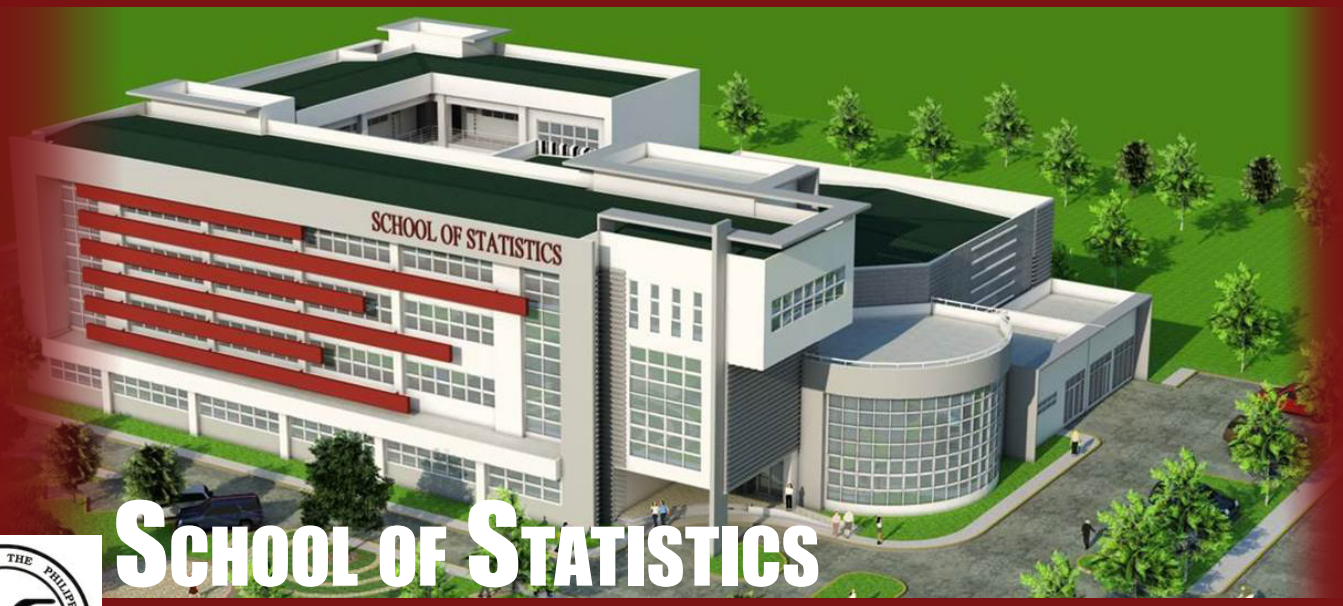

SCHOOL OF STATISTICS

PAARALAN ng ESTADISTIKA

Location: Magsaysay Avenue, UP Diliman, Quezon City, 1101 Philippines
Telephone Number: +63-2-9280881
Email Address: updstat@yahoo.com
Website: www.stat.upd.edu.ph

The School of Statistics (Stat)[a] was established as the Statistical Training Center (later as the Statistical Center) by the BOR at its 565th meeting on 09 October 1953, under a bilateral agreement between the government of the Philippines and the United Nations. Its primary objective then was to work towards the improvement of statistical services in the government. Ten years later, the Center was formally turned over to the University of the Philippines and in 1964, the BOR approved the Bachelor of Science (Statistics) program. The B.S. (Statistics) program started accepting students beginning AY 1967-1968.

It has since grown into a degree-granting institution whose mission is to advance the development and maintenance of a high level of efficiency in statistical activities in the country and in the Asia-Pacific Region through its academic programs, research, and extension services. In 26 November 1998, as approved during the 1126th meeting of the BOR, the Statistical Center changed its name to School of Statistics in order to reflect its expanded character as a degree-granting institution. At present, the School of Statistics offers one undergraduate program and three graduate programs. These are the B.S. (Statistics) program, the Master of Statistics (MOS) program, the M.S. (Statistics) program and the Ph.D. (Statistics) program. Through these programs, the School of Statistics has produced numerous distinguished statisticians in various professions and is widely recognized as the primary source of statistical expertise for the Philippine Statistical System and in the Industry. At present, it is the only CHED Center of Excellence in Statistics in the country.

PROGRAMS OFFERED

UNDERGRADUATE PROGRAM

Bachelor of Science in Statistics

The BS (Statistics) program is a 4-year course that provides students with a sound understanding of statistical methods—their underlying theories and their applications. It aims to prepare the students for immediate work as statisticians in government, industry, and research institutions. The program also aims to provide students with a good foundation to pursue graduate studies in statistics or other fields.

The program equips students with the necessary skills to design studies, analyze data, manage and process data using a variety of software packages, and communicate the results of the study to the end-users. This provides the graduates of the program with professional flexibility and exciting opportunities for rewarding careers in different fields such as biostatistics, market research, econometrics, actuarial science, and statistical computing.

GRADUATE PROGRAM

Master of Statistics (MOS)

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

Master of Science (MS Statistics)

MS Statistics prepares its graduates for advanced level work in the profession and provides them with the necessary foundation for high quality PhD work, both in the theoretical and practical aspects.

[a] *official rendition of the new School of Statistics building (expected time of completion: June 2014)*

Doctor of Philosophy (PhD Statistics)

PhD Statistics provides students with advanced background in statistics to enable them to participate in the development of statistical methods. Emphasis is placed on training in research.

The MOS program aims to prepare the students to meet the needs of industry and government for statistical personnel at the supervisory level. It provides the students with a sound understanding of statistical concepts and methods and their applications. The MS and the PhD programs aim to improve the quality of graduates and prepare them for jobs not only in the academe and in research but also in one or more of the following areas: business, economics, computing, industry, social science, natural sciences, among others.

ADMISSION POLICIES/REQUIREMENTS

UNDERGRADUATE

1. Applicants from another unit of the University may be admitted to the School provided that they have obtained a weighted average grade of 2.50 or better for all the statistics and mathematics subjects taken in the University; provided further that the quota set by the Dean has not been filled.
2. Applicants from another University may be admitted provided that they have obtained a general weighted average grade of 2.0, 86% or B or better and a weighted average grade of 1.75 for all the statistics and mathematics subjects taken outside the University in addition to satisfying University requirements governing transfer students; and provided further that the quota set by the Dean has not been filled.

Scholastic Delinquency Rules

1. Students who, at the end of the semester, obtain final grades below "3" in 25% to 49% of the total number of academic units enrolled in as of the last day of late registration shall receive a warning from the Dean to improve their work.
2. Students who, at the end of the semester, obtain final grades below "3" in 50% to 75% of the total number of academic units in which final grades have been obtained as of the last day of late registration shall be placed on probation and may be given a reduced load for the succeeding semester.
3. Students shall be permanently dropped from the roll of the School of Statistics for any of the following reasons:
   a. At the end of the semester they obtain final grades below "3" in at least 76% of the total number of academic units in which final grades have been received as of the last day of late registration;

   b. They were on probation the previous semester and then at the end of the semester, they obtain final grades below "3" in 50% or more of the total number of units in which they have received final grades;

   c. At the end of the school year they fail to pass at least 21 units of their total load for the school year. If the student is at least a sophomore, 6 units of these 21 units must be statistics subjects; and

   d. They fail a statistics subject three times.

4. Students who drop a course or courses unofficially shall be considered delinquent and their load may be reduced by the total number of units dropped unofficially.

GRADUATE

In addition to University rules and regulations governing graduate programs, the following apply to the School of Statistics graduate programs:

Master of Statistics (MOS) Program

Students will be required to take a validation examination in the areas of Calculus, Matrix Algebra, and Introductory Statistics. If students fail the examination, one or two of Stat 100, Stat 195, or Stat 117 will be taken during the summer or semester prior to admission to the MOS program.

To facilitate the monitoring of students' progress, students will have to submit a concept paper on a possible research topic as part of the application requirement.

Students will be considered candidates 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.

For the MOS Special Problem, students should demonstrate capability in 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.

Master of Science (MS Statistics) Program

Students should have a strong foundation in mathematics (calculus) and mathematical statistics.

To facilitate the monitoring of students' progress, students need to submit a concept paper on a possible research topic as part of the application requirement.

Students will be considered candidates 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 thesis.

For the MS thesis, students should be able to demonstrate capability in conducting basic research in statistics. The work should contribute to the body of knowledge in statistical science. The new knowledge

generated from the thesis can be derived analytically or computationally (use of simulations).

Scholastic Delinquency Rules

The following average grades are required of students enrolled in the masters programs:

No. of Units Taken	Average Grade Required
6	2.50
9	2.30
12	2.20
15	2.15
18	2.10
21	2.05
27 or more	2.0

Students who do not satisfy the above grade requirements will be dropped from the roll of the School.

Doctor of Philosophy (PhD Statistics) PROGRAM

Application for admissions must be filed with the Director for Graduate Studies at least one month before the start of the registration period of the proposed term of entrance.

Applicants with a bachelor's or master's degree or equiv degree or title from any recognized institution of higher learning and who satisfy the University rules on admission to a graduate program may be admitted to the PhD program subject to the following conditions:

Applicants with a bachelor's or master's degree other than in statistics may be required to take additional mathematics and statistics courses before admission to the PhD program.

Additional requirements shall be determined by the Graduate Committee of the School.

Students must obtain a grade of 2.0 or better in the qualifying examination based on the core courses of the MS Statistics program of the School before being allowed to continue in the doctoral program. Graduates of MS Statistics of the School are exempted from taking the qualifying examination.

Advancement to Candidacy

Students are qualified to take the candidacy examination based on the PhD core courses (Stat 301, Stat 302, Stat 303, Stat 311, and Stat 312), provided that their weighted average in these courses is 1.75 or better.

After passing the candidacy examination with a grade of 1.75 or better, students are considered advanced to candidacy for the degree. Failure at a second try shall bar the student permanently from the PhD program.

Graduation Requirement

Submission of an approved dissertation successfully defended in an oral examination.

Scholastic Delinquency

The following are the grade requirements for students enrolled in the doctoral program:

No. of Units Taken	Average Grade Required
6	2.50
9	2.30
12	2.20
15	2.15
18	2.10
21	2.05
27 or more	2.0

Students who do not satisfy the above grade requirements will be dropped from the roll of the School.

PRIVATE SCHOLARSHIP

The School has two private scholarships that students can avail themselves of.

1) Rosario Chew Scholarship for Statistics
2) Cristina Parel Scholarship for Statistics

FACILITIES & SERVICES

The School maintains one of the best statistics libraries in the country, with new titles continuously being added to its already sizable collection. It subscribes to 25 titles of foreign statistical journals, including the online version of databases of journal compilations the University subscribes to. Its Statistical Computing Laboratory (SCL) houses powerful computers equipped with the latest statistical software like SAS, SPSS, Stata, EViews, and Minitab.

BACHELOR OF SCIENCE (STATISTICS)
139 units

APPROVAL
120th Special UPD UC : 02 April 2012 | President AEPascual : 04 June 2012

FIRST YEAR

1st Semester (17 units)		2nd Semester (17 units)	
GE (AH 1) Free Choice	3	GE (AH 2) Eng 10	3
GE (MST 1) Free Choice	3	GE (SSP 2) Philo 1	3
GE (SSP 1) Free Choice	3	Math 53	5
Math 17	5	Stat 115	3
Stat 114	3	Stat 117	3
PE	(2)	PE	(2)

SECOND YEAR

1st Semester (17 units)		2nd Semester (18 units)	
GE (AH 3) Fil 40*	3	GE (AH 4) Free Choice	3
GE (SSP 3) Kas 1*	3	GE (MST 2) Free Choice	3
Math 54	5	Math 55	3
Stat 121	3	Stat 122	3
Stat 124	3	Stat 125	3
PE	(2)	Free Elective [1]	3
		PE	(2)

THIRD YEAR

1st Semester (19 units)		2nd Semester (18 units)	
GE (AH 5) Comm 3	3	GE (SSP 5) Free Choice	3
GE (SSP 4) Free Choice	3	Stat 132	3
GE (MST 3) Free Choice	3	Stat 133	3
Stat 131	4	Stat 136	3
Stat 135	3	Stat 138	3
Math/Stat Elective[2]	3	Free Elective	3
NSTP	(3)	NSTP	(3)

FOURTH YEAR

1st Semester (18 units)		2nd Semester (15 units)	
GE (MST 4) STS	3	Stat 143	3
Stat 145	3	Stat 148	3
Stat 146	3	Stat 149	3
Stat 147	3	PI 100	3
Math/Stat Elective	3	Math/Stat Elective	3
Technical Writing Course	3		

[1] A Free elective is any course that is not equiv to a required statistics course in the program.
[2] A Stat elective is any statistics course number 191 to 197.
A Math elective is any mathematics course number higher than 109 that is not equiv to a required statistics course in the program.

* Kas 1 and Fil 40 satisfy the 6-unit Philippine Studies requirement

Note: As a requirement for graduation, all students must take six (6) units in one of the National Service Training Program (NSTP) components: Civic Welfare Training Service (CWTS), Literacy Training Service (LTS), and Reserved Officer's Training Corps Military Science (ROTC Mil Sci). These are offered by UPD.

MASTER OF STATISTICS
37 units

APPROVAL
112th UPD UC : 26 March 2010 | President ERRoman: 19 April 2010

FIRST YEAR

1st Semester (9 units)		2nd Semester (9 units)	
Stat 221	3	Stat 222	3
Stat 251	3	Stat 223	3
Elective	3	Elective	3

Student will start working for the special problem at this point.

SECOND YEAR

1st Semester (10 units)		2nd Semester (9 units)	
Stat 250	3	Elective	3
Stat 290	1	Stat 290	1
Elective	3	Stat 298	5
Elective	3		

Note: The student will be required to take a validation examination in the areas of Calculus, Matrix Algebra, and Introductory Statistics. If the student fails 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 program

MASTER SCIENCE (STATISTICS)
38 units

APPROVAL
112th UPD UC : 26 March 2010 | President ERRoman: 19 April 2010

FIRST YEAR

1st Semester (9 units)		2nd Semester (9 units)	
Stat 230	3	Stat 232	3
Stat 231	3	Stat 250	3
Elective	3	Elective	3

Student will start working for the special problem at this point.

SECOND YEAR

1st Semester (10 units)		2nd Semester (9 units)	
Stat 233	3	Stat 234	3
Stat 290	1	Stat 290	1
Elective	3	Stat 300	5
Elective	3		

Checklists for Undergraduate and Graduate programs are for guidance of students only and are based on approved Program of Study (POS)

DOCTOR OF PHILOSOPHY (Statistics)
40 units

APPROVAL
46th UPD UC : 15 April 1996

F I R S T Y E A R

1st Semester 9 units		2nd Semester 8 units	
Stat 301	3	Stat 302	3
Elective	3	Stat 311	3
Elective	3	Stat 390	2

S E C O N D Y E A R

1st Semester 8 units		2nd Semester 3 units	
Stat 312	3	Stat 390	2
Stat 303	3	Stat 396	1
Stat 390	2		

T H I R D Y E A R

1st Semester		2nd Semester	
Stat 400	12		

COURSE OFFERINGS

UNDERGRADUATE

Statistics (Stat)

100 **Calculus and Matrix Algebra for Statistics.** Differential and integral calculus. Infinite series. Matrix algebra. 3 u.

101 **Elementary Statistics.** Presentation of data; frequency distributions; measures of central tendency; measures of dispersion; index numbers; probability distributions; statistical inference; correlation and regression. Prereq: Math 11. 3 u.

114 **Descriptive Statistics.** Statistics; statistical measurement; statistical notations; collection, organization and presentation of data; measures of central tendency, location, dispersion, skewness, kurtosis; letter values, boxplots and stem-and-leaf display; measures of association and relationship; rates, ratios, and proportions; construction of index numbers and indicators. Coreq: Math 17/equiv. 3 u.

115 **Basic Statistical Methods.** Computer assisted statistical analysis on the following: tests for means; tests for proportions; tests for independence; simple linear regression; analysis of variance; forecasting using classical techniques. Prereq: Stat 101/114/equiv. 3 u.

117 **Mathematics for Statistics.** Principles of logic; methods of proof; fields, sigma fields and sequences of sets; the real number system; sequences and series; combinatorial analysis. Prereq: Math 17/equiv. 3 u.

121 **Probability Theory I.** Elements of probability; random variables; discrete and continuous random variables; probability distributions; special distributions; mathematical expectations; functions of a randon variable. Prereq: Math 53, Stat 117/equiv; Coreq: Math 54. 3 u.

122 **Probability Theory II.** Joint, marginal, and conditional distributions; independence of random variables; distributions and expectations of functions of random variables; charactertization of F, t, and $\chi 2$ distributions, normal approximation to discrete distributions. Prereq: Stat 121. 3 u.

124 **Introduction to Programming.** Introduction to microcomputer and operating systems; principles of programming; programming using a high-level computer language (e.g., PASCAL). Prereq: Stat 101/114/equiv. 3 u.

125 **Applications Software and Software Packages.** Use of statistical software packages (e.g., SAS, SPSS) for database management and basic statistical analysis. Prereq: Stat 101/115/equiv, Stat 124/equiv. 3 u.

130 **Introduction to Mathematical Statistics for Computer Science.** Probability; random variables and distribution functions; special distributions; sampling distributions; maximum likelihood estimation; interval estimation; hypothesis testing; application of the central limit theorem to large sample inference; linear regression and correlation. Prereq: Math 55. 3 u.

131 **Parametric Statistical Inference.** Population and sample; statistics and sampling distributions; limit theorems; point and interval estimation; statistical hypothesis testing; inference based on the normal distribution and applications of z, t, $\chi 2$, and F distributions. Prereq: Math 55, Stat 122. 4 h. (3 lec, 1 lab). 4 u.

132 **Nonparametric Statistical Inference.** Levels of measurement; goodness-of-fit tests; sign and signed rank tests; distribution tests; association tests; tests for independence. Prereq: Stat 131, Stat 125. 3 u.

133 **Bayesian Statistical Inference.** Elements of Bayesian inference; assessment of prior likelihood and posterior distributions; Bayesian estimation and hypothesis testing; predictive distribution and asymptotics; Bayesian Hierarchical Models; introduction to Empirical Bayes; use of statistical software. Prereq: Stat 131, Stat 124. 3 u.

135 **Matrix Theory for Statistics.** Matrix operations; properties of matrices; special matrices; matrix calculus; determinants; eigenvalues and eigenvectors; linear systems; vector spaces; use of software; applications. Prereq: Math 53, Stat 125. 3 u.

136 **Introduction to Regression Analysis.** Linear regression model; model selection; regression diagnostics; use of dummy variables; remedial measures. Prereq: Stat 131, Stat 135.

138 **Introduction to Sampling Designs.** Probability and non-probability sampling; simple random, systematic, cluster, stratified, and multi-stage sampling designs; sampling with probability proportional to size; applications . Prereq: Stat 131, Stat 125. 3 u.

143 **Survey Operations.** Research process; techniques of data collection; principles of questionnaire design; data coding and encoding; data quality control; presentation of research findings. Prereq: SS[a], Technical Writing course, Oral Communication Skills course. 3 u.

145 **Introduction to Time Series Analysis and Forecasting.** Classical methods; ARIMA models; Box-Jenkins method; unit root processes; intervention analysis; GARCH Models; regression with time series data; applications. Prereq: Stat 136. 3 u.

146 **Introduction to Exploratory Data Analysis.** Displaying and summarizing batches; re-expressing data; median polish; robust and resistant measures; fitting resistant lines. Coreq: Stat 136. 3 u.

147 **Introduction to Multivariate Analysis.** Multivariate normal distribution; inference on mean vector and dispersion matrices; principal component analysis; canonical correlation analysis; discriminant analysis; factor analysis; cluster analysis; other multivariate techniques; applications. Prereq: Stat 136. 3 u**.**

148 **Introduction to Experimental Designs.** Principles of experimentation; completely randomized design; randomized complete block design; Latin-square design; cross-over design; factorial experiments; incomplete block design; other experimental designs; applications. Prereq: Stat 136. 3 u.

149 **Introduction to Categorical Data Analysis.** Categorical data; cross-classification tables; analysis using loglinear, logistic and logit models. Prereq: Stat 136. 3 u.

191 **Special Topics in Biological and Medical Statistics.** Prereq: COI. 3 u.

191.1 **Introduction to Biostatistics.** Descriptive and inferential statistics in the health sciences: clinical trials, epidemiologic studies: survival analysis. Prereq: Stat 125. Coreq: Stat 148. 3 u.

192 **Special Topics in Business and Economic Statistics.** Prereq: COI. 3 u.

192.1 **Statistics in Market Research.** Market research process; primary data collection; research design concepts; descriptive, inferential, and multivariate statistics in market research; communicating market research results; applications. Coreq: Stat 147. 3 u.

192.2 **Advanced Linear Models.** Instrumental variables: limited dependent variable models; panel data estimation. Prereq: Stat 136. 3 u.

193 **Special Topics in Industrial and Physical Science Statistics.** Prereq: COI. 3 u.

193.1 **Introduction to Statistical Quality Control.** Overview of quality control and improvement; identifying sources of variation; control charts; process capability analysis; acceptance sampling; reliability. Prereq: Stat 125, Stat 131. 3 u.

194 **Special Topics in Social and Psychological Statistics.** Prereq: COI. 3 u.

195 **Introduction to Mathematical Statistics.** Probability distributions, sampling distributions, parametric and non-parametric inference. 3 u.

196.1 **Advanced Statistical Computing.** Advanced data management and processing; Structured Query Language; modular codes; simulations; resampling methods. Prereq: Stat 136. 3 u.

[a]*A student has SS if s/he requires at most 18 major units to graduate*

197 **Special Topics in Statistics.** Prereq: COI. 3 u., may be taken thrice, topics to be indicated for record purposes.

GRADUATE

Statistics (Stat)

210 **Statistical Software.** Database management and programming using statistical software. 3 u.

211 **Statistical Computing.** Algorithms for statistical computing; numerical analysis for linear and nonlinear models; random number generation; Monte Carlo methods. 3 u.

221 **Introductory Probability.** Combinatorial analysis; sample space and random variables, probability distribution function; expectation; stochastic independence; common probability distributions. 3 u.

222 **Introduction to Statistical Inference.** Sampling distributions; point and interval estimation; tests of hypothesis. Prereq: Stat 221. 3 u.

223 **Applied Regression Analysis.** Model building; diagnostic checking; remedial measures; applications. Coreq: Stat 222/equiv. 3 u.

224 **Experimental Designs.** Completely randomized designs; randomized complete block design; Latin square design; factorial experiments; incomplete block design; higher-order designs. Prereq: Stat 223/equiv. 3 u.

225 **Time Series Analysis.** Classical procedures; stationarity; Box-Jenkins modeling procedure: autocorrelation function, partial autocorrelation function, identification, estimation, diagnostic checking, forecasting; transfer functions; applications. Prereq: Stat 223/equiv. 3 u.

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. Coreq: Stat 223/equiv. 3 u.

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. 3 u., may be repeated provided that the topics are different; topics to be indicated for record purposes.

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; characteristic functions. Coreq: Stat 230/equiv. 3 u.

232 **Parametric Inference.** Exponential family of densities; point estimation: sufficiency, completeness, unbiasedness, equivariance; hypothesis testing. Prereq: Stat 231. 3 u.

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. Prereq: Stat 232. 3 u.

234 **Multivariate Analysis.** Distribution theory for multivariate analysis; the multivariate one-and-two sample models; the multivariate linear model. Prereq: Stat 233. 3 u.

235 **Survey of Stochastic Processes.** Markov chains; Markov processes; Poisson processes; renewal processes; martingales. Prereq: Stat 221. 3 u.

240 **High Dimensional Data.** High dimensional data; high dimensional data visualization; high dimensional data analysis; dimension reduction; pattern search; clustering; applications. Prereq: Stat 226/equiv, Stat 223/equiv. 3u.

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. Prereq: Stat 223/equiv. 3 u.

242 **Econometric Methods.** Distributed lag models; structural change; simultaneous equations; limited dependent variables; ARCH, GARCH processes; cointegration; applications. Prereq: Econ 101, Stat 223/equiv. 3 u.

243 **Categorical Data Analysis.** Cross-classified tables, multidimensional tables; loglinear model; logit models, measures of association; inference for categorical data; applications. Prereq: Stat 223/equiv. 3 u.

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. Prereq: Stat 223/equiv. 3u.

245 **Survival Analysis.** Functions of survival time; estimation of survival functions; survival distributions and their applications; distribution fitting and goodness-of-fit tests. Prereq: Stat 222/equiv. 3 u.

246 **Response Surface Methods.** Product design and development; optimal designs; response surface models; response surface optimization; applications. Prereq: Stat 223/equiv. 3u.

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. Prereq: Stat 210/equiv, Stat 226/equiv, Stat 223/equiv, and Stat 225/equiv. 3u.

249 **Nonparametric Modeling.** Smoothing methods; kernel smoothing; spline smoothing; regression trees; projection pursuit; nonparametric regression; cross-validation; scoring; high dimensional predictors; additive models; backfitting. Prereq: Stat 222/232 and Stat 223/equiv. 3u.

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. Coreq: Stat 222/232. 3 u.

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. Prereq: Stat 222; Coreq: Stat 223. 3 u.

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. Prereq: Stat 222/232 and Stat 223/equiv. 3u.

260 **Quantitative Risk Management.** Market risk; financial time series; copulas; extreme value theory; credit risk models; operational risks. Prereq: Stat 223 and Stat 225. 3u.

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. Prereq: Stat 221/231/equiv. 3 u.

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. Prereq: Stat 232. 3 u.

263 **Bayesian Analysis.** Bayesian inference; empirical and hierarchical analysis; robustness; numerical procedures. Prereq: Stat 232. 3 u.

264 **Elements of Decision Theory.** Basic concepts, risk function, Bayes and minimax solutions of decision problems, statistical decision functions, formulation of general decision problems. Prereq: Stat 231. 3 u.

265 **Robust Statistics.** Breakdown point and robust estimators; M-, R- and L-estimates; robust tests; robust regression and outlier detection. Prereq: Stat 232. 3 u.

266 **Applied Nonparametric Methods.** Methods for single, two and k samples; trends and association; nonparametric bootstrap. Prereq: Stat 222 and Stat 223. 3 u.

267 **Advanced Applied Multivariate Analysis.** Confirmatory factor analysis; multidimensional scaling; correspondence analysis; classification trees; CHAID; procrustes analysis; neural networks; structural equation modeling. Prereq: Stat 226/equiv/COI. 3u.

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. Prereq: Stat 223/equiv and 225/equiv. 3u.

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. Prereq: Stat 222/equiv. 3 u.

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. Prereq: Stat 222. 3 u.

272 **Reliability Theory.** Coherent systems; paths and cuts, life distribution; dependent components; maintenance policies and replacement models; domains of attraction. Prereq: Stat 231. 3 u.

273 **Six Sigma Statistics.** DMAIC (define-measure-analyze-improve-control) methodology; statistical process control; process capability; failure mode and effects analysis (FMAE); measurement system analysis; optimization by experimentation; Taguchi method. Prereq: COI. 3 u.

274 **Market Research.** The marketing research; data and data generation in marketing research; analytical methods; consumer behavior modeling. Prereq: Stat 223/equiv and Stat 226/equiv. 3 u.

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. Prereq: Stat 222/232 and Stat 250. 3 u.

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, tesselations and spatial autocorrelation;

spatial modeling and prediction; some sampling theory; applications. Prereq: COI. 3 u.

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. Prereq: COI. 3 u.

280 **Special Fields of Statistics.** Courses in special fields, new areas or latest developments in statistics. Prereq: COI. 3 u., may be repeated provided that the topics are different; topics to be indicated for record purposes.

290 **Statistical Consulting.** Application of statistical concepts and methodologies to data of researchers seeking statistical consultancy services. Prereq: COI. 1 u.

298 **Special Problem. T**he report is on a subject involving the use of statistical methods and analysis. 5 u.

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. 6 u.

301 **Theory of Probability I.** Measure theory; probability spaces; random variables; integration; expectation and moments; convergence. 3 u.

302 **Theory of Probability II.** Conditional expectations; dependence; martingales. Prereq: Stat 301. 3 u.

303 **Stochastic Processes.** The theory of stochastic processes; some stochastic processes. Prereq: Stat 302. 3 u.

311 **Theory of Statistical Inference I.** Sufficiency, completeness, exponential families, unbiasedness; equivariance; Bayes estimation; minimax estimation; admissibility. Prereq: Stat 301. 3 u.

312 **Theory of Statistical Inference II.** Uniformly most powerful tests; unbiased tests; invariance; linear hypothesis; minimax principle. Prereq: Stat 311. 3 u.

313 **Decision Theory.** Recent developments and applications in decision theory. Prereq: Stat 311. 3 u.

321 **Asymptotic Methods for Statistics.** Limit theorems; U-statistics; M-, R- and L- estimators; differentiable functionals; asymptotic tests. Prereq: Stat 311. 3 u.

380 **Advanced Special Topics.** Advanced topics in statistics to be presented in lecture series as unique opportunities arise. 3 u., may be repeated provided that the topics are different; topics to be indicated for record purposes.

390 **Reading Course.** 2 u., must be taken three times.

396 **Seminar.** Faculty and graduate student discussions of current researches in statistics. 1 u.

400 **Dissertation.** 12 u.