UGRC 120
NUMERACY SKILLS

STUDY GUIDE
For Undergraduates Level 100

2014/15–2016/17 Academic Year

Dr. Ezekiel N. N. Nortey, University of Ghana, Department of Statistics
Mr. Enoch Nii Boi Quaye, University of Ghana, Department of Statistics
Acknowledgements

The Department of Statistics wishes to thank all those who contribution to this instructional material.
CONTENTS

COURSE DESCRIPTION .................................................................................................................. 4

1. COURSE WEBSITE .............................................................................................................. 4

2. INSTRUCTORS ...................................................................................................................... 4

3. Support Contact Information ............................................................................................... 4

5. PROBLEM-BASED LEARNING APPROACH ...................................................................... 5

7. LEARNING OUTCOMES ...................................................................................................... 6

7.1 KNOWLEDGE .................................................................................................................. 6
7.2 SKILLS ............................................................................................................................. 6
7.3 COMPETENCE ................................................................................................................ 6

8. ASSESSMENT ....................................................................................................................... 7

8.1 Interim Assessment ......................................................................................................... 7

9. RECOMMENDED TEXT ..................................................................................................... 7

DETAILED CLASS SCHEDULE ................................................................................................. 8

10. SCHEDULE OF SESSIONS .................................................................................................. 8

11. SESSION 0 – REVIEW OF BASIC ALGEBRAIC MATHEMATICS (I) .............................. 8

11.1 Overview ....................................................................................................................... 8
11.2 Goals and Objectives .................................................................................................... 8
11.3 Activities and Assignments ......................................................................................... 9

12. SESSION 1 – REVIEW OF BASIC ALGEBRAIC MATHEMATICS (II) ........................... 9

12.1 Overview ....................................................................................................................... 9
12.2 Goals and Objectives .................................................................................................... 9
12.3 Activities and Assignments ......................................................................................... 9

13. SESSION 2 – MATHEMATICAL REASONING ................................................................. 9

13.1 Overview ....................................................................................................................... 9
13.2 Goals and Objectives .................................................................................................... 10
13.3 Activities and Assignments ......................................................................................... 10
<table>
<thead>
<tr>
<th>Session</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>SESSION 3 – SET THEORY</td>
<td>10</td>
</tr>
<tr>
<td>14.1</td>
<td>Overview</td>
<td>10</td>
</tr>
<tr>
<td>14.2</td>
<td>Goals and Objectives</td>
<td>10</td>
</tr>
<tr>
<td>14.3</td>
<td>Activities and Assignments</td>
<td>10</td>
</tr>
<tr>
<td>15</td>
<td>SESSION 4 – ELEMENTARY PROBABILITY</td>
<td>11</td>
</tr>
<tr>
<td>15.1</td>
<td>Overview</td>
<td>11</td>
</tr>
<tr>
<td>15.2</td>
<td>Goals and Objectives</td>
<td>11</td>
</tr>
<tr>
<td>15.3</td>
<td>Activities and Assignments</td>
<td>11</td>
</tr>
<tr>
<td>16</td>
<td>SESSION 5 – STATISTICAL DISPLAYS: TABLES, GRAPHS AND CHARTS</td>
<td>11</td>
</tr>
<tr>
<td>16.1</td>
<td>Overview</td>
<td>11</td>
</tr>
<tr>
<td>16.2</td>
<td>Goals and Objectives</td>
<td>11</td>
</tr>
<tr>
<td>16.3</td>
<td>Activities and Assignments</td>
<td>12</td>
</tr>
<tr>
<td>17</td>
<td>SESSION 6 – SUMMARY STATISTICS</td>
<td>12</td>
</tr>
<tr>
<td>17.1</td>
<td>Overview</td>
<td>12</td>
</tr>
<tr>
<td>17.2</td>
<td>Goals and Objectives</td>
<td>12</td>
</tr>
<tr>
<td>17.3</td>
<td>Activities and Assignments</td>
<td>12</td>
</tr>
<tr>
<td>18</td>
<td>SESSION 7 – MEASURE OF LINEAR ASSOCIATION AND RELATION</td>
<td>13</td>
</tr>
<tr>
<td>18.1</td>
<td>Overview</td>
<td>13</td>
</tr>
<tr>
<td>18.2</td>
<td>Goals and Objectives</td>
<td>13</td>
</tr>
<tr>
<td>18.3</td>
<td>Activities and Assignments</td>
<td>13</td>
</tr>
<tr>
<td>Appendix A</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
COURSE DESCRIPTION

1. COURSE WEBSITE
   http://sakai.ug.edu.gh

2. INSTRUCTORS
   **Dr. Ezekiel N. N. Nortey**
   Department of Statistics  
   School of Physical and Mathematical Sci.  
   University of Ghana  
   P. O. Box LG 78  
   Legon, Accra  
   Email: ennortey@ug.edu.gh

   **Mr. Enoch Nii Boi Quaye**
   Department of Statistics  
   School of Physical and Mathematical Sci.  
   University of Ghana  
   P. O. Box LG 78  
   Legon, Accra  
   Email: enbquaye@ug.edu.gh

   *Dr. Ezekiel N. N. Nortey is the instructor.*

3. Support Contact Information
   School of Continuing and Distance Education  
   University of Ghana  
   P. O. Box LG 31  
   Legon, Accra

   Phone: +233 (0) 309-388-55  
   Email: scede14@gmail.com
4. OVERVIEW

Generally, the objective of this course is to equip students with basic numeracy skills needed to solve real life problems. To make the learning process more participatory, this course integrates teaching with activities requiring use of computer packages such as Excel in analyzing data. Upon completion of this module, you should be able to:

- To give a simple and clear presentation of the fundamentals, logic and meaning of mathematics and statistics to beginners.
- To help students gain self-confidence and familiarity with the subject
- To help students attain proficiency in both mathematics and statistics simultaneously while participating in their practical applications.

A wide range of topics is covered in this module although the treatment is limited to the elementary level. There are solved, partly solved and unsolved assignments with every section, to make the student familiar with the methods introduced. Topics covered broadly include: review of Basic Algebraic Mathematics, Mathematical Reasoning and Set Theory, Elementary Probability, Displays: Tables Graphs and Charts, Summary Statistics and Measures of Linear Association.

5. PROBLEM-BASED LEARNING APPROACH

Problem-based learning (PBL) is a student-centered pedagogy in which students learn about a subject through the experience of problem solving. The goals of PBL are to help the students develop flexible knowledge, effective problem solving skills, self-directed learning, effective collaboration skills and intrinsic motivation. This course will use a problem-based learning approach.

Working in groups, students identify what they already know, what they need to know, and how and where to access new information that may lead to resolution of the problem. The role of the instructor/lecturer/tutor is to facilitate learning by supporting, guiding, and monitoring the learning process. The tutor will help build students’ confidence to take on the problem, and encourage the students, while also stretching their understanding.

6. COURSE FORMAT

The course content will be delivered online through the SAKAI Learning Management System (Sakai LMS). The Sakai LMS will be used to deliver

- Video Lecture Sessions
- Session Slides
- Session Reading Materials
- Assessments – Tests, Quizzes and Assignments (including a Problem-based Term Paper)
- Group activities – Discussions and Presentations

Announcements will be posted to the course website and/email accordingly. It is the responsibility of students to check on announcements made in class, on the Course Website, and through email.
7. LEARNING OUTCOMES

The learning outcomes for the course are outlined along three strands: knowledge, skills and outcomes.

7.1 KNOWLEDGE

Students must have knowledge on:
1. The definition and categorisation of basic types of numerical measures used in mathematics and statistics.
2. Mathematical reasoning and set theory (i.e. inductive and deductive reasoning, definition of sets and its representation and laws of operations in set algebra etc).
3. Elementary mathematical and statistical computations to be used on each numerical measure.
4. The types of statistical datasets and how to work with each.
5. The basic descriptive statistical analysis which can be employed on available datasets.
6. The concept of elementary probability, its related rules and applications in real life problems.
7. How to develop tables and summaries on datasets.
8. Introductory use of Excel in data analysis and mathematical calculations.

7.2 SKILLS

Students must be able to:
1. Identify all existing types of numbers and proficiently employ each in practical computation problems.
2. Construct sets, and efficiently apply related laws and operation of sets.
3. Efficiently organise and categorise data into their respective types and conveniently obtain frequency distributions when needed.
4. Undertake basic descriptive statistics using graphical charts and numerical measures.
5. Analyse and draw inference from existing datasets.
6. Outline the relevance and appropriateness of use of graphs and charts in data analysis.
7. Analyse and develop an appropriate research design to address a specific research problem.

7.3 COMPETENCE

Students should in the future be able to:
1. Understand and perform basic mathematical operations on numbers and solve linear equations.
2. Compute rates and proportions.
3. Make inductive and deductive statements and solve problems involving sets.
4. Understand and solve problems in probability.
5. Understand and apply basic concepts in statistics.
6. Draw graphs and charts to give vivid description of any mass of data.
7. Understand, compute and describe basic summary measures such as averages, spread or shape.
8. Understand, compute and describe basic measures of linear associations between two variables.
8. ASSESSMENT

The assessment for this course has been designed to help all students to maximize their individual and group/team learning opportunities. A summary of the assessment tasks is provided below.

<table>
<thead>
<tr>
<th>ITEM</th>
<th>FORM OF ASSESSMENT</th>
<th>DELIVERED</th>
<th>MARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual Class Assignments</td>
<td>Paper Based Submission</td>
<td>End of Session</td>
<td>10%</td>
</tr>
<tr>
<td>Interim Assessment</td>
<td>Multiple Choice Questions</td>
<td>Middle of Semester</td>
<td>20%</td>
</tr>
<tr>
<td>Written Examination</td>
<td>Semester Examination</td>
<td>End of semester</td>
<td>70%</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

8.1 Individual Class Assignments

Students are required to submit End-of-Session assignments. These constitute 10% of individual assessment. Assignments will be issued at the end of each session. Paper-based submissions are to be made by students to instructor.

8.2 Interim Assessment

Interim Assessment (IA) is in the form of Multiple Choice Questions (MCQs) within the middle of the semester. UGRC 120 IA will be conducted within the 8th – 9th week in the semester. This will cover 30% of the students' assessment.

8.3 Written Examination

Written end of semester examination for UGRC 120 is a Multiple Choice Question (MCQs). This will cover all sessions undertaken for the semester. It forms 70% of students' grading.

9. RECOMMENDED TEXT


Mendenhall, W., Beaver, R. J. and Beaver, B. M., (2009). Introduction to probability and statistics: USA: Brooks/Cole


DETAILED CLASS SCHEDULE

The course is organized into 8 SESSIONS along the following lines: (1) Overview; (2) Goals and Objectives; and (3) Activities and Assignments.

10. SCHEDULE OF SESSIONS

<table>
<thead>
<tr>
<th>Week</th>
<th>Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Session 0</td>
</tr>
<tr>
<td>2</td>
<td>Session 1</td>
</tr>
<tr>
<td>3</td>
<td>Session 2</td>
</tr>
<tr>
<td>4</td>
<td>Sessions 3</td>
</tr>
<tr>
<td>5</td>
<td>Session 3</td>
</tr>
<tr>
<td>6</td>
<td>Session 4</td>
</tr>
<tr>
<td>7</td>
<td>Session 4</td>
</tr>
<tr>
<td>8</td>
<td>Session 5</td>
</tr>
<tr>
<td>9</td>
<td>Session 5</td>
</tr>
<tr>
<td>10</td>
<td>Interim Assessment (IA)</td>
</tr>
<tr>
<td>11</td>
<td>Session 6</td>
</tr>
<tr>
<td>12</td>
<td>Session 6</td>
</tr>
<tr>
<td>13</td>
<td>Session 7</td>
</tr>
</tbody>
</table>

11. SESSION 0 – REVIEW OF BASIC ALGEBRAIC MATHEMATICS (I)

11.1 Overview

Session 0 introduces the student to a review on types of numbers, algebraic expressions and basic algebraic computation concepts i.e. mathematical operations on numbers and algebraic expressions, change of subject or formulae. Topic covered include the following:

- Types and categorization of numbers and mathematical expressions
- Addition and Subtraction of Numbers and Algebraic expressions
- Multiplication and Division of Numbers and Algebraic expressions (Real and Rational)
- Change of Subject or Formulae (Constants and Variables)
- Algebraic Expressions-Expansions and Factorizations.

11.2 Goals and Objectives

At the end of the session, the student will be able to:

1. Define and identify numbers types and commonly used forms of algebraic expressions.
2. Perform basic mathematical operations such as addition, subtraction, multiplication and division of numbers.
3. Perform basic mathematical operations such as addition, subtraction, multiplication and division of algebraic expressions.
4. Change the subject of a relation or formulae (both for constants and variables) as they apply to real world problems.
11.3 Activities and Assignments

This week, complete the following tasks:
1. Log onto the UG Sakai LMS course site: http://sakai.ug.edu.gh
2. Watch the Video for Session 0 – Review of Basic Algebraic Mathematics I
3. Read Unit 1 (sections 1, 2, 3, and 4) of the above Recommended Text – Numeracy Skills: The Basics and Beyond. Read chapter One of Anderson et al. Statistics for Business and Economics.
4. Complete the attached end of session multiple choice questions and submit by the indicated deadline.
5. Complete all activities outlined in each session.
6. Visiting the Chat Room to introduce yourself while discussing your expectations for the course.
7. Explore the online tools available in Sakai.

12. SESSION 1 – REVIEW OF BASIC ALGEBRAIC MATHEMATICS (II)

12.1 Overview

Session 1 builds on Session 0. Here, we seek to introduce students to the concept approximations and standard forms, solving problems involving rates and linear equations involving one or two unknown variables.

12.2 Goals and Objectives

At the end of the session, the student will be able to:
1. Understand and compute basic measures of rates such as ratios, fractions, proportions and percentages.
2. Perform basic approximations of numbers e.g. decimals and significant figures.
3. Solve linear equations in one or two unknown variables.
4. Formulate and solve linear equations from real world problems.

12.3 Activities and Assignments

This week, complete the following tasks:
1. Log onto the UG Sakai LMS course site: http://sakai.ug.edu.gh
2. Read Unit 1 (sections 5, 6 and 7) of Recommended Text
3. Watch the Videos on the topic
4. Review Lecture Slides: Session 1 – Review of Basic Algebraic Mathematics II
5. Complete attached review questions on Unit 1 of Recommended Text.
6. Visit the Chat Room and discuss the Forum question for Session 1
7. Complete the Individual Assignment for Session 1

13. SESSION 2 – MATHEMATICAL REASONING

13.1 Overview

Being proficient with introductory concepts in Sessions 0 and 1, we proceed to build an essential fundamental knowledge in Mathematical Reasoning. Together, as we build along on
you will find out how most reasonable actions we take in life are based on mathematical reasoning. This session entails practical application to real life scenarios; students are encouraged to relate concepts learned to everyday happenings.

13.2 Goals and Objectives

At the end of the session, the student will be able to:

1. State the types of statements
2. Perform or solve problems using inductive and deductive reasoning
3. Draw valid conclusions from statements and truth tables
4. Comment on the validity of otherwise of statements.

13.3 Activities and Assignments

This week, complete the following tasks:

1. Log onto the UG Sakai LMS course site: http://sakai.ug.edu.gh
2. Read Section 1 of Unit 2 of Recommended Text
3. Watch the Videos on the topic
4. Review Lecture Slides: Session 2 – Mathematical Induction
5. Complete attached review questions on Unit 2 of Recommended Text.
6. Visit the Chat Room and discuss the Forum question for Session 2
7. Complete the Individual Assignment for Session 2

14. SESSION 3 – SET THEORY

14.1 Overview

All mathematical objects and constructions have a basis in set theory. The idea of a set is fundamental in all applications of academic studies. In the social sciences and arts, we encounter sets of data, sets of items produced, sets of outcomes of decisions, sets of theories and arguments etc. words such as group, family, association, club, etc are often used to convey the idea of a set in everyday life. Enumeration and management of these lead to numerical representations whose study give good insight into the depths of the subject matter. In this session, we give a definition of a set and follow up with some examples including mathematical computations

14.2 Goals and Objectives

At the end of the session, the student will be able to:

1. Define sets, give example of sets and identify types of sets
2. Construct sets, identify and enumerate notations and elements of a set
3. Draw Venn diagrams and use it to solve two-and three-set problems.

14.3 Activities and Assignments

This week, complete the following tasks:

1. Log onto the UG Sakai LMS course site: http://sakai.ug.edu.gh
2. Read Unit 2 (sections 2,3,4,5 and 6) of Recommended Text
3. Watch the Videos on the topic
4. Review Lecture Slides: Session 3 – Mathematical Induction
5. Complete attached review questions on Unit 2 of Recommended Text.
6. Visit the Chat Room and discuss the Forum question for Session 3
7. Complete the Individual Assignment for Session 3

15. SESSION 4 – ELEMENTARY PROBABILITY

15.1 Overview
Uncertainties surround all daily activities of life. By now, you may have used the term “risk” on numerous occasions. Decisions we take always result in an outcome which may either be expected or unexpected. The likelihood of an outcome occurring (either with certainty or uncertainty) is loosely defining the term “probability of the outcome”. In this session, we will discuss some basic concepts of probability and relate them to real life problems. Probability helps us to measure risk better.

15.2 Goals and Objectives
At the end of the session, the student will be able to:
1. Define probability of an event
2. Identify types of probability
3. Understand and apply the basic principles of probability
4. Do computations involving basic probability
5. Apply the basic rules of probability in solving real life problems.

15.3 Activities and Assignments
This week, complete the following tasks:
1. Log onto the UG Sakai LMS course site: http://sakai.ug.edu.gh
2. Read Unit 3 (sections 1 - 5) of Recommended Text
3. Watch the Videos on the topic
4. Review Lecture Slides: Session 4 – Elementary Probability
5. Complete attached review questions on Unit 3 of Recommended Text.
6. Visit the Chat Room and discuss the Forum question for Session 4
7. Complete the Individual Assignment in Session 4

16. SESSION 5 – STATISTICAL DISPLAYS: TABLES, GRAPHS AND CHARTS

16.1 Overview
This session introduces the student to types of variables, the kind of data they generate and their respective graphical display charts and tabular analysis. We will get acquainted with how to organize data pictorially to reveal details of concealing features that are not explicit in any dataset. Some assignments will involve the use of Microsoft Excel tools.

16.2 Goals and Objectives
At the end of the session, the student will be able to:
1. Organize and present data in the form of tables, graphs and charts.
2. Develop frequency distribution tables and draw graphs of numerical data
3. Develop frequency distribution tables and draw graphs of categorical data
4. Determine the appropriateness and relevance of the use of each type of graph or chart.

16.3 Activities and Assignments

This week, complete the following tasks:
1. Log onto the UG Sakai LMS course site: http://sakai.ug.edu.gh
2. Read Unit 4 (sections 1 - 6) of Recommended Text
3. Watch the Videos on the topic
4. Review Lecture Slides: Session 5 – Statistical Displays: Tables, Graphs and Charts
5. Complete attached review questions on Unit 4 of Recommended Text.
6. Visit the Chat Room and discuss the Forum question for Session 5
7. Complete the Individual Assignment in Session 5

17. SESSION 6 – SUMMARY STATISTICS

17.1 Overview

Real-life datasets come in large forms. A common feature of large dataset is that of implicit characteristics. Details such as mean, mode, median and other measures which describe the data are mostly concealed. Session 6 of this study guide introduces students to summary statistics, the fundamental statistical concept used to describe data structure for useful inferences. We will learn about the varied type forms of distributions which a dataset may follow. Accurate data description will inform the student on which advanced statistical tests to adopt for data analysis.

17.2 Goals and Objectives

At the end of the session, the student will be able to:
1. Understand and apply the index and sigma notations
2. Compute the measures of central tendency
3. Make comparison of the mean, mode and median as they relate to the shape of the curve (Normal and Skewed Distributions).
4. Carry out computations involving the range, semi-inter-quartile range, the mean deviation and the standard deviation.
5. Give practical interpretation of each of these measures
6. Compute the above related measures in excel.

17.3 Activities and Assignments

This week, complete the following tasks:
1. Log onto the UG Sakai LMS course site: http://sakai.ug.edu.gh
2. Read Unit 5 (sections 1 - 6) of Recommended Text
3. Watch the Videos on the topic
4. Review Lecture Slides: Session 6 – Statistical Displays: Tables, Graphs and Charts
5. Complete attached review questions on Unit 5 of Recommended Text.
6. Visit the Chat Room and discuss the Forum question for Session 6
7. Complete the Individual Assignment in Session 6
18. SESSION 7 – MEASURE OF LINEAR ASSOCIATION AND RELATION

18.1 Overview

It is possible to find a relationship or some form of association between variables of a dataset. Being a researcher, it is first expedient to determine if some degree of association or relationship exists and further ascertain the nature of existing relationship. Though several forms of relationships can be identified, this section of the study guide considers measures of linear relationships. This is commonly applied to bivariate data.

18.2 Goals and Objectives

At the end of the session, the student will be able to:
1. Understand the essence of correlation between two variables
2. Carry out computations involving linear and rank correlation
3. Compute a correlation coefficient
4. Interpret the value of computed correlation coefficient

18.3 Activities and Assignments

This week, complete the following tasks:
1. Log onto the UG Sakai LMS course site: http://sakai.ug.edu.gh
2. Read Unit 6 (sections 1 - 6) of Recommended Text
3. Watch the Videos on the topic
4. Review Lecture Slides: Session 7 – Measures of Linear Association and Relation
5. Complete attached review questions on Unit 5 of Recommended Text.
6. Visit the Chat Room and discuss the Forum question for Session 7
7. Complete the Individual Assignment in Session 7.