

## **FACULTY OF PHYSICAL SCIENCES**

### **DEPARTMENT OF STATISTICS M.SC AND PH.D DEGREE PROGRAMMES**

#### **PHILOSOPHY**

This programme is concerned with the foundations of statistical methods, their inputs, and results. It will advance the frontiers of statistical theory and new data analysis techniques through research. The statistical theories and its applications are adapted to planning, policy formulation and evaluation in diverse areas. The Department hopes to produce, through this programme, graduates who have comprehensive knowledge of diverse theories and applications of statistics.

#### **OBJECTIVE OF THE PROGRAMME**

The objective of the programme is to provide high-level manpower in Statistics needed in research institutes, polytechnics, Universities, ministries, agencies and industries. The programme when completed would have equipped the candidates well enough on methodology for statistical modelling and data analysis and interpretation and to carry out independent empirical and theoretical research in statistics or in collaboration with other researchers in various fields.

#### **SCOPE**

The programme is designed to cover most areas of Statistics, which include: Probability and Inference, Stochastic Processes, Design of Experiment, Categorical Data Analysis, Time Series Analysis, Operations Research and Sample Survey Theory and Methods.

#### **JOB OPPORTUNITIES**

Statistics has a wide area of application; so on successful completion of the programme a graduate has a variety of choices in both public and private sectors, e.g. banks, insurance companies, academic institutions, research institutes, teaching hospitals and manufacturing industries. A graduate in Statistics can be a self-employed consultant.

#### **LIST OF APPROVED SUPERVISORS**

##### **PROFESSORS**

P.E. Chigbu, Design and Analysis of Experiment  
B.Sc, M.Sc (Nig) Ph.D (London)

F.C. Okafor, Sample Survey Theory and Methods  
B.Sc, M.Sc (Nig) Ph.D (Ibadan)

F.I. Ugwuowo, Stochastic/Time Series Modelling  
B.Sc, M.Sc, Ph.D (Nig)

##### **READER**

Dr A. U. Udom Stochastic Processes/Optimization  
B.Sc, M.Sc, Ph.D (Nig)

## **LECTURER I**

Dr A.V. Oladugba  
B.Sc, M.Sc, Ph.D (Nig)

Design and Analysis of Experiment

## **MASTER OF SCIENCE (M.SC) DEGREE PROGRAMME IN STATISTICS**

### **ENTRY REQUIREMENTS**

#### **1. M.SC**

- (a) All candidates must have five credit passes including English Language, Mathematics or Additional Mathematics, Physics and any other two relevant Science subject at O' Level.
- (b) Candidates with Bachelor's degrees in Statistics from an approved university must obtain a minimum of second class lower division with a CGPA of 2.5/5.0 for an academic programme.
- (c) Candidates with at least a third class degree or HND in Mathematics or Statistics and university PGD with CGPA of 2.5/5.0 in Statistics may be considered for admission into academic Master's degree programme.

#### **2. PH.D**

Candidates must satisfy the following conditions

- (a) Candidates must have five credit passes including English Language, Mathematics or Additional Mathematics, Physics and any other two relevant Science subject at O' Level.
- (b) Candidates with Bachelor's degree from an approved university must obtain a minimum of second class lower division in Statistics with a CGPA of 2.5/5.0.
- (c) Candidates must have Academic Master's degree in Statistics with a CGPA of 3.5/5.0 and thesis score not lower than 60% (B).

### **MODE OF STUDY**

#### **1. M.SC**

A study for the degree of Master of Science in Statistics is prosecuted by course work to be examined in written papers together with research work to be embodied in a project report where course work predominates over research and constitutes not less than two-thirds of the total credit load

#### **2. PH.D**

The programme is primarily prosecuted by research to be embodied in seminar papers and thesis. However, Departmental Postgraduate Committee may prescribe some courses of not more than 12 units to be taken by the student.

A student shall present at least two successful seminars before the thesis proposal. A Doctoral (Ph.D) thesis of 12 units **MUST** be defended before a Panel of Internal and External Examiners.

### **DURATION OF M.SC PROGRAMME**

#### **1. M.SC**

Full-time: A minimum of 3 semesters and a maximum of 5 semesters.

Part-time: A minimum of 5 semesters and a maximum of 8 semesters.

## 2. PH.D

Full-time: A minimum of 6 semesters and a maximum of 10 semesters.

Part-time: A minimum of 8 semesters and a maximum of 12 semesters.

### STRESS AREAS

General Courses	0
Probability	1
Inference	2
Design of Experiments/Analysis	3
Sample Survey/Demography	4
Stochastic Processes/Time Series	5
Operations Research/Methods	6
Statistical Computing	7
Thesis/Seminar/Project	9

### MASTERS (M.Sc) COURSES

#### FIRST SEMESTER

##### Core Courses

Course Code	Course Title	Units
PGC 601:	ICT and Research Methodology	3
STA811:	Advanced Probability Theory	3
STA831:	Design and Analysis of Experiments	3
<b>Total</b>		<b>9</b>

##### Elective Courses

STA833:	Advanced Linear Regression Analysis	3
STA835:	Biostatistics	3
STA 837:	Categorical Data Analysis	3
STA 823:	Non-parametric Methods	3
STA 853:	Applied Time Series	3
STA 861:	Quality Control	3

At least 3 units must be taken from the electives at the first semester.

#### SECOND SEMESTER

##### Core Courses

		Units
SCI 802:	Management and Entrepreneurship	2
STA 822:	Statistical Inference	3
STA 842:	Sample Survey Techniques	3
STA 892:	Seminar (M.Sc)	3
STA 894:	M.Sc. Project	6
<b>Total</b>		<b>17</b>

##### Electives

STA 852:	Stochastic Processes	3
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STA 824:	Advanced Bayesian Inference	3
STA 832:	Logistic Regression	3
STA 834:	Multivariate Analysis	3
STA 862:	Operations Research	3
STA872:	Statistical Computing/Consulting	3
STA 844:	Advanced Demography	2

At least 3 units must be taken from the electives at the second semester.

## **COURSE DESCRIPTION**

### **SCI 802: Management and Entrepreneurship (2 Units)**

The course will cover business environment, general management, financial management, entrepreneurship development, feasibility studies, marketing and managerial problem solving.

### **PGC601: ICT and Research Methodology (3 Units)**

The course should cover essentials of spreadsheets, internet technology, statistical packages, precision and accuracy of estimates, principles of scientific research, concepts of hypothesis formulation and testing, organization of research and report writing. All registered Master's degree students must attend a solution-based interactive workshop to be organized by the School of Postgraduate Studies for a practical demonstration and application of the knowledge acquired from the course, conducted by selected experts.

### **STA 811: Advanced Probability Theory (3 Units)**

Introduction to measure theorem – probability measures and space. Derivation and transformation of probability distributions. Limit theorems. Modes of convergence. Generating and characteristic functions. Special parametric univariate and multivariate distributions and large sample theory. Further theory of statistical inference.

### **STA 821: Advanced Bayesian Inference (3 Units)**

Sampling theory and its critique, subjective probability, likelihood principles, Bayes theorem, Bayesian analysis of Normal theory inference problems, the Behrens-Fisher problem, assessment of model assumptions, robustness of inference, analysis of variance, estimation of variance components, empirical Bayes, some aspects of multivariate problems, sequential nature of Bayesian inference, prior and posterior distributions of parameters in binomial, Poisson, exponential and normal populations, comparison of two normal distributions, predictive distributions, decision theory, utility, risk aversion, extensive form of analysis, two-action problems, point estimation, best population problems, economics of sampling.

### **STA 822: Statistical Inference (3 Units)**

Properties of estimator: Consistence and BAN, loss and Risk functions; sufficiency – factorization criterion, exponential family; minimum variance unbiased and maximum likelihood estimation under quadratic loss, lower bound for variance using Cramer-Rao inequality. Uniformly most powerful test and locally powerful tests. Sequential tests of hypothesis. Introduction to Bayesian inference and nonparametric methods.

### **823: Non-parametric Methods (3 Units)**

Distribution of order Statistics and quantiles Non-parametric statistics through invariance properties. Non-parametric test statistics: Kolmogorov type and rank order statistics. Efficiency properties. Estimates based on rank test statistics.

**STA 831: Design and Analysis of Experiments (3 Units)**

Overview of statistical and scientific procedures to the efficient design of experiments. Generalized linear models; Generalized inverse approach to the analysis of design models. Factorial experiments: Symmetric and Asymmetric. Balanced and partially balanced incomplete block designs. Row-column designs, nested designs and split-plot designs. Response surface methodology. Optimality criteria of block design; Construction procedures for optimal designs.

**STA 832: Logistic Regression (3 Units)**

Odds and Odd ratio. Simple logistic regression model estimation and testing for the significance of the coefficients. Multiple logistic regression model estimation of parameters of the model, testing the significance of the model. Interpreting the coefficients of the logistic regression model. Stepwise logistic regression. Measures of goodness-of-fit. Applications.

**STA 833: Advanced Linear Regression Analysis (3 Units)**

Least Squares variables Estimation: Finite-Sample Properties of Ordinary Least Squares, Properties of least squares and instrumental variables; Maximum Likelihood Estimation — asymptotic properties of maximum likelihood estimator. Asymptotically Equivalent Test Procedures — The Likelihood Ratio Test, The Wald Test, The Lagrange Multiplier Test; Testing the Significance of the Regression Coefficients; Specification and misspecification-types and test of misspecification, misspecification error or bias, testing for endogeneity, testing functional form (specification), testing for heteroscedasticity; multi-collinearity, heteroscedasticity serial correlation — causes, detection, and their consequences on estimators. Simultaneous-equation methods.

**STA 834: Multivariate Analysis (3 Units)**

Multivariate normal distribution: Estimation of the mean vector and covariance matrix, the distribution of the sample mean vector, properties of estimators of the mean vector, distribution of the sample covariance matrix (the Wishart distribution) and its properties, the generalized variance. The Hotelling's  $T^2$  distribution (with proof). Distributions of the sample partial and multiple correlation coefficients. Distribution of linear and quadratic forms. The canonical correlation and variates. Classification problems and factor analysis.

**STA 835: Biostatistics (3 Units)**

Advanced Regression, Bia-assays, Probit and Logit models, Growth Curves; Logistic Regression, Potency/efficacy determination. Theory of clinical trials, Ethical Issues in Medical Data Collection.

**STA 837: Categorical Data Analysis (3 Units)**

Inference for two-way contingency tables. Log-linear models and estimates of parameters. Models for binary, ordinal and multinomial response variables. Building, fitting and applying log-linear and logit models. Repeated categorical response data. Models for matched pairs.

**STA 842: Sample Survey Techniques (3 Units)**

Basic definitions and concepts, further aspects of stratified sampling – construction and choice of strata, allocation to strata with more than one item. Unequal probability selection schemes and inclusion probabilities. Multistage sampling (unequal probability sampling): Estimation of means and their variances; optimum sampling fractions. Double sampling and successive sampling estimation procedures. Non-sampling errors, including their treatments. Variance estimation in complex surveys. Introduction to adaptive cluster sampling.

**STA 844: Advanced Demography (2 Units)**

Review of main demographic concepts. Cohort analysis. Construction of life tables. Evaluation and adjustment of demographic data. Estimation of population parameters from defective data. Mathematical treatment of demographic analysis.

**STA 852: Stochastic Processes (3 Units)**

Simple, compound and generalized Poisson processes. Markov chains; renewal processes, renewal theory and random walks, Branching processes. Queuing theory including M/G/1 and G/M/1, and associated waiting time models. Gambler's ruin problems. Inventory models. Estimation problems and Applications.

**STA 853: Applied Times Series Analysis (3 Units)**

General stationary and non-stationary models, auto covariance and autocorrelation functions, spectral density functions, linear stationary and non-linear stationary models, identification, estimation and forecasting in linear models.co-integration and error correction techniques Estimation of spectral density. Transfer function model, intervention analysis. Multiple time series models.

**STA 862: Operations Research (3 Units)**

Theory of simplex algorithm, Duality theory, Perturbations; Sensitivity analysis. Parametric programming. Gradient methods for unconstrained optimization, Newton-Ralphson method. Quadratic, fractional, dynamic, Geometric programming. Goal programming. Network analysis. Project management. Applications.

**STA 861: Quality Control and Practice (3 Units)**

Analysis and control of variations in a production process OC of a control chart. Control charts for attributes and variables. Cumulative sum control charts. Other control charts. Methods of controlling several related characteristics; process capability analysis. Design of control charts. Specification and tolerance.

**STA872: Statistical Computing/Consulting (3 Units)**

The design and use of existing statistical software; methods of simulation of random processes; numerical methods of fitting linear models, multivariate analysis; methods for nonlinear modeling. Introduction of key aspects of statistical consulting and data analysis activities, report writing and presentation.

**STA 892: Seminar (3 Units)**

Based on student's review of current journal article in the student's area of research interest.

**STA 894: M.Sc Project (6 Units)**

The research topic is to be carried out based on agreed specific research topic under the guidance of approved postgraduate supervisor. It should be original and show some significant contribution in the student's area of specialization.

**DOCTORAL (Ph.D) COURSES**

<b>COURSE CODE</b>	<b>COURSE TITLE</b>	<b>UNITS</b>
PCG 701	Synopsis And Grant Writing	3 Units
STA 825	Recent Topics in Statistics	3 Units
STA 893	Seminar I	3 Units
STA 894	Seminar II	3 Units
STA 895	Thesis	12 Units

Note: The seminars to be presented before the thesis proposal are covered in STA 893 and STA 894.

**COURSE DESCRIPTION**

**PCG 701 SYNOPSIS AND GRANT WRITING (3 Units)**

Identification of types and nature of grants and grant writing; mining of grants application calls on the internet. Determining appropriate strategy for each grant application. Study of various grant application structures and contents and writing of concept notes, detailed project description, budgeting and budget defence. Study of sample grant writings in various forms and writing of mock research and other grants. Identification of University of Nigeria synopsis structure and requirements (Introduction, Methodology and Results).Determining the content of each sub-unit of the synopsis. Steps in writing the synopsis from the Dissertation/Thesis document. Structural and Language issues. Common errors in synopsis writing and strategies for avoiding them. The roles of the students and supervisor in the production of a synopsis. Writing of mock synopsis. All registered Ph.D students must attend a solution-based interactive workshop to be organized by the School of Postgraduate Studies for a practical demonstration and application of the knowledge acquired from the course, conducted by selected experts.

**STA 825 Recent Topics in Statistics (3 Units)**

Review based on theory and applications of recent topics in Time series, Stochastic Processes, Probability and Inference, Design and Analysis of Experiments, Categorical Data Analysis, Multivariate Analysis and Sample Survey Design and Analysis.

**STA 893 Seminar I (3 Units)**

Based on the student's review of at least two or more current journal articles from impact factor/indexed journal(s) in the student's area of specialization.

**STA 894 Seminar II**

**(3 Units)**

Further reviews of at least two or more current journal articles from impact factor/indexed journal(s) in the student's area of specialization.

**STA 895 Ph.D. Thesis**

**(12 Units)**

The work shall consist of an in-depth and comprehensive research to be embodied in a thesis. It should be an original contribution to knowledge in the student's area of specialization. In addition, the student must present one progress report seminar and at least one seminar at the conclusion of the Ph.D. research work, all to the satisfaction of the Departmental postgraduate committee. In addition, a Ph.D. student is required to have at least an acceptance letter in any Impact Factor Indexed Journal approved by the University for Promotion. In the absence of acceptance letter, evidence of a galley-proof version of the article can be accepted. In addition, the student shall show evidence of attendance and presentation of paper in a National or International conference in his/her field.