Subject: Statistics (STAT)				
General				
	Course Units	**Status**	**Pre-requisite**	**Co-requisite**
Year 1 Sem 1	STAT 11014 Statistical Modelling	C	A/L Combined Mathematics/ Mathematics	STAT 11021
	STAT 11021 Statistical Laboratory I	C	A/L Combined Mathematics/ Mathematics	STAT 11014
Year 1 Sem 2	STAT 12033 Probability Distributions and Applications I	C	STAT 11014 and STAT 11021	None
	STAT 12042 Operational Research I	C	None	None
Year 1	STAT 14142 Statistics for Natural Sciences	A	None	None
Year 2 Sem 1	STAT 21053 Probability Distributions and Applications II	C	STCS 12033	None
	STAT 21062 Statistical Inference I	C	STAT 21053	None
Year 2 Sem 2	STAT 22073 Statistical Inference II	C	STAT 21062	None
	STAT 22082 Survey Methods and Sampling Techniques	C	STAT 22073	None
Year 3 Sem 1	STAT 31094 Operational Research II	O	STAT 12042	STAT 31101
	STAT 31101 O.R. Laboratory	O	STAT 12042	STAT 31094
	PRPL 31012 Professional Placement	O	All STAT compulsory units offered in levels 1 & 2	
Year 3 Sem 2	STAT 32112 Statistical Quality Control	O	STAT 21053	None
	STAT 32123 Linear Models	C	STAT 22073	None
	STAT 32131 Statistical Laboratory II	O	STAT 11021	None

STATISTICS

Level 1

Course Code : STAT 11014
Title : Statistical Modeling
Pre-requisite : A/L Combined Mathematics/Mathematics.
Co-requisite : STAT 11021

Learning Outcomes:
On successful completion of this course unit the student should be able to: (i) demonstrate the importance of statistics in making decisions on day-to-day life problems, (ii) construct appropriate statistical models for real-life situations and apply concepts and procedures in statistical decision making to those models.

Course Content: Introduction:
Rationale for learning Statistics, How the Statistics serves the scientists, Basic terminology, Essence of Science, Types of measurement and Statistical approach. **Descriptive Statistics:** Frequency distribution, Measures of Central Tendency, Measures of Dispersion and Shapes of distributions. **Probability:** Algebra of sets, Permutations and Combinations, Random or non-deterministic experiment, Sample space, Events and event space, Classical definition of probability, Frequency definition of probability, Axiomatic definition of probability, Conditional probability, Partition of a sample space, Total probability and Bayes' Theorem. **Probability distributions:** Binomial distribution, Poisson distribution and Normal distribution**. Fitting a theoretical distribution to set of observed values:** Binomial, Poisson and Normal distributions. **Sampling and sampling distributions:** Random sampling, Stratified sampling, Sampling error, Sampling distributions and Degrees of freedom. **Tests of Hypotheses:** Basic terminology of scientific research, Rationale of scientific decision making, Limitations of scientific decisions and the ways that they may be in error. **Decisions about relationships:** Introduction to Correlation, Relationship between interval/ratio variables, Geometric appearance of relationship, Product-Moment Correlation. **Linear Regression:** Prediction of one variable from another, Linear regression.

Method of teaching and learning: A combination of lectures and tutorials.

Assessment: End of course examination and assignments.

Recommended reading:
1. Runyon Richard P., Harber Andrey, Pittenger David J., Coleman Kay, 8th edition, (2002), '***Fundamentals of Behavioural Sciences***', McGraw-Hill.
2. Horvath Theadore, (1985), '***Basic Statistics for Behavioural Sciences***', LittleBrown & Company.
3. Erricker B. C., (1975), Reprint, '***Advanced General Statistics***', Alden Press Oxford.

Course Code : STAT 11021
Title : Statistical Laboratory I
Pre-requisite : A/L Combined Mathematics/Mathematics.
Co –requisite : STAT 11014

Learning Outcomes:
On successful completion of this course unit the student should be able to apply techniques provided in Statistical Packages to solve problems in Statistics.

Course Content:
Introduction of one of the statistical packages Minitab, SPSS, or SAS, Features of the package, How to use the package, Solving problems based on the course unit STAT 11014 using the statistical package.

Method of teaching and learning: Laboratory work.

Assessments: End of course practical examination and assignments

Recommended reading:
Manuals relevant to statistical packages

1. Runyon Richard P., Harber Andrey, Pittenger David J., Coleman Kay, 8th edition, (2002), '***Fundamentals of Behavioural Sciences***', McGraw-Hill.
2. Horvath Theadore, (1985), '***Basic Statistics for Behavioural Sciences***', LittleBrown & Company.
3. Erricker B. C., (1975), Reprint, '***Advanced General Statistics***', Alden Press Oxford.

Course Code **:** STAT 12033
Title **:** Probability Distributions and Applications I
Pre-requisite **:** STAT 11014 & STAT 11021
Co-requisite **:** None

Learning Outcomes:
On successful completion of this course unit the student should be able to design an experiment and generate the probability distribution corresponding to a given real-life situation involving one variable and apply principles of Probability and Statistics to such experiments.

Course Content: Random variables:
Rationale for the introduction of random variables, Definition of a random variable, Types of random variable. **Distributions:** Discrete probability density function of a discrete random variable, Probability density function of a continuous random variable and Cumulative probability distribution function of a random variable. **Expectation of a function of a random variable:** General definition, Properties of expectation, Mathematical expectation, Variance and Standard deviation, Moments, Moment generating function, Probability generating function and Characteristic function. **Discrete Probability Distributions:** Discrete uniform, Bernoulli, Binomial, Poisson, Geometric and Negative binomial. **Continuous Probability Distributions**: Uniform, Normal, Negative exponential and Gamma.

Method of teaching and learning: A combination of lectures and tutorials.

Assessment: End of course examination and assignments.

Recommended reading:
1. Alexander M. Mood., Franklin A. Graybill, Pittenger Duane C. Boes, 3rd edition, Reprint (2005), '***Introduction to the Theory of Statistics***', McGraw-Hill.
2. Hoel Paul G., Port Sidney C., Stone Charles J., 1st edition, (1971), '***Introduction to Probability Theory***', Houghton Mifflin Company

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Course Code **:** STAT 12042
Title **:** Operational Research (OR) I
Co-requisite **:** None

Learning Outcomes: At the end of this course unit the student should be able to (i) translate real life situations involving linear relationship into Linear Programming (LP) Models, (ii) apply OR techniques in solving LP models.

Course Content: Introduction to OR, Construction of Mathematical Models, **Solution Techniques:** Graphical Method, **Simplex Method:** Algebraic Approach**, Tabulation Approach : Standard Form, Non Standard Form, Duality and Sensitivity Analysis**: Formulation of the dual problem, Primal Dual relationship, Dual Simplex method, The Primal-Dual method, Interior Point Method: Karmarkar"s Projective Algorithm.

Methods of teaching and learning: A combination of lectures and tutorials.

Assessment: End of course examination and assignments.

Recommended readings:
1. Fredrick S. Hiller, Gerald J. Lieberman, 8th Edition,(2005),'***Introduction toperations Research'***, Mc-Graw Hill.
2. Hamdy A.. Taha, 8th Edition, (2007***), 'Operations Research'***, Tara Mc-Graw Hill.
3. Bazaraa M.S., Javis J.J., Sherali H. D**.,** 2nd Edition, (1990), ***'Linear programming and network flows'***.

Course Code : STAT 14142
Title : Statistics for Natural Sciences
Pre-requisite : None
Co-requisite : None

Learning Outcomes: On successful completion of this course unit the student should be able to design experiments and analyze the data using the appropriate statistical method.

Course Content: Introductory concepts: Descriptive statistics, An introduction to probability, Some important probability distributions, Sampling techniques. **Parametric Inference:** Inferences associated with a single population, Inferences associated with two populations. **Goodness-of-fit tests, Correlation and Regression analysis, An introduction to analysis of variance procedures**. **Nonparametric statistical methods**.

Method of teaching and learning: A combination of lectures and tutorials

Assessments: End of course examination and assignments.

Recommended reading:
1. Anderson, D.R., Sweeney, D.J. and William, T.A, 2nd Edition, (1991), ***'Introduction to Statistics Concepts and Applications'***, West Publishing Company.
2. McClave, J.T., Dietrich, F.H. and Sincich, T., 7th Edition, (1997), ***'Statistics',*** Prince Hall

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Level 2

Course Code : STAT 21053
Title : Probability Distributions and Applications II
Pre-requisite : STAT 12033
Co-requisite : None

Learning Outcomes: On successful completion of this course unit the student should be able to demonstrate the knowledge and the skills of multi dimensional probability models in solving real-life situations involving more than one variable.

Course Content: Two-dimensional Random variables: Rationale for the introduction of two-dimensional random variables, **Cumulative distribution function of two-dimensional random variable:** Definition, Properties of bivariate cumulative distribution function, Joint density functions, Marginal density functions, Conditional probability distributions, Independence and related theorems. Expectations: Expectation of a function of two-dimensional random variable, Covariance and correlation coefficient, Conditional expectation and related theorem, Conditional variance and related theorem, Joint moments, Joint moment generating function, Uncorrelated random variables and Cauchy-Schwartz Inequality. **Distributions of functions of random variables and Expectations:** Distributions of sum, difference, product and quotient of two continuous random variables, Expectations and related theorems. **Probability distributions of maximum and minimum of a set of random variables, Moment generating technique for obtaining probability distributions, Transformations, Sampling and sampling distributions:** Sampling, Distribution of a sample, Sample moments, Sample variance, Law of Large Numbers, Central Limit theorem, sampling from Normal distribution, Chi-square distribution, Student's t distribution and F distribution.

Method of teaching and learning: A combination of lectures and tutorials.

Assessment: End of course examination and assignments.

Recommended reading:
Alexander M. Mood., Franklin A. Graybill, Pittenger Duane C. Boes, 3rd edition, Reprint (2005), '***Introduction to the Theory of Statistics***', McGraw-Hill.

Course Code : STAT 21062
Title : Statistical Inference I
Pre-requisite : STAT 21053
Co-requisite : None

Learning Outcomes: At the end of this course unit the student should be able to demonstrate a good knowledge and understanding on techniques of estimation and properties of the estimators of the population parameters.

Course Content:
Techniques of Finding Point Estimators: Introduction to Point Estimation**; Methods of Estimation :** Methods of Moments, Maximum Likelihood Method, **Bayes Estimators:** Loss and Risk Functions, Prior and Posterior Distributions, Bayes Risk, Bayes Estimator, **Properties of Point Estimators:** Closeness, Mean – Squared Error, Unbiasedness, Consistency and BAN, Loss and Risk Functions, **Sufficiency, Unbiased Estimation:** UMVUE, Cramer-Rao Inequality, Sufficiency and Completeness, Rao-Blackwell Theorem, Lehmann-Scheffe Theorem;
Interval Estimation: An Introduction to Intervals, Pivotal Quantity Method**, Sampling from Normal Distribution:** Confidence Interval for the Mean, Confidence Interval for the variance, Simultaneous Confidence Region for the Mean and Variance, Confidence Interval for difference in Means, **Approximate Confidence Intervals, Basian Interval Estimates**

Methods of teaching and learning: A combination of lectures and tutorials.

Assessment: End of course examination and assignments.

Recommended readings:
1. Alexander M.. Mood , Franklin A..Graybill , Pittenger Duane C. Boes, 3rd Edition, Reprinted (2005), ***'Introduction to the Theory of Statistics'***, McGraw-Hill.
2. Ronald E. Walpole, Raymand H..Mayers, 6th Edition (1997), ***'Probability and Statistics for Engineers and Scientits'.***

Course Code : STAT 22073
Title : Statistical Inference II
Pre-requisite : STAT 21062
Co-requisite : None

Learning Outcomes: At the end of this course unit the student should be able to demonstrate the knowledge and understanding of testing hypotheses in making decisions.

Course Content:
Test of Hypotheses: Introduction and Termonology to Hypotheses, Simple Versus Simple : Simple Likelihood Ratio Test**, Most Powerful Test :** Definition**,** Neyman-Pearson Lemma**.Composite Hypotheses:** Generalized Likelihood Ratio Test, Uniformly Most Powerful Test **; Sampling from the Normal Distribution:** Tests on the mean, Test on the variance, Tests on the several Means, Tests on Several Variances; **Chi-Squre Tests:** Asymptotic Distribution of Generalized Likelihood-ratio, Chi-square Goodness-of-fit Test, Test of Independence in Contingency Tables : Two-way Contingency Tables; **Nonparametric Methods:** Introduction to Nonparametric Methods, **Equality of Two Distributions:** Two-sample Sign Test, Run Test, Signed Rank Test, Median Test, Rank-sum Test, Wald-wolfwoitz Runs Test.

Methods of teaching and learning: A combination of lectures and tutorials.

Assessment: End of course examination and assignments.

Recommended readings:
1. Alexander M.. Mood , Franklin A..Graybill , Pittenger Duane C. Boes, 3rd Edition, Reprinted (2005), ***'Introduction to the Theory of Statistics'***, McGraw-Hill.
2. Ronald E. Walpole, Raymand H..Mayers, 6th Edition,(1997),***'Probability and Statistics for Engineers and Scientits'***.

Course Code : STAT 22082
Title : Survey Methods and Sampling Techniques
Pre-requisite : STAT 22073
Co-requisite : None

Learning Outcomes: At the end of this course unit the student should be able to demonstrate the knowledge in planning surveys and analyzing the results using the most appropriate sampling technique.

Course Content: Introduction and terminology, **Techniques of data collection, Sampling methods:** Introduction, Simple Random Sampling, Sampling Proportions and Percentages, Stratified Random Sampling, Ratio estimators, Regression estimators, Introduction to cluster sampling and systematic sampling.

Method of teaching and learning: A combination of lectures, tutorial and practical sessions

Assessments: End of course examination and assignments

Recommended reading:

1. Cochran, W.G., 3rd Edition, (1977), ***'Sampling Techniques'*** , John Wiley & Sons
2. Barnet, V. , 3rd Edition, (1974),***'Elements of Sampling Theory'*** , London: The English University Press Ltd

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Level 3

Course Code : STAT 31094
Title : Operational Research (OR) II
Pre-requisite : STAT 12042
Co-requisite : STAT 31101

Learning Outcomes: At the end of this course unit the student should be able to apply O.R. techniques in Queuing Theory, Network models, Integer programming models and Game theory to real life problems.

Course Content:
The Transportation Models and their solution techniques , The Assignment Models and their solution techniques, **Queuing Theory**: Queuing Systems, Queue Characteristics, Poisson Process, and M/M/1 System, Other Systems (M/M/s, M/M/1/k, and M/M/s/k). **Network Models:** Shortest path Problem, The Minimum Spanning Tree Problem, The Maximum Flow Problem, The Minimum Cost Flow Problem, Project Planning and Control with PERT-CPM, Project Management, **Integer programming:** Introduction to Integer programming, Formulation Possibilities with Binary Variables, Perspectives on Solving Integer programming Problems, The Branch and Bound Techniques and its Application to Binary Integer Programming, **Game Theory:** Formulation of Two-Person, Zero-Sum Games, Solving Simple Games, Game with Mixed Strategies, Graphical Solution Procedure, Solving by Linear Programming .

Methods of teaching and learning: A combination of lectures and tutorials.

Assessment: End of course examination and assignments.

Recommended readings:

1. Fredrick S. Hiller, Gerald J. Lieberman, 8th Edition , (2005), '***Introduction to Operations Research',*** Mc-Graw Hill.
2. Hamdy A.. Taha, 8th Edition, (2007***), 'Operations Research'***, Tara Mc-Graw Hill.
3. Bazaraa M.S., Javis J.J., Sherali H. D**.,** 2nd Edition, (1990), '***Linear programming and network flows'***.
4. Laurence A. Wolsey, Edition, (1998), '***Integer Programming'.***

Course Code : STAT 31101
Title : O.R. Laboratory
Pre-requisite : STAT 12042
Co-requisite : STAT 31094

Learning Outcomes: On successful completion of this course unit the student should be able to apply techniques provided in O.R. Packages to solve problems in O.R.

Course Content: Introduction of one of the O.R. Packages TORA, Solver, LINGO or LINDO, features of the package, Solving problems based on the course units STAT 12042 and STAT 31094 using the statistical package.

Method of teaching and learning: Laboratory work.

Assessments: End of course practical examination and assignments

Recommended readings:
1. Fredrick S. Hiller, Gerald J. Lieberman, 8th Edition,(2005), ***'Introduction to Operations Research',*** Mc-Graw Hill.
2. Hamdy A.. Taha, 8th Edition, (2007***), 'Operations Research'***, Tara Mc-Graw Hill.

Course Code : STAT 32112
Title : Statistical Quality Control
Pre-requisite : STAT 21053
Co-requisite : None

Learning Outcomes: At the end of this course unit the student should be able to demonstrate the knowledge and understanding of the principles of statistical quality control to solve problems that arise in the industry.

Course Content: Classification of Inspection plans, OC-curve, process curve, methods of choosing sampling plans, acceptance sampling schemes, inspection by variables, control charts, cumulative sum charts, decision rules, continuous sampling plans, process trouble shooting.

Method of teaching and learning: A combination of lectures and tutorials.

Assessment: End of course examination and assignments.

Recommended reading:
Douglas C. Montgomery, 5th Edition, (2004), ***Introduction to Statistical Quality Control'***, John Wiley and Sons

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Course Code : STAT 32123
Title : Linear Models
Pre-requisite : STAT 22073
Co-requisite : None

Learning Outcomes: At the end of this course unit the student should be able to effectively apply regression and analysis of variance techniques to solve real life problems.

Course Content: Regressions: Simple linear regression model, Parameter estimation, Gauss-Markov Theorem, Inferences about the model, Prediction, Analysis of variance approach, Model adequacy, Lack of fit. Multiple linear regression model, Parameter estimation, Inferences about the model, Prediction, Model adequacy, Variable selection and model building procedures, Multicolinearity

Design an Analysis of experiments: Principles of design, Analysis of variance for one-way classification, Analysis of variance for two-way classification, Missing values, Multiple comparisons.

Method of teaching and learning:
A combination of lectures, tutorial and practical sessions

Assessments:
End of course examination and assignments

Recommended reading:

1. Draper, N.R and smith, 3rd Edition, (1998), 'A***pplied Regression Analysis',*** John Wiley & Sons.
2. Montgomery, D.C., 5th Edition, (2001), ***'Design and Analysis of Experiments',*** John Wiley & Sons.
3. Hicks, C.R., 4th Edition, (1993), ***'Fundamental Concepts in Design of Experiments'***, Oxford University Press.

Course Code **:** STAT 32131
Title **:** Statistical Laboratory II
Pre-requisite **:** STAT 11021
Co-requisite **:** None

Learning Outcomes: On successful completion of this course unit the student should be able to effectively analyze data using a standard statistical package.

Course Content: Solving problems based on inferential statistics, sampling techniques and linear models using a standard statistical package

Method of teaching and learning: Laboratory work.

Assessments: End of course practical examination and assignments

Recommended reading: Manual relevant to the statistical package

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