

Course Code: AGE 304
Course Title: Statistics for Engineers
Number of Units: 3 Units
Course Duration: Three Hours of Lecture per Week

Course Details

Course Coordinator: Dr. Olawale Usman Dairo *B.Sc, M.Sc. PhD*
Email: dairoou@unaab.edu.ng
Office Location: Room 2 Civil Engineering Building, COLENG
Other Lecturers:

Course Content:

Probability, Random variables, distribution and density functions. Expectations, Normal distribution. Central limit theorem. Estimation of parameters, confidence intervals. Regression, least square fit, correlation. Quality control

Course Requirement:

Students must have a minimum 70% attendance

Reading List:

1. Richard A. J. Probability and Statistics for Engineers. 1999. 5th Edition ELBS New York
2. Spiegel M. Theory and Problems of Statistics. 1995. McGraw-Hill. USA
3. Dairo, O. U. 2010. Engineering Statistics- Compilation of Notes.

Basic Knowledge

- ◉ Statistics the application of logic and objectivity in the understanding of events
- ◉ Collection, organizing, summarizing, presenting and analyzing to draw conclusions and making reasonable decisions based on such analysis
- ◉ Data .. Result of observations
- ◉ Population .. Universe _ collection of sets of groups
 - > Finite population
 - > Infinite population
- ◉ Sample subset of population
- ◉ Inductive statistics..... Statistical inferences
- ◉ Deductive statistics Descriptive statistics

- ◉ Variable Domain
 - > Constant ... variable with one value
 - > Qualitative
 - > Quantitative
 - > Continuous
 - > Discontinuous
 - > Discrete
- ◉ Enumerationcollection of discrete data
- ◉ Measurement ... collection of continuous data
- ◉ Raw data Unorganized data
- ◉ Array arrangement of raw data in order of magnitude

Central Tendencies

- ◉ Measure of a representative data set in a bid to summarize the data
- ◉ Called averages or measures of central tendencies
- ◉ Types
 - > Arithmetic mean
 - > Median
 - > Mode
 - > Geometric mean
 - > Harmonic mean
 - > Weighted Arithmetic mean
- ◉ Various examples and methods of determination to be treated in lecture

Probability Theory

- ◉ Event (E) happening in a total number of possible ways (Success) is the probability of occurrence
- ◉ Probability of Non-Occurrence
 - ◉ $p + q = 1$
- ◉ $\Pr(E) + \Pr(\bar{E}) = 1$
- ◉ Conditional Probability
- ◉ Independent Event
- ◉ Dependent event
- ◉ Compound event
- ◉ Mutually exclusive event

Combinational Analysis

- ◉ Factorial $n!$
- ◉ Permutation nPr

- ◉ Combination nCr
- ◉ Probability Distribution
- ◉ Binomial distribution
- ◉ Normal distribution
- ◉ Poisson distribution

Sampling Theory

- ◉ Relationship between sample and population
- ◉ Random samples and number
 - > Methods of determination

Decision Theory

- ◉ Decisions about population based on sample information are called statistical decisions
- ◉ The decision are based on hypotheses
- ◉ Hypotheses Statistical assumptions made about a population True or not true
- ◉ True hypotheses are called Null while an hypotheses that is untrue is called alternative hypotheses
- ◉ Examples are to be discussed in the classroom
- ◉

Test of Hypotheses and significance

- ◉ Procedures that are used to enable us decide whether to accept or reject an hypotheses and determine if samples are significantly different from each other statistically Called tests of hypotheses, test of significance or rule of decisions
- ◉ Errors in Decision Making
- ◉ Type I error
 - > Rejecting an hypotheses when it should be accepted
- ◉ Type II error
 - > Accepting an hypotheses when it should be rejected
- ** A way to minimize error in decision making is the have an enlarged sample size
- ◉ Level of Significance
 - > THE MAXIMUM PROBABILITY that the experimenter is willing to take in order to risk a Type I error is called the level of significance
 - > This must be decided before the commencement of data collection
 - > In practice it is usually 0.01 and 0.05 1% and 5% respectively
 - > Alternatively we can call it a confidence level of 99% and 95% respectively

Tests Involving Normal Distribution

- ◉ Use a normal distribution curve standardized value denoted by Z
- ◉ Decision making
 - > Reject test hypotheses when z-score lies outside the range at the significant level on the normal distribution curve
 - > Accept the hypotheses lies within the range on the normal distribution curve
- ◉ One tailed or Two Tailed Tests
 - > Interest in one extreme of the distribution curve is known as a one-tailed test
 - > When interest is on two extremes we have a two-tailed test
 - > eg... when testing if one method is better than the other we have a one-tailed test however, if the test is whether there is a difference between two methods then we are talking of a two tailed test. Since it could be better or worse (two extremes)
- ◉ Values of normal distribution z is given in a table to be distributed in Class and used with examples

Small Sampling Theory

- ◉ Small samples have sample size N less than 30 usually called exact sampling theory
- ◉ Distribution used (test statistics)
 - > Student's "t" test using t-test formula
 - > Chi-square test using chi-square formula
- ◉ Used to test hypotheses
- ◉ Using means and differences between means
- ◉ Examples and test statistics are as illustrated and discussed in class room

Test involving differences of Means

Examples

1. To test the efficacy of a new process line in the production of garri, experiment were set up using process A and process B. The cyanide contents of samples from the processes were used in comparison. The mean cyanide content of process A was 0.125 mg/mg with a set of 0.021, while that of process B was 0.205 mg/mg with standard deviation of 0.05.
 - i. Is there any significant difference between the two processes at 5% and 1% level of significance
 - ii. Is the new process better than the old process at 5% level of significanceThe number of samples in process 1 and 2 are 100 and 150 respectively
2. In the second semester examination result showed that 68% passed AGE 304 while 52% passed AGE 308. The number of students offering AGE 304 and 308 are 52 and 60 respectively.

Determine at 5% significant level if

 - i. There is a difference between the performances in both courses
 - ii. The candidates preferred AGE 304 and 308

Correlation Theory

- ◉ Simple correlation
- ◉ Simple regression
- ◉ Multiple correlation
- ◉ Multiple regression
- ◉ Linear correlation
- ◉ Least square regression lines
- ◉ Coefficient of Correlation

Example

An experimental data set obtained by varying the speed of rotation of an oil shaft at a constant temperature with the output quantity measured as shown in Table1.

- a. Find the least square line representing the data set
- b. Draw a scatter diagram

Shaft speed (rpm)	50	70	90	150	210	270	350
Oil Yield (kg)	240.5	290.0	330.5	420.3	510.0	590.0	650.0