delivery does not arrive until after 12:00. (5)
- (c) Find the probability that the delivery arrives after 13:00, given that we know that it has not arrived before 12:00. (5)
- (d) Find the expected value and variance of X . (5)
- (e) Find the moment generating function, $m(t)$, of X . (5)

QUESTION 5**[Total 39 marks]**

Let Y be a continuous random variable with probability density function.

$$f(y) = \begin{cases} cy^2 & \text{for } 0 \leq y \leq 2 \\ 0 & \text{otherwise.} \end{cases}$$

- (a) Find the value of c that makes $f(y)$ a probability density function. (5)
- (b) Find $F(y)$, the distribution function of Y . (6)
- (c) Use $F(y)$ to find $P(Y > 1)$. (4)
- (d) Find $E(Y)$ and $Var(Y)$. (10)
- (e) Find the moment generating function, $m(t)$, of Y . (8)
- (f) Find $E(2(Y+1)^2)$. (6)

QUESTION 6**[Total 23 marks]**

Let Y be a continuous random variable with the cumulative distribution function

$$F(y) = \begin{cases} 0 & \text{for } y \leq 0 \\ \frac{2}{3} \left(y + \frac{1}{2}y^2 \right) & \text{for } 0 < y \leq 1 \\ 1 & \text{for } y > 1 \end{cases}$$

- (a) Prove that F is a cumulative distribution function of a continuous distribution. (4)
- (b) Find $E(Y)$ and $Var(Y)$. (8)
- (c) Find $P(Y > 1/2)$. (5)
- (d) Find $P(Y > 3/4 | Y > 1/2)$. (6)

QUESTION 7**[Total 27 marks]**

- (a) Assume that the incomes per month for pensioners in a town are normally distributed with expected value 3000 and variance 200. Find the probability that the income per month of a randomly chosen pensioner exceeds 3500. (5)
- (b) Assume that the time until the next thunderstorm has the exponential distribution with an expected value of 20 days.
- (i) What is the probability that the time until the next thunderstorm is more than 10 days but less than 30 days? (5)
- (ii) What is the probability that the second thunderstorm counting from today comes after day 20, given that the first thunderstorm counting from today is on day 10? (6)
- (c) Let X follow the Beta distribution with parameters $\alpha = 1$ and $\beta = 3$.
- (i) Find $E(X)$ and $Var(X)$. (6)
- (ii) Find $P(X < 1/2)$. (5)

Total: [162]

B.2 Assignment 02

ONLY FOR SEMESTER 2 STUDENTS
ASSIGNMENT 02
Unique Nr.: 853238
Fixed closing date: 14 SEPTEMBER 2017

QUESTION 1**[Total 42 marks]**

Assume that a joint distribution function of random variables Y_1 and Y_2 is given by

$$f(y_1, y_2) = \begin{cases} c(y_1 + y_2), & 0 < y_1 < 2, \quad 0 < y_2 < 1 \\ 0 & \text{elsewhere.} \end{cases}$$

- (a) Find c . (6)
- (b) Find the marginal density functions $f_1(y_1)$ and $f_2(y_2)$ of the random variables Y_1 and Y_2 . (8)
- (c) Find $P(Y_1 < 1, Y_2 > 1/2)$. (6)
- (d) Find $P(Y_1 < 1 | Y_2 > 1/2)$. (8)
- (e) Find $P(Y_1 < 1 | Y_2 = 1/2)$. (8)
- (f) Find $E(Y_1 + Y_2)$. (6)

QUESTION 2**[Total 22 marks]**

Let Y_1 have the uniform distribution over $[1, 3]$ and let Y_2 have the uniform distribution over $[1, 4]$. Assume that Y_1 and Y_2 are independent of each other.

- (a) Find the joint density function of Y_1 and Y_2 . (6)
- (b) Find $P(Y_1 < Y_2)$. (8)
- (c) Find the density function of the random variable $X = 2Y_1 + 5$. (8)

QUESTION 3**[Total 16 marks]**

Let Y be a continuous random variable with the density function.

$$f(y) = \begin{cases} e^{-y} & \text{for } 0 \leq y \leq \infty \\ 0 & \text{otherwise.} \end{cases}$$

- (a) Find the density function of the random variable $U = 2 - 3Y$ using the method of distribution functions. (8)
- (b) Find the density function of the random variable $U = 2 - 3Y$ using the method of transformations. (8)

QUESTION 4**[Total 41 marks]**

Assume that a joint distribution function of random variables Y_1 and Y_2 is given by

$$f(y_1, y_2) = \begin{cases} c, & 0 < y_2 < y_1 < 2 \\ 0 & \text{elsewhere.} \end{cases}$$

- (a) Draw a sketch of the area where $f(y_1, y_2)$ is not zero. (5)
- (b) Find c . (10)
- (c) Find the marginal density functions $f_1(y_1)$ and $f_2(y_2)$ of the random variables Y_1 and Y_2 . (10)
- (d) Find $P(Y_1 < 1)$. (8)
- (e) Find $E(Y_1)$. (8)

Total: [121]**B.3 Assignment 03****ONLY FOR SEMESTER 1 STUDENTS****ASSIGNMENT 03****Unique Nr.: 827335****Fixed closing date: 6 OCTOBER 2017**

The questionnaire will be sent out to you later in the semester. Fill it in, and submit it in the assignment covers or through myUnisa by the due date, to get 100% for this assignment.