UNIVERSITY OF NAIROBI
SCHOOL OF BIOLOGICAL SCIENCES
SZI 303 : BIOSTATISTICS

A. COURSE DESCRIPTION

The course explores the meaning of statistics. It introduces students to some basic terms like variable, continuous variables, discrete variables, population, sample, histogram, frequency, classes, class intervals and frequency distribution; a distribution in statistical terms: mode, mean, median; measuring the spread of a distribution; range, semi-interquartile range, distribution curve, distribution of t, calculating the limits of a mean; and comparing the means of two samples: null hypothesis, alternate hypothesis, differences between standard deviations, limits of standard deviation and variance. The course also examines a comparison of three or more samples: Simple analysis of variance; correlation of two variables: scatter diagram, correlation coefficient, regression lines, mean centre; and chi-square test: the 2x2 contingency table. Learners are taken through planning experiments: layout of experiments, controls, precision of measurements, number of replicates, randomization, Latin squares, and interaction.

Practical sessions involve data analyses and problem solving using computers.

B. COURSE REQUIREMENTS

- Regular attendance and participation in class discussion
- Sitting all the required CATs and the Final examination
- Adequate preparation for every class
- Reading the required and recommended texts, and
- Doing and submitting class assignments at the right time

C. TEACHING METHODS

Lectures
Power point presentations
Class discussions

D. TEACHING METHODS

LCD projectors
White boards

E. COURSE OUTLINE AND SCHEDULE:

Lecture Topic	Lecture Detailed outline	Reading Assignments
INTRODUCTION TO BIOSTATISTICS	• Meaning of biostatistics • Types of variables • Population and samples ✓ Populations ✓ Samples from populations ✓ Random sampling ✓ Parameters and statistics	Read on types of biological data Stem-and-leaf diagrams Cyclic and circular data
	References used Chernick & Friis (2003) Pages 1 - 46	Follow Up Activities Discuss applications and limitations of Stem-and-leaf diagrams
PRESENTATION OF BIOLOGICAL DATA	• Frequency distribution • Cumulative frequency distribution	Drawing histograms Pie charts
	References used Chernick & Friis (2003)Pages 46 - 61	Follow Up Activities Of a given set of data, draw a frequency distribution curves and polygons

Lecture Topic	Lecture Detailed outline	Reading Assignments
DESCRIPTIVE STATISTICS	• Measures of Central Tendency ✓ Arithmetic mean ✓ Median ✓ Quartiles ✓ Mode Measures of dispersion ✓ Range Mean deviation ✓ Variance ✓ Standard deviation ✓ The coefficient of variation	Read and discuss the purpose of descriptive statistics highlighting advantages and disadvantages mean, mode and median
	References used Chernick & Friis (2003) Pages 68 - 85	Follow Up Activities Differentiate the following terms a) Histogram and frequency polygon b) Descrete variables and continuous variables c) Sample and population d) Mean deviation and standard deviation e) Measures of dispersion and measures of central tendency

Lecture Topic	Lecture Detailed outline	Reading Assignments
• PROBABILITY AND STATISTICS	• Probability ✓ Laws of probability o Counting possible outcomes o Probability of an event o Adding probabilities o Multiplying probabilities • Permutation and combinations ✓ Permutations ✓ Combinations	Read of generalised multiplication rule Probabilities with equal outcomes Baye's theorem
	References used Chernick & Friis (2003) Pages 92 - 109	Follow Up Activities Assignment and computer exercise

• NORMAL DISTRIBUTION	• Symmetry and Kurtosis • Proportions of normal distribution • The distribution of means • Statistical hypothesis testing • Assessing departures from normality	Read on standard Normal distribution and probabilities
	References used Chernick & Friis (2003) Pages 121 - 122	Follow Up Activities A normally distributed population of maize seed weights has a mean of 63.5g and a standard deviation of 12.2g. a) What proportion of this population is 78.0g or larger? b) What proportion of this population is 78.0g or smaller? c) If there 1000 weights in this population, how many of them are 78.0g or larger? d) What is the probability of choosing at random from this population a weight smaller than 41.0g?

Lecture Topic	Lecture Detailed outline	Reading Assignments
• CAT & Revision	• Testing topics covered in weeks 1, 2 & 3.	
• BIONOMIAL AND POISSON DISTRIBUTION	• Binomial distribution • Poisson distribution	Normal approximation to Poisson distribution
	References used Chernick & Friis (2003) Pages 109	Follow Up Activities A total of 24 potted plants were used in an experiment designed to test nitrogen fixation potential of a Rhizobia strain on three different plant species. Twelve (12) potted plants of *Sesbania* sp., eight (8) of *Calliandra* sp. and four (4) of *Acacia* sp. How many different sequences of these species are possible in a greenhouse setup

Lecture Topic	Lecture Detailed outline	Reading Assignments
• STANDRAD ERROR AND CONFIDENCE INTERVAL	• Standard error • Confidence interval	Variance and standard deviation for grouped data Calculating the combined mean and variance of several samples
	References used Chernick & Friis (2003) Pages 133 - 161	Follow Up Activities The time taken for cessation of bleeding was recorded for a large number of persons whose fingers had been pricked. The mean time was found to be 1.407 min and the standard deviation was 0.588 min. In an effort to determine whether pressure applied to the upper arm increases bleeding time, six persons had pressure equal to 20 mmHg applied to their upper arms and had their fingers pricked. For these six persons, the times taken for bleeding to stop were 1.15, 1.75, 1.32, 1.28, 1.39, and 2.50min. a) State appropriate Null hypothesis for this experiment b) Give a 95% confidence interval for the mean bleeding time under pressure for the six

		persons c) Draw a conclusion as to whether pressure increases bleeding time or not.
• HYPOTHESIS TESTING	• Null hypothesis and alternative hypotheses • The standard format for hypothesis testing	General formulation of hypothesis and hypothesis testing
	References used Chernick & Friis (2003) Pages 182 - 191	Follow Up Activities Assignment and computer exercise

Lecture Topic	Lecture Detailed outline	Reading Assignments
• THE *t*-DISTRIBUTION	• One group of observations (or one sample test) • Two independent group of observation ✓ Variances not known ✓ Variances known	Confidence intervals of means using *t* distribution Comparison of variances
	References used Chernick & Friis (2003) Pages 193 – 195	Follow Up Activities Assignment and computer exercise
• THE CHI-SQUARE DISTRIBUTION	• Testing the Goodness of fit • Test of independence ✓ The 2 x 2 Contingency table ✓ The 2 x 4 Contingency table	Goodness of fit to prescribed probabilities Yate's correction
	References used Chernick & Friis (2003) Pages 232 - 239	Follow Up Activities Assignment and computer exercise

Lecture Topic	Lecture Detailed outline	Reading Assignments
• ANALYSIS OF VARIANCE	• One-way (Single factor) ANOVA ✓ Equal replication (Sample size) ✓ Unequal replications (sample size) • Two-way (factor) ANOVA • Multiple comparisons ✓ The Tukey test ✓ The Newman-Keuls test • Assumptions of ANOVA • Data transformation ✓ Logarithmic ✓ Square root ✓ Arcsine (angular)	Read on Experimental designs Sample size determination.
	References used Chernick & Friis (2003) Pages 296 – 301	Follow Up Activities Assignment and computer exercise
• SIMPLE LINEAR REGRESSION	• Simple linear regression equation • Simple linear regression analysis	Read on why and when to choose regression analysis How to handle outliers
	References used Chernick & Friis (2003) Pages 252-259	Follow Up Activities Assignment and computer exercise

Lecture Topic	Lecture Detailed outline	Reading Assignments
• SIMPLE LINEAR CORRELATION	• Simple linear correlation	Product-moment correlation coefficient Testing the significance of *r*
	References used Chernick & Friis (2003) Pages 252 - 277	Follow Up Activities Assignment and computer exercise
• NON-PARAMETRIC STATISTICS	• The Mann-Whitney ✓ The two-tailed Mann-Whitney test ✓ The one-tailed Mann-Whitney test with tied ranks • The median test • Kruskal-Wallis test	Read on Non-parametric analysis
	References used Chernick & Friis (2003) Pages 308 - 324	Follow Up Activities Assignment and computer exercise

F. RECOMMENDED TEXTS FOR THE COURSE:

1. Chernick M. R. and Friis R.H. (2003). Introductory Biostatistics for the health sciences. John-Wiley and sons Inc. New Jersey.
2. Cramer D. (1997). *Basic statistics for social research*. London: Routledge.
3. Haber A. and Runyon, R. P. (1977). *General statistics*. London: Addison-Wesley Publishing Company.