

## THE MASTER OF STATISTICS (MOS) PROGRAM

The program aims to produce practitioners who are knowledgeable with statistical methodologies and capable of the practice of general statistics and in some key areas.

### ADMISSION AND GRADUATION OF STUDENTS

The student will be required to take a validation examination in the areas of Calculus, Matrix Algebra, and Introductory Statistics. If the student failed the examination, one or two of Stat 100, Stat 195, or Stat 117 will be taken during the summer/term prior to admission to the MOS/MS program.

To facilitate monitoring of progress of students, they will be required to submit a concept paper of possible research topic as part of the application requirement.

The student will be considered candidate for graduation upon completion of all required and elective courses with a weighted average of "2.0" or better and submission and successful defense of a Special Problem (MOS).

For the MOS Special Problem, the student should demonstrate capability of statistical analysis through the application of more recent statistical methods in solving real-life problems or the novel application of statistical methods in solving real-life problems.

### AREAS OF ELECTIVES

The following areas of electives can be pursued by the MOS students.

- **Computational Statistics** –the emergence of computational statistics was stimulated by the availability of very large data sets. These data are often generated by heterogeneous mechanisms, from unknown process, or from non-random mechanism. The availability of powerful computing facilities and efficient algorithms simplified the analysis of these data. Oftentimes, the methods used are iterative in nature, thus, exact sampling distributions are not mathematically tractable. Computational statistics is a venue where statistical theory evolves from a dominantly nonparametric framework and uses computing technology.
- **Industrial Statistics** – there is a wide range of applications of statistics in the industry. Quality assurance, quality improvement, product development, etc. are some of the areas where statistics can be very useful.
- **Mathematical Statistics** – many statistical theories were developed with the aid of mathematical tools. Large sample properties, approximations, exact distributions, are some of the important results of mathematical statistics. This area may help prepare the students for more advanced work in statistical theory.
- **Risk Assessment Methods** – financial systems are vulnerable to random shocks that can easily topple old institutions. Many statistical methods can be tailor-fitted to address the concern of the financial sector, specifically, for risk management. The area of focus aims to produce students with quantitative skills they can use in effective risk management especially in the finance sector.

- **Social Statistics** – the generation of official statistics by the government requires statistical methods that are commonly used in social and economic applications. This area targets students working/intends to work for the government and those who eventually wish to pursue further studies in the social sciences or in economics.
- **Statistical Methods for Market Research and Business Intelligence** - from data collected through face-to-face interviews, focused group discussions, product testing, etc., the paradigm of market research is gradually changing. Data is now generated from actual usage/purchase history of consumers, cases where streaming data is generated from continuous consumer activities. While the data collection does not really follow some probabilistic methods, their volume is huge enough to treat it as approximating the population. This area incorporates both the 'traditional' and modern methods of market research leading towards business intelligence.

## THE MOS CURRICULUM

### *Core Courses*

- Stat 221 Introductory Probability
- Stat 222 Introduction to Statistical Inference
- Stat 223 Applied Regression Analysis
- Stat 250 Sampling Designs
- Stat 251 Survey Operations

### *Other Courses*

- Stat 298 Special Problem
- 2 u of Stat 290 Statistical Consulting
- 15 u of Electives.

The elective courses should be taken in one of the list below:

- **Industrial Statistics:** Stat 210, Stat 211, Stat 224, Stat 241, Stat 243, Stat 244, Stat 245, Stat 246, Stat 266, Stat 270, Stat 271, Stat 272, Stat 273, Stat 276
- **Statistical Methods for Market Research and Business Intelligence:** Stat 210, Stat 211, Stat 225, Stat 226, Stat 241, Stat 243, Stat 247, Stat 266, Stat 267, Stat 268, Stat 270, Stat 274, Stat 276
- **Social Statistics:** Stat 210, Stat 224, Stat 225, Stat 226, Stat 242, Stat 243, Stat 251, Stat 266, Stat 267, Stat 270, Stat 275, Stat 276, Cognates in Demography
- **Mathematical Statistics:** Stat 211, Stat 226, Stat 235, Stat 240, Stat 241, Stat 249, Stat 252, Stat 261, Stat 262, Stat 263, Stat 264, Stat 265, Stat 267
- **Computational Statistics:** Stat 210, Stat 211, Stat 226, Stat 240, Stat 241, Stat 247, Stat 249, Stat 252, Stat 262, Stat 265, Stat 267, Stat 277
- **Risk Assessment Methods:** Stat 211, Stat 225, Stat 226, Stat 241, Stat 242, Stat 260, Stat 261, Stat 264, Stat 267, Stat 268

### Checklist for the MOS Program

Term	Course	Units
Summer	Stat 100 Calculus and Matrix Algebra for Statistics	(3)
	Stat 195 Introduction to Mathematical Statistics	(3)
	<b>Total</b>	<b>(6)</b>
First Semester	Stat 221 Introductory Probability	3
	Stat 251 Survey Operations	3
	Elective	3
	<b>Total</b>	<b>9</b>
Second Semester	Stat 222 Introduction to Statistical Inference	3
	Stat 223 Applied Regression Analysis	3
	Elective	3
	<b>Total</b>	<b>9</b>
<b>Student will start working for the special problem at this point.</b>		
Third Semester	Stat 250 Sampling Designs	3
	Stat 290 Statistical Consulting	1
	Elective	3
	Elective	3
	<b>Total</b>	<b>10</b>
Fourth Semester	Elective	3
	Stat 290 Statistical Consulting	1
	Stat 298 Special Problem	5
	<b>Total</b>	<b>9</b>
<b>Total</b>		<b>37</b>

## DESCRIPTION OF COURSES

### **STAT 100      CALCULUS AND MATRIX ALGEBRA FOR STATISTICS.**

Differential and integral calculus; infinite series; matrix algebra

Credit:            3 u

### **STAT 195      INTRODUCTION TO MATHEMATICAL STATISTICS.**

Probability distribution, sampling distribution, parametric and nonparametric inference.

Credit:            3 u

### **STAT 210      STATISTICAL SOFTWARE.**

Database management and programming using statistical software.

Credit:            3 u

### **STAT 211      STATISTICAL COMPUTING.**

Algorithms for statistical computing; numerical analysis for linear and nonlinear models; random number generation; Monte Carlo methods.

Credit:            3 u

### **STAT 221      INTRODUCTORY PROBABILITY.**

Combinatorial analysis; sample space and random variables, probability distribution function; expectation; stochastic independence; common probability distributions.

Credit            3 u

### **STAT 222      INTRODUCTION TO STATISTICAL INFERENCE.**

Sampling distributions, point and interval estimation; tests of hypothesis.

Pre-requisite: Stat 221

Credit:            3 u

### **STAT 223      APPLIED REGRESSION ANALYSIS.**

Model building; diagnostic checking; remedial measures; applications

Co-requisite: Stat 222 or equivalent

Credit:            3 u

### **STAT 224      EXPERIMENTAL DESIGNS.**

Completely randomized designs; randomized complete block design; Latin square design; factorial experiments; incomplete block design; higher-order designs.

Pre-requisite: Stat 223 or equivalent

Credit:            3 u

### **STAT 225      TIME SERIES ANALYSIS.**

Classical procedures; stationarity; Box-Jenkins modeling procedure: autocorrelation function, partial autocorrelation function; identification, estimation, diagnostic checking, forecasting; transfer functions; applications.

Pre-requisite: Stat 223 or equivalent

Credit:            3 u

**STAT 226 APPLIED MULTIVARIATE ANALYSIS.**

Multivariate normal distribution; principal components analysis; biplots and h-plots; factor analysis; discriminant analysis; cluster analysis; multidimensional scaling; correspondence analysis; canonical correlation analysis; graphical and data oriented techniques; applications

Co-requisite Stat 223 or its equivalent

Credit: 3 u

**STAT 230 SPECIAL TOPICS IN MATHEMATICS FOR STATISTICS.**

Special topics in mathematics and their applications in statistics. To be arranged according to the needs of students.

Credit: 3 u

(may be repeated provided that the topics are different; topics to be indicated for record purposes)

**STAT 231 PROBABILITY THEORY.**

Probability spaces and random variables; probability distributions and distribution functions; mathematical expectation; convergence of sequences of random variables; laws of large numbers; characteristics functions.

Co-requisite: Stat 230

Credit: 3 u

**STAT 232 PARAMETRIC INFERENCE.**

Exponential family of densities; point estimation: sufficiency, completeness, unbiasedness, equivariance; hypothesis testing.

Pre-requisite: Stat 231

Credit: 3 u

**STAT 233 LINEAR MODELS.**

Subspaces and projections; multivariate normal distribution, non-central distributions, distribution of quadratic forms; the general linear model of full column rank, tests about the mean; tests about the variance; the general linear model not of full column rank; estimability and testability.

Pre-requisite: Stat 232

Credit 3 u

**STAT 234 MULTIVARIATE ANALYSIS.**

Distribution theory for multivariate analysis; the multivariate one-and-two sample models; the multivariate linear model.

Pre-requisite: Stat 233

Credit: 3 u

**STAT 235 SURVEY OF STOCHASTIC PROCESSES.**

Markov chains; Markov processes; Poisson processes; renewal processes; martingales.

Pre-requisite: Stat 221

Credit: 3 u

**STAT 240 HIGH DIMENSIONAL DATA.**

High dimensional data; high dimensional data visualization; high dimensional data analysis; dimension reduction; pattern search; clustering; applications

Pre-requisite: Stat 226/Equivalent, Stat 223/Equivalent

Credit: 3 u

**STAT 241 NONLINEAR REGRESSION.**

Classification of nonlinear models; iterative estimation and linear approximation; practical considerations: model specification, starting values, transformations; convergence; multiresponse model; models from differential equations; nonlinear inference regions; measures of nonlinearity; applications.

Pre-requisite: Stat 223 or equivalent

Credit: 3 u

**STAT 242 ECONOMETRIC METHODS.**

Distributed lag models; structural change; simultaneous equations; limited dependent variables; ARCH, GARCH, processes; cointegration; applications.

Pre-requisite: Econ 101, Stat 223 or equivalent

Credit: 3 u

**STAT 243 CATEGORICAL DATA ANALYSIS.**

Cross-classified tables, multidimensional tables; loglinear model; logit models, measures of association; inference for categorical data; applications

Pre-requisite: Stat 223 or equivalent

Credit: 3 u

**STAT 244 DESIGN AND ANALYSIS OF CLINICAL EXPERIMENTS.**

Reliability of measurements; parallel groups design; control of prognostic factors; blocking and stratification; analysis of covariance; repeated measurements and crossover studies; balanced incomplete block designs; factorial experiments; split-plot designs; applications.

Pre-requisite: Stat 223 or equivalent

Credit: 3 u

**STAT 245 SURVIVAL ANALYSIS.**

Functions of survival time; estimation of survival functions; survival distributions and their applications; distribution fitting and goodness-of-fit tests.

Pre-requisite: Stat 222 or equivalent

Credit: 3 u

**STAT 246 RESPONSE SURFACE METHODS.**

Product design and development; optimal designs; response surface models; response surface optimization; applications.

Pre-requisite: Stat 223/Equivalent

Credit: 3 u

**STAT 247 DATA MINING AND BUSINESS INTELLIGENCE.**

Principles of data mining; methods of data mining; themes of data mining; applications of data mining in business intelligence.

Pre-requisite: Stat 210/Equivalent, Stat 226/Equivalent,  
Stat 223/Equivalent, and Stat 225/Equivalent

Credit: 3 u

**STAT 249 NONPARAMETRIC MODELING.**

Smoothing methods; kernel smoothing; spline smoothing; regression trees; projection pursuit; nonparametric regression; cross-validation; scoring; high dimensional predictors; additive models; backfitting.

Pre-requisite: Stat 222/232 and Stat 223/Equivalent

Credit: 3 u

**STAT 250 SAMPLING DESIGNS.**

Concepts in designing sample surveys; non-sampling errors; simple random sampling; systematic sampling; sampling with varying probabilities; stratification, use of auxiliary information; cluster sampling; multi-stage sampling;

Co-requisite: Stat 222/Stat 232

Credit: 3 u

**STAT 251 SURVEY OPERATIONS.**

Planning a survey; sample design and sample size, frame construction; tabulation plans; preparation of questionnaires and manual of instruction; field operations; processing of data, preparation of report.

Pre-requisite: Stat 222

Co-requisite: Stat 223

Credit: 3 u

**STAT 252 BOOTSTRAP METHODS.**

Empirical distribution functions; resampling and nonparametric statistical inference; optimality of the bootstrap; bootstrap in hypothesis testing; bootstrap in confidence intervals; bootstrap in regression models; bootstrap for dependent data.

Pre-requisite: Stat 222/232 and Stat 223/Equivalent

Credit: 3 u

**STAT 260 QUANTITATIVE RISK MANAGEMENT.**

Market risk; financial time series; copulas; extreme value theory; credit risk models; operational risks.

Pre-requisite: Stat 223 and Stat 225

Credit: 3 u

**STAT 261 STOCHASTIC CALCULUS FOR FINANCE.**

Continuous-time model; Brownian motion; random walk; quadratic variation; Ito formula; Black-Scholes equation; risk-neutral measure; martingale representation theorem; fundamental theorems of asset pricing

Pre-requisite: Stat 221/231/Equivalent

Credit: 3 u

**STAT 262 NONPARAMETRIC STATISTICS.**

Distribution-free statistics; U-statistics; power functions; asymptotic relative efficiency of tests; confidence intervals and bounds; point estimation; linear rank statistics; other methods for constructing distribution-free procedures.

Pre-requisite: Stat 232

Credit: 3 u

**STAT 263 BAYESIAN ANALYSIS.**

Bayesian inference; empirical and hierarchical analysis; robustness; numerical procedures.

Pre-requisite: Stat 232

Credit: 3 u

**STAT 264 ELEMENTS OF DECISION THEORY.**

Basic concepts, risk function, Bayes and minimax solutions of decision problems, statistical decision functions, formulation of general decision problems.

Pre-requisite Stat 231

Credit: 3 u

**STAT 265 ROBUST STATISTICS.**

Breakdown point and robust estimators; M-, R-, and L- estimates; robust tests; robust regression and outlier detection.

Pre-requisite: Stat 232

Credit: 3 u

**STAT 266 APPLIED NONPARAMETRIC METHODS.**

Methods for single, two and k samples; trends and association; nonparametric bootstrap.

Pre-requisite: Stat 222 and Stat 223

Credit: 3 u

**STAT 267 ADVANCED APPLIED MULTIVARIATE ANALYSIS.**

Confirmatory factor analysis; multidimensional scaling; correspondence analysis; classification trees; CHAID; procrustes analysis; neural networks; structural equation modeling.

Pre-requisite: Stat 226 or equivalent/COI

Credit: 3 u



**STAT 268      ADVANCED TIME SERIES ANALYSIS.**

Nonstationarity; cointegration; interventions models; state space models; transfer functions; frequency domain; panel data; nonparametric methods for time series; nonparametric prediction; AR-Sieve; block bootstrap

Pre-requisite: Stat 223/Equivalent and 225/Equivalent

Credit:            3 u

**STAT 270      EXPLORATORY DATA ANALYSIS.**

Graphical methods; single batch analysis and analysis of several batches; order statistics; resistant estimators; robust tests; robust regression; median polish; applications.

Pre-requisite: Stat 222 or equivalent

Credit:            3 u

**STAT 271      STATISTICAL QUALITY CONTROL.**

Overview of the statistical methods useful in quality assurance; statistical process control; control charts for variables and attributes, cusum chart, multivariate chart; process capability analysis; acceptance sampling; MIL STD tables and JIS tables; off-line quality control; introduction to response surface analysis; Taguchi method; applications.

Pre-requisite: Stat 222

Credit:            3 u

**STAT 272      RELIABILITY THEORY.**

Coherent systems; paths and cuts, life distribution; dependent components; maintenance policies and replacement models; domains of attraction.

Pre-requisite: Stat 231

Credit:            3 u

**STAT 273      SIX SIGMA STATISTICS.**

DMAIC(define-measure-analyze-improve-control) methodology; statistical process control; process capability; failure mode and effects analysis (FMEA); measurement system analysis; optimization by experimentation; taguchi method.

Pre-requisite: COI

Credit:            3 u

**STAT 274 MARKET RESEARCH.**

The marketing research; data and data generation in marketing research; analytical methods; consumer behavior modeling.

Pre-requisite: Stat 223/Equivalent and Stat 226/Equivalent

Credit:            3 u

**STAT 275 ECONOMIC STATISTICS.**

The Philippine Statistical System; surveys being regularly conducted by the system: questionnaire designs, sampling designs, estimators, issues; official statistics being generated: national accounts, consumer price index, input-output table, poverty statistics, leading economic indicators, seasonally adjusted series; statistical methods useful in generating official statistics.

Pre-requisite: Stat 222/232 and Stat 250

Credit:            3 u

**STAT 276 STATISTICS FOR GEOGRAPHIC INFORMATION SYSTEMS.**

Components of a geographical information system, data structures and elements of spatial modeling; exploratory spatial data analysis; quadrat analysis, tessellations and spatial autocorrelation; spatial modeling and prediction; some sampling theory; applications.

Pre-requisite: Consent of Instructor

Credit: 3 u

**STAT 277 STATISTICS FOR IMAGE ANALYSIS.**

Radiometric enhancement techniques; geometric enhancement using image domain techniques; multispectral transformation of data; supervised classification techniques; clustering and unsupervised classification; applications.

Pre-requisite: Consent of Instructor

Credit: 3 u

**STAT 280 SPECIAL FIELDS OF STATISTICS.**

Courses in special fields, new areas or latest developments in statistics.

Pre-requisite: Consent of Instructor

Credit: 3 u

*(may be repeated provided that the topics are different; topics to be indicated for record purposes)*

**STAT 290 STATISTICAL CONSULTING.**

Application of statistical concepts and methodologies to data of researchers seeking statistical consultancy services.

Pre-requisite: Consent of Instructor

Credit: 1 unit

**STAT 298 SPECIAL PROBLEM.**

The problem is on a subject involving the use of statistical methods and analysis.

Credit: 5 u

**STAT 300 THESIS.**

The thesis may be on a subject involving original investigation, which in some respect modifies or enlarges what has been previously known and is recommended for approval by the major professor or adviser.

Credit: 6 u