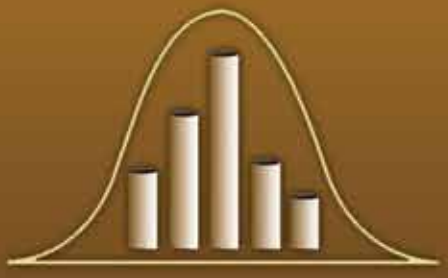
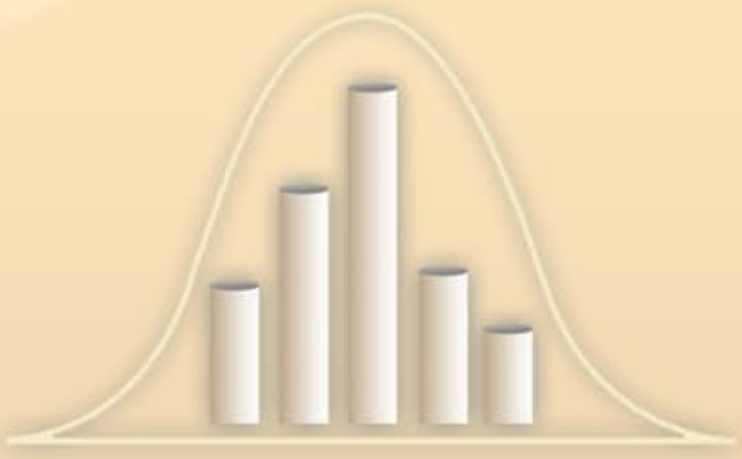
College of Sciences

Department of Statistics and Operations Research





College of Sciences

Department of Statistics and Operations Research

1430 /1431 H – 2009/ 2010 G


بسم الله الرحمن الرحيم

Contents

Introduction

The Department of Statistics and Operations Research was a founded in 1399 AH (1980 G). Prior to that, it was part of the Department of Mathematics which was established upon the founding of the College of Sciences in 1378 AH (1959 G). The Department has evolved rapidly during the few years since its foundation as it began offering a Master's Program in Statistics in 1400AH (1980 G). Furthermore, the Department has experienced a significant increase in the number of students after establishing the Operations Research Program in 1406 AH (1986 G). The Females' Branch was opened in 1408 AH (1988 G).

The Department of Statistics and Operations Research acquires a special importance through the role played by Statistics and Operations Research in decision making inside different organizations in the search for optimal solutions to the problems they face.

The Department now offers a Bachelor of Science degree in Statistics and in Operations Research. It also offers a Master of Science degree in Statistics and in Operations Research and a Ph. D. degree in Statistics. As for the Females' Branch, only post graduate degrees are offered. The Department provides different services inside and outside the University since it offers courses in Statistics for students in the College of Science and for other students in different colleges such as Engineering, Computer Science, Agriculture, Social Studies, Medicine, Applied Medical Science, Dentistry and Pharmacy. Also, the Department provides statistical consultations to applied research projects within and outside the University, both in designing the statistical research or in data analysis and the interpretation of results. Furthermore, the Department provides, through the branch of Operations Research, advice on problem modeling and solving, project planning, scheduling, production control and optimal use of resources.

The Department of Statistics and Operations Research has two locations inside the College of Science (Building 4). The first location is on the second floor which is occupied by the office of the chairman of the Department, the offices of the faculty members and the teaching assistants, and the Department library. The second location is on the ground floor which is occupied by offices of some faculty members, computer laboratories that facilitate the research needs, students training, and other teaching purposes.

Currently, the Department has ten professors, 11 associate professors, 8 assistant professors and a total of 15 lecturers, technicians and research assistants.

The Department has the following facilities serving the teaching and research activities:

Ten computer laboratories containing 200 PCs.

- Three E-Learning rooms.
- One Self Learning Computer Laboratory.
- A library for faculty members and Graduate students.

The Females' Branch of the Department of Statistics and Operations Research is located in Building 9 in the College of Science in Malaz Campus. Its staff consists of one professor, five assistant professors, and a total of 11 lecturers, technicians and research assistants. The Females' Branch is expected to relocate in the near future to the new Building in Deriyah Campus which will contain new infrastructure and better facilities. However, they currently have:

- Three computer laboratories containing 90 PCs.
- E-Learning rooms shared with other departments.
- A library for faculty members and students.

Vision

Leadership in the fields of Statistics and Operations Research and an effective role in the development and the culture of decision-making.

Mission

To fulfill the needs of society in the fields of Statistics and Operations Research by providing quality and effective educational programs to achieve the ambitions of the development plans of the society, with continued efforts at improving these programs and maintaining the quality of scientific research.

Objectives

1. To meet the needs of the labor market and to contribute to the development witnessed in all areas in the Kingdom.
2. To keep abreast of global scientific issues and strengthen the relationship with the government institutions and the private sector.
3. To attract distinguished students to the graduate programs in applied and theoretical fields.
4. To offer training and consultation to the public and private institutions in the areas of Statistics and Operations Research.
5. To contribute to expanding the Arabic scientific literature through authoring Arabic books and translating the relevant books and references to the Arabic language.
6. To contribute to advancing the fields of Statistics and Operations Research through innovative scientific research and hosting and participating in international conferences.

Research Activities

The faculty members are involved in writing research papers presented for publication in scientific journals, whereas some members are also involved in editing and refereeing a number of international journals and others participate in programs of international research cooperation with distinguished universities such as McMaster University and Oklahoma University. Furthermore, some faculty members have authored many scientific books published in Arabic.

Some international and national awards have been gained by the Department's faculty members, namely:

- *The 1995 Kuwait Prize for Basic Sciences awarded to Professor Abdulhamid Alzaid.*
- *The Award of Distinguished Web Sites among the College of Science faculty Members for the academic year 2008/2009 G, awarded to Professor Abdullah Alshihah and Dr. Mohamed Kayid.*

Serving the Community

The Department's faculty members participate extensively in serving the community with consultations in different areas of Statistics and Operations Research. Five faculty members work as full time consultants in various government and private institutions, while some others work as part time consultants in numerous government and private institutions. Many graduate students and other researchers visit the Department seeking advice on topics related to the areas of statistics and operations research.

Graduates Job Opportunities

It is rare to find a ministry, a government authority, or a private institution that does not have a department of Statistics falling under different headings such as: Statistics, Documentation, Studies, Planning, or Research. Statisticians work in these departments under various titles such as: Statistics Researcher, Head of the Department of Statistics, Statistics Expert, Data Analyst, Statistics Specialist, and Planner. Graduates of the Operations Research Program can be appointed to work in institutions that require optimal decisions in areas such as the planning of production processes, distribution of products, inventory control, scheduling of tasks, projects management, transportation, and economic planning, military, and security processes.

■ Programs Offered by the Department

• The Nature of the Curricula:

The Department is undergoing continuous development in the curricula so that it offers excellent education to the students through its vitality and persistent endeavor to meet the goal of designing curricula that help students succeed in their future working life. The Department curricula feature a clear and carefully maintained balance between the theoretical and applied aspects to enable the graduate to assume his place in the labor market with many applied skills, or to allow him to continue his postgraduate studies with ease.

In the theoretical aspects of the Statistics Curriculum, priority is given to statistical theory and statistical extrapolation. The probability courses are directed towards serving the needs of the Statistical Theory and providing a good entry to the Theory of Probabilities and its applications.

In the applied aspect of the Statistics Curriculum, a balance is maintained between statistical methods in general, experimental design, regression methods, data analysis, sampling, computational statistics, and using statistical software in data analysis. The Curriculum also includes courses in stochastic process, time series, quality control, and demography studies.

Regarding the Operations Research Curriculum, the guiding objective is to balance between theory and application, and to form a strong base of knowledge needed to pursue studies in Operations Research since students take courses in Mathematics, Statistics, and Computer Science. The Operations Research Curriculum focuses on the following major topics: model building, mathematical programming such as linear and non-linear programming, integer programming, dynamic programming, and goal programming, optimization methods, queuing theory, inventory control, reliability, forecasting methods, networks analysis, and game theory, in addition to some other special topics.

■ Programs Offered by the Department

• The Department offers five Programs:

1. Bachelor's Degree in Statistics (Males only).
2. Bachelor's Degree in Operations Research (Males only).
3. Master's Degree in Statistics.
4. Master's Degree in Operations Research.
5. Ph.D, Degree in Statistics.

Bachelor's Degrees

Bachelor's Degree of Science in Statistics

Study Plan for the Department of Statistics and Operations Research
Specialization: Statistics
Degree: Bachelor of Science

Preparatory Year (31 credit hours)				
Course Code and Number	Title	Credit Hours	Pre-requisite(s)	Co-requisite(s)
ENG 140	English Language 1	8		
ENG 150	English Language 2	8		
MATH 140	Introduction to Mathematics	2		
MATH 150	Differential Calculus	3		
CT 140	Computer skills	3		
CI 140	Learning, Thinking and Research Skills	3		
CHS 150	Health and fitness	1		
ENT 101	Entrepreneurship	1		
MC150	Communication skills	2		
Total		31		

University Requirements (8 credits hours)
A student selects 8 credits hours from the Islamic Culture courses#

Compulsory Requirements From Within the Department (57 credits)				
Course Code and Number	Title	Credit Hours	Pre-requisite(s)	Co-requisite(s)
STAT 100	Introduction to Statistics	3	MATH 150	
OPER 100	Introduction to Operations Research	4	MATH 150	STAT 100
STAT 105	Statistical Methods (E)	4	STAT 100	
STAT 215	Probability (1)	4	STAT 100 + MATH 111	
STAT 223	Theory of Statistics (1)	3	STAT 215	
STAT 315	Probability (2) (E)	3	STAT 215 + MATH 207	
STAT 319	Theory of Statistics (2) (E)	3	STAT 222 + MATH 207	STAT 315
STAT 328	Statistical Packages (E)	3	STAT 105	
STAT 333	Nonparametric Statistical Methods	3	STAT 105	
STAT 331	Sampling Techniques	3	STAT 223	
STAT 332	Regression Analysis	3	STAT 328 + MATH 244	
STAT 401	Econometrics (E)	3	STAT 332	
STAT 436	Time Series and Forecasting	3	STAT 332	
STAT 437	Design and Analysis of Experiments	3	STAT 328	
STAT 438	Multivariate Statistical Methods	3	STAT 332	
STAT 439	Data Analysis (E)	3	STAT 436 + STAT 438	
STAT 441	Quality Control	3	STAT 319	
STAT 497	Graduation Project (1) (E)	1	STAT 332	Stat 436 + Stat 438
STAT 498	Graduation Project (2) (E)	2	STAT 497	
Total		57		

Compulsory Requirements From Other Departments (17 credits)				
Course Code and Number	Title	Credit Hours	Pre-requisite(s)	Co-requisite(s)
MATH 111	Integral Calculus (E)	4	MATH 150	
MATH 207	Advanced Integral and Differential Calculus (E)	3	MATH 111	
MATH 244	Linear Algebra (E)	3	MATH 111	
CSC 201	Computer Programming (E)	4		
CSC 202	Computer Programming using MATLAB (E)	3	CSC 201	
Total		17		

Elective Requirements from the Department Group A (student selects 14 credit hours from this group)				
Course Code and Number	Title	Credit Hours	Pre-requisite(s)	Co-requisite(s)
STAT 231	Population study "Demography" (E)	2	STAT 100	
STAT 325	Decisions Theory (E)	3	STAT 223	
STAT 362	Reliability Theory	3	STAT 223	
STAT 399	Longitudinal Data Analysis (E)	3	STAT 332	
STAT 406	Survival Analysis (E)	3	STAT 223	
STAT 431	Insurance Methods (E)	3	STAT 319	
STAT 432	Survey Methods	2	STAT 331	
STAT 434	Linear Models	3	MATH 244	
OPER 213	Linear Programming	4	OPER 100	MATH 244
OPER 322	Inventory Control	3	OPER 213 + MATH 207	
OPER 351	Network Analysis	3	OPER 213 + CSC 202	
OPER 441	Modeling and Simulation (E)	4	STAT 215 + CSC 201	
OPER 472	Stochastic Processes and Queues (E)	4	OPER 213 + STAT 215	

Elective Requirements From Other Departments Group B (student selects 9 credit hours from this group)				
Course Code and Number	Title	Credit Hours	Pre-requisite(s)	Co-requisite(s)
MATH 160	Computational Mathematics	2	CT 140 & MATH 111	
MATH 225	Introduction to Differential Equations	4	MATH 207	
MATH 352	Numerical Analysis	4	MATH 160 & MATH 244	
MATH 382	Real Analysis I	4	MATH 207	
MGT 101	Principles of Management and Business	3		
MGT 102	Human Resources Management	3	MGT 101	
MGT 103	Entrepreneurship	3	MGT 101	
MGT 104	Principles of Public Administration	3		
MGT 319	Management of Small and Medium Size Businesses	3	MGT 101	
MGT 371	Operations Management	3	MGT 101	
MIS 201	Management Information Systems	3	MGT 101	
ACCT 201	Principles of Accounting and Financial Reporting	3		
ACCT 202	Principles of Cost Managerial Accounting	3	ACCT 201	
ACCT 311	Accounting for Government and Non-Profit Organizations	3	ACCT 201	
ACCT 317	Intermediate Accounting (1)	3	ACCT 201	

Elective Requirements From Other Departments Group B (student selects 9 credit hours from this group)				
Course Code and Number	Title	Credit Hours	Pre-requisite(s)	Co-requisite(s)
ACCT 318	Intermediate Accounting (2)	3	ACCT 317	
ECON 101	Principles of Microeconomics	3		
ECO N 102	Principles of Macroeconomics	3	ECON 101	
ECO N 201	Microeconomics Analysis	3	ECON 102	
ECON 202	Macroeconomics Analysis	3	ECON 102	
ECON 211	Money and Banking	3	ECON 102	
ECON 314	Islamic Economics	3	ECON 102	
ECON 317	Managerial Economics	3	ECON 102	
ECON 318	Transportation and Insurance Economics	3	ECON 102	
MKT 201	Principles of Marketing	3	MGT 101 + Econ 101	
FIN 200	Principles of Finance	3	ACCT 201	
FIN 210	Corporate Finance	3	FIN 200	
FIN 220	Investment Essentials	3	FIN 200	
FIN 230	Financial markets and institutions	3	FIN 200	
FIN 240	Principles of Risk & Insurance	3	FIN 200	
FIN250	International Finance	3	FIN 200	
QUA 127	Mathematics of Finance	3	MATH 140	

Suggested Study Plan

Level I				
Course Code and Number	Title	Pre-requisite(s)	Co-requisite(s)	Credit Hours
ENG 140	English Language (1)			8
MATH 140	Introduction to Mathematics			2
CI 140	Learning, Thinking and Research Skills			3
CHS 140	Health and Fitness			1
ENT 101	Entrepreneurship			1
Total				15

Level II				
Course Code and Number	Title	Pre-requisite(s)	Co-requisite(s)	Credit Hours
ENG 150	English Language (2)			8
MATH 150	Differential Calculus			3
CT 140	Computer Skills			3
MC 150	Communication Skills			2
Total				16

Level III				
Course Code and Number	Title	Pre-requisite(s)	Co-requisite(s)	Credit Hours
STAT 100	Introduction to Statistics	MATH 150		3
OPER 100	Introduction to Operations Research	MATH 150	STAT 100	4
MATH 111	Integral Calculus (E)	MATH 150		4
	University requirement			2
	University requirement			2
	Optional Course from Group B			3
Total				18

Level IV				
Course Code and Number	Title	Pre-requisite(s)	Co-requisite(s)	Credit Hours
STAT105	Statistical Methods	STAT 100		4
CSC 201	Computer Programming(E)			4
MATH 244	Linear Algebra (E)	MATH 111		3
MATH 207	Advanced Integral and Differential Calculus (E)			3
STAT 215	Probability (1)	STAT 100 +MATH 111		4
Total				18

Level V				
Course Code and Number	Title	Pre-requisite(s)	Co-requisite(s)	Credit Hours
CSC 202	Computer programming using MATLAB (E)	CSC 201		3
STAT 223	Theory of Statistics (1)	STAT 215		3
STAT 328	Statistical Packages (E)	STAT 105		3
	University requirement			2
	University requirement			2
	Optional Course from Group B			3
Total				16

Level VI				
Course Code and Number	Title	Pre-requisite(s)	Co-requisite(s)	Credit Hours
STAT 315	Probability (2) (E)	STAT 215 + MATH 207		3
STAT 319	Theory of Statistics (2) (E)	STAT 222 + MATH 207	STAT 315	3
STAT 333	Nonparametric Statistical Methods	STAT 105		3
STAT 331	Sampling Techniques	STAT 223		3
STAT 332	Regression Analysis	STAT 328 + MATH 244		3
	Optional Course from Group B			3
Total				18

Level VII				
Course Code and Number	Title	Pre-requisite(s)	Co-requisite(s)	Credit Hours
STAT 436	Time Series and Forecasting	STAT 332		3
STAT 437	Design and Analysis of Experiments	STAT 328		3
STAT 438	Multivariate Statistical Methods	STAT 332		3
STAT 497	Graduation Project (1) (E)	STAT 332	STAT 436 + STAT 438	1
	Optional Course from Group A			7
Total				17

Level VIII				
Course Code and Number	Title	Pre-requisite(s)	Co-requisite(s)	Credit Hours
STAT 439	Data Analysis (E)	STAT 436 + STAT 438		3
STAT 441	Quality control	STAT 319		3
STAT 401	Econometric-s (E)	STAT 332		3
STAT 498	Graduation Project (2) (E)	STAT 497		2
	Optional Course from Group A			7
Total				18

Analyzing the Statistics Curriculum

Course Type		Credit Hours		Percentage	
Preparatory Year			31		23 %
University Requirements			8		6 %
Required Courses Inside Dept.	Statistics	53	57	39%	42 %
	Operations Research	4		3%	
Required Courses Outside Dept.	Mathematics*	10	17	7 %	12 %
	Comp. Programming	7		5 %	
Elective Courses Inside Dept.	Statistics and Operations Research		14		10 %
Elective Courses Outside Dept.			9		7 %
Total			136		100%

* In addition to two courses given in the Preparatory Year.

Statistics Courses Description

• Compulsory Requirements from the Department

STAT 100: Introduction to Statistics	Credit hours: 3 (2+0+1)

Descriptive statistics - Measures of central tendency - Measures of dispersion - Basic probability concepts - Conditional probability - Expectation - Variance - Bayes law - Random variables - Probability distribution - Binomial distribution - Poisson distribution - Hypergeometric distribution - Normal distribution - Applications by Excel.

Prerequisite: Math 150 - Co-requisite :None

OPER100: Introduction to Operations Research	Credit hours: 4 (3+0+1)

History and nature of Operations Research - Introduction to system analysis - Problem investigation and formulation - Linear programming models and graphical solutions - Sensitivity analysis - Transportation problem - Assignment problem - Introduction to graph theory and optimization in networks: The shortest path problem - Introduction to stochastic models in Operations Research.

Prerequisite : None - Co-requisite : STAT 100

STAT 105 Statistical Methods	Credit hours: 4 (3+0+1)

Some Statistical distributions - Sampling distributions - Central limit theorem - Chebychev's inequality - Interval estimation - Testing hypotheses (two populations case) - Introduction to experimental designs (CRD and RBD)- Analysis of variance (one and two ways) - Regression (simple) - Correlation (Pearson and Spearman) - Chi square tests and application - Some nonparametric tests.

Prerequisite: STAT 100 - Co-requisite :None

STAT 215: Probability (1)	Credit hours: 4 (3+0+1)

Random variables and probability distributions (Discrete and continuous) - Famous discrete and continuous probability distributions – Random vectors - Expectation and variation - Discrete bivariate probability distributions - Marginal and conditional probability distributions – Independence, correlation and covariance - Moments and moment generating function - Distributions of Function of one and two random variable.

Prerequisite: STAT 100 + MATH 111 - Co-requisite :None

STAT 223: Theory of Statistics (1)	Credit hours: 4 (3+0+1)

Sampling distributions - Central limit theorem - Point Estimation - Properties of estimator: (unbiasedness - mean square error - consistency - sufficiency - minimal sufficiency) - Exponential family - Uniformly Minimum Variance Unbiased estimator - Cramer-Rao inequality - Fisher's information - Rao-Blackwell theorem - sufficiency and completeness - Lehmann-Sheffe theorem - Methods of Estimation: Method of Moments - Maximum Likelihood estimators and their properties including asymptotic properties - The Baysian Approach: Use of a prior density - Bayes estimators - Bayes estimators with mean square error loss function - invariant methods: Location invariant and scale invariant classes of estimators - Interval estimation (one population case): Confidence interval estimators - Pivotal methods - Bayesian credible intervals.

Prerequisite: STAT 215 - Co-requisite :None

STAT 315: Probability (2)	Credit hours: 3 (2+0+1)

Sequence of Events – Continuous random vector - Joint probability distribution - marginal and conditional probability functions - Conditional expectation and variation - Joint probability distributions of functions of random variables - Joint moment generating functions - Order statistics - Probability inequalities - Sequences of random variables and modes of convergences - Central limit theorem and proof - normal approximation.

Prerequisite: STAT 215 + MATH 207 - Co-requisite : STAT 315

STAT 319: Theory of Statistics (2)	Credit hours: 3 (2+0+1)

Interval estimation (two population cases): Confidence interval estimators, Pivotal methods - Hypotheses Testing: Type I and Type II error, power of the tests - Most powerful test, Neymann-pearson lemma, asymptotic tests - unbiased test - uniformly most powerful test. Monotone tests – Neymann Pearson theorem - power curves - Likelihood ratio tests - asymptotic distribution of likelihood ratio statistics - The Sequential Probability Ratio Test - Goodness of-fit Tests - Bayesian testing hypotheses

Prerequisite: STAT 223 and MATH 207 - Co-requisite : None

STAT 328: Statistical Packages	Credit hours: 3 (2+0+1)

Using program code in a statistical software package (Excel – Minitab – SAS – SPSS - R - Maple - Matlab) to write a program for data and statistical analysis. Topics include creating and managing data files - graphical presentation - and Monte Carlo simulations.

Prerequisite: STAT 105 - Co-requisite :None

STAT 333: Nonparametric Statistical Methods	Credit hours: 3 (2+0+1)

Concept of nonparametric statistics -Statistical tests based on the binomial distribution (binomial test and estimation of ratio - quantile test - tolerance limits) - Contingency tables in (median tests - measures of dependence - chi-square tests - Cochran test for related observations) - Some nonparametric tests that depend on ranks (two independent samples -several independent samples - test for equal variances - measures of rank correlations-nonparametric regression methods - several related samples - tests of randomization) -Tests of the Kolmogorov-Smirnov type (the Kolmogorov goodness of fit tests - goodness of fit tests for families of distributions).

Prerequisite: STAT 105 - Co-requisite :None

STAT 331: Sampling Techniques	Credit hours : 3 (2+0+1)

Definition of Population and sample - Types of surveys - sampling methods - Parameters estimation- Estimation of (population mean - Estimation of population ratios - Population total). Confidence intervals for population parameters - Selecting the sample size for estimating population mean and total number.

Prerequisite: STAT 223 - Co-requisite :None

STAT 332: Regression Analysis	Credit hours : 3 (2+0+1)

Simple linear regression model - Multiple linear regression - Analysis of residuals and predictions. - Stepwise regression - Some nonlinear regression models and data transformations - Student will use statistical computer packages such as SAS - SPSS - Minitab - …etc.

Prerequisite: STAT 328 + MATH 244 - Co-requisite :None

STAT 401: Econometrics	Credit hours : 3 (3+0+0)

Simple and Multiple regression models - Non-Linear regression models - Dummy Variables - Multicollinearity Problem-Identification Errors - Generalized Least Square Method – Heteroscedasticity Problem - Autocorrelation Problem - Time series models - Simultaneous Equations - Errors in variables.

Prerequisite: STAT 332 - Co-requisite :None

STAT 436: Time Series and Forecasting	Credit hours : 3 (2+0+1)

Data sources: Historical data - the Web - Checking time series components: trend – seasonality – cyclica - Transformation: Differences method - Seasonal adjustment - Forecasting: How to forecast the future - adequacy of a forecast - regression forecasting against time series forecasting - some adequacy measures (MAD - MSE - MAPE) -Decomposition and smoothing of times series: moving averages - exponential smoothing. Box-Jenkins models ARIMA(p -d -q): Autocorrelation and partial autocorrelation functions - identification of appropriate model - dealing with seasonal time series - fitting models to real and simulated data sets. Diagnostic checks on the residuals. Case studies: training on how to analyze real life data sets using the statistical package MINITAB - write reports.

Prerequisite: STAT 332 - Co-requisite :None

STAT 437: Design and Analysis of Experiments	Credit hours : 3 (2+0+1)

Introduction: Review of statistical inference. Main principals of experimental design: Replication – Randomness – Blocks – Simple comparisons experiments: t-test and alike tests. Single Factor Experiments: Completely randomized design – Model adequacy checking – Contrasts and orthogonal contrasts – Comparing pairs of treatment means. Block designs: Randomized complete block design – Latin square design – Graeco-Latin square design. Factorial designs: Two-Factor factorial design – Three-Factor factorial design – General factorial designs. Designs with two-level factors: Two factors with two levels designs – Three factors with two levels designs – General two-level factors designs. Confounding. Fractional factorial designs.

Prerequisite: STAT 328 - Co-requisite :None

STAT 438: Multivariate Statistical Methods	Credit hours : 3 (2+0+1)

Matrix algebra and Random Vector - The multivariate normal distribution -Inferences about a Mean vector - Hotelling's T and comparisons of several multivariate Means – MANOVA (One and two way) - Principle components -- Discrimination and classification Application using computer packages. SAS-SAS/IML -SPSS – Minitab.

Prerequisite: STAT 332 - Co-requisite :None

STAT 439: Data Analysis	Credit hours : 3 (2+0+1)

Introduction to Data Analysis. Introduction to software. Introduction to types of Data: study of qualitative and quantitative variable. Graphical representation of data. Sample studies for paired data. Correlation for qualitative and quantitative data. ANOVA - Regression Analysis: Logistic regression. K means - Time series Analysis.
Remark: This course is based on SAS or SPSS or MINITAB.

Prerequisite: STAT 436 + STAT 438 - Co-requisite :None

STAT 441: Quality Control	Credit hours : 3 (2+0+1)

Historical background of Quality Control - What is Quality? - the formation of Quality Control - Quality Planning - Quality Improvement - Quality Assurance and Total Quality Management - Modeling Process Quality - Review of statistical distributions used in Quality Control - Statistical inference and test of hypotheses - Statistical Process Control (SPC) - Magnificent Seven - Introduction of Control Charts - Statistical process in Quality Improvement - Pareto Chart - Cause and Effect Diagram - Scatter Diagram - Types of control charts - Control Charts for Variables - Process Capability Ratios - Process Capability Cpk - Control Charts for Attribute data - Acceptance Sampling - Operating Characteristic Curve.

Prerequisite: STAT 319 - Co-requisite :None

STAT 497: Graduation Project (1)	Credit hours : 1 (1+0+0)

Recognition of the problem (chosen from real - world problems) under study. Gathering of references and collection of data for problem investigation under the supervision of a Faculty Member.

Prerequisite: STAT 332 - Co-requisite : STAT 436 + STAT 438

STAT 498: Graduation Project (2)	Credit hours : 2 (2+0+0)

The student builds and solves the model of the problem previously investigated in STAT 498 under the supervision of a Faculty Member.

Prerequisite: STAT 497 - Co-requisite : None

Compulsory Requirements from other Departments:

MATH 111:Integral Calculus	Credit hours : 4 (3+0+1)

Definition of Definite Integral and its Properties - The Anti-derivative - Indefinite Integral and the Fundamental Theorem of Calculus. Change of Variables. Integrals of natural and general exponential functions. Integrals of natural and general Logarithmic functions. Derivatives and Integrals of Hyperbolic and Inverse-Hyperbolic functions. Techniques of Integration: by parts - Trigonometric substitutions - Completing the square - Integrals of rational functions - Miscellaneous Substitutions. Indeterminate forms - Improper Integrals. Applications of Integration: Area - Solids of Revolutions - Arc length and Surface of Revolution - Linear Motion - Work - Momentum and Center of Mass. Numerical Integration. Polar coordinates - relation between polar and Cartesian coordinates - Graphs of polar curves - Area in polar coordinates. Parametric Equations.

Prerequisite: MATH 150 - Co-requisite : None

MATH 207: Advanced Differential and Integral Calculus	Credit hours : 3 (3+0+0)

Cartesian coordinates - Functions of two or several variables - limits and continuity - partial derivatives - Chain rule - Maxima and minima for functions of two and several variables - Lagrange multipliers - Double integrals and their applications - Triple integrals and their applications - Sequences - Infinite series - Geometric Series - Convergence tests - Alternative series - Absolute Convergence - Conditional Convergence - Functions representation by power series - Taylor' series - Maclaurin' series - Binomial series - First Order differential equations.

Prerequisite: MATH 111 - Co-requisite : None

MATH 244: Linear Algebra	Credit hours : 3 (2+0+1)

Matrices and their operations - Types of matrices. Elementary transformations. Determinants - Elementary properties. Inverse of a matrix. Linear systems of equations. Vector spaces - linear independence - Finite dimensional spaces - linear subspaces. Inner product spaces. Linear transformations - Kernel and image of a liner transformation. Eigen values and Eigen vectors of a matrix and of a linear operator.

Prerequisite: MATH 111 - Co-requisite : None

CSC 201:Computer Programming	Credit hours : 4 (3+0+1)

Introduction: Introduction to C programming - Structured program development - Program control - Functions - Recursion. Arrays - Pointers. Strings - Structures and enumerations - File processing - Data structures.

Prerequisite: None - Co-requisite : None

CSC202:Computer Programming Using MATLAB	Credit hours : 3 (2+0+1)

Interacting with MATLAB - Program design and algorithm development - M-files - Designing GUI (graphical user interface) - Calculus with MATLAB - Vectors and Matrices - Strings - Functions - 2-D and 3-D graphics - MATLAB programming - Data analysis operations - Errors - Applications: (randomness - simulation - Markov process - linear equations - some numerical methods) - integrating MATLAB based algorithms with external applications and languages such as C - C++ - Fortran - Java - COM - and Microsoft Excel.

Prerequisite: CSC 201 - Co-requisite : None

Elective Courses

STAT 231: Population Study "Demography"	Credit hours : 2 (2+0+0)

Introduction - The Nature of Demography - Rates and Ratios - Relative numbers - The use of ratios in demography - Vital statistics rates - Types of ratios - Sex ratio - Child-Woman ratio - Territorial distribution - Density of population - The rate of population growth - Crude birth and death rate - Age-Specific death rate - Infant death rate - Age-Specific birth rate - General fertility ratio - Total fertility rate - Gross reproduction rate - Accuracy and Error - Life Tables - The smoothing of data. - The Study of Mortality - Measurement of Fertility - Growth of Population - Migration and the Distribution of Population.

Prerequisite: STAT 100 - Co-requisite : None

STAT 325: Decision Theory	Credit hours : 3 (3+0+0)

The elements of making decision problem without data: Utility - Actions Space - State of nature space - Pure actions - MinMax and Bayes actions - MinMax mixed actions - Using data for making decisions (Decision Rule) - MinMax pure and mixed decision rules - Bayes decision rule - Estimation as a decision problem: for instance Bayes Estimate - Testing hypothesis as a decision problem: for instance - Most powerful - MinMax and Bayes tests - Comparing tests.

Prerequisite: STAT 223 - Co-requisite : None

STAT 362: Reliability Theory	Credit hours : 3 (3+0+0)

Concept of reliability - Structural properties of coherent systems - Reliability of coherent systems - Joint Structural and Reliability importance - Some parametric lifetime models (continuous and discrete) - Classes of lifetime distributions (notions of aging) - Reliability operation - Specialized models (competing risks - accelerated models - ..) - Life data analysis.

Prerequisite: STAT 223 - Co-requisite : None

STAT 399: Longitudinal of Data Analysis	Credit hours : 3 (3+0+0)

Exploring longitudinal data - Analysis of variance for repeated measures - Single-Group Repeated Measures - Crossover Designs and Parallel Group - General Linear Mixed Models - Generalized Linear Models for Longitudinal Data - MLE and Restricted/Residual Maximum Likelihood Estimation (REML) - Multilevel Models; Using GLM - MIXED and GENMOD in SAS.

Prerequisite: STAT 332 - Co-requisite : None

STAT 406: Survival Analysis	Credit hours : 3 (3+0+0)

Description of survival distributions - Survival and hazard function - Their relationship - Problems of inference - Estimation and comparison of survival curves (Kaplan-Meier and life-table estimates - …) - Estimation under complete and censored data (typre I - type II - progressive - …) - Hypothesis testing - Life testing - Parametric regression models - Cox proportional models.

Prerequisite: STAT 223 - Co-requisite : None

STAT 430: Insurance Methods	Credit hours : 3 (2+0+1)

Survival Distributions: Future lifetime - Life tables; fundamental theorems for calculating moments of actuarial functions - Other actuarial functions; 3 assumptions for fractional ages; analytical laws of mortality - Net Single Premiums for Life Insurance Contracts: Definition using a stochastic approach - distribution of the actuarial - present value function for different insurance contracts - Life Annuities: Actuarial accumulation function; aggregate payment and current payment techniques - life annuities with monthly payments - complete annuities (immediate) - apportionable annuities (due) - recursive equations - Net Annual Premiums: Actuarial equivalence principle; basic contracts; monthly premiums; life insurance with accumulation type benefits - Reserves: Definition of prospective loss - basic contracts - monthly premiums reserves: recursive equations for discrete reserves - reserves at fractional durations - allocation of the loss to the policy years.

Prerequisite: STAT 319 - Co-requisite : None

STAT 432: Survey Research	Credit hours : 2 (2+0+0)

Research Methodology (Choosing Research Problems and Methods) - Ethical issues in scientific research - An introduction to Survey Methodology - Inference and Error in Surveys - Research problem - goals - questions - and hypotheses for quantitative and qualitative studies - Target Population - Sampling frames - Coverage - Sampling Design and Sampling Error - Non-response in Sampling surveys - Data Collection Methods - Types of Variables - Data and Measures - Method of Data Collection - Computerized Data: Description and Analysis

Prerequisite: STAT 331 - Co-requisite : None

STAT 434: Linear Models	Credit hours : 3 (3+0+0)

Review of necessary concepts of Matrix Algebra - Normal distribution with n-variables - Quadratic forms and their distributions - The general linear model of full rank - Estimation and hypothesis testing in the full rank model - Estimation and hypothesis testing in the less than full rank model - Computational Methods - Applications in regressions - experimental design and ANOVA using statistical packages.

Prerequisite: STAT 332 + MATH 244 - Co-requisite : None

OPER 213: Linear Programming	Credit hours : 4 (3+0+1)

Definitions and formulation of linear programs - Graphical solution - Review of linear algebra and convex analysis - Algebra of the simplex method - The simplex method - The revised simplex method - Duality theory and economic interpretation of duality - Sensitivity analysis - Some applications of linear programming

Prerequisite: OPER 100 + MATH 244 - Co-requisite : MATH 244

OPER 322: Inventory Control	Credit hours : 3 (2+0+1)

Definitions and models of inventory control - The simple economic order quantity (EOQ) model - The EOQ model with shortages - The economic production quantity (EPQ) model - The (EPQ) model with shortages - Single or multiple items constrained inventory control models - Some dynamic inventory control models with deterministic or probabilistic demand - Inventory control models with continuous demand rate - Some probabilistic inventory control models.

Prerequisite: OPER 213 and MATH 207 - Co-requisite : None

OPER 351: Network Analysis	Credit hours : 3 (2+0+1)

Introduction to Graph theory - Network models - Mathematical formulation of network problems - Shortest path problem: Bellman algorithm, Dijkstra's algorithm, Bellman-Ford algorithm - Maximum Flow Problem: Ford and Fulkerson algorithm, Max-flow min-cut theorem - Minimum cost flow problem - Project scheduling: CPM and PERT

Prerequisite: OPER 213 and CSC 202 - Co-requisite : None

OPER 441: Modeling and Simulation	Credit hours : 4 (3+0+1)

Random number generators - Monte Carlo techniques - Simulation design - Input modeling - Model validation - Analysis of simulation output - Evaluation of alternatives - Applications to various operations research models using simulation languages such as SLAM, GPSS and Arena.

Prerequisite: STAT 215 and CSC 202 - Co-requisite : None

OPER 472: Stochastic Processes and Queuing Models	Credit hours : 4 (3+0+1)

Definition of stochastic processes - Finite Markov chains - One step and multi-steps transition probability matrices - Chapman-Kolmogorof equation. State classification. Long run distribution of Markov chains - Continuous-time Markov processes (Birth-and-death processes, Poisson process) - Queuing theory and models: Cumulative diagrams of queues. Performance measures - Basic Markovian queuing models (single server queue, multi-server queue, finite capacity queues) - Some Non-Markovian queues - Some Non-Markovian queues with bulk arrival and service.

Prerequisite: OPER 213 and STAT 215 - Co-requisite : None

Bachelor's Degrees

• Bachelor's Degree of Science in Operations Research

The study plan for the Department of Statistics and Operations Research
Specialization: Operations Research
Degree: Bachelor of Science

Preparatory Year (31 credit hours)				
Course Code and Number	Title	Credit Hours	Pre-requisite(s)	Co-requisite(s)
ENG 140	English Language 1	8		
ENG 150	English Language 2	8		
MATH 140	Introduction to Mathematics	2		
MATH 150	Differential Calculus	3		
CT 140	Computer Skills	3		
CI 140	Learning, Thinking and Research Skills	3		
CHS 150	Health and Fitness	1		
ENT 101	Entrepreneurship	1		
MC150	Communication Skills	2		
Total		31		

University requirements (8 credits hours)
The student selects 8 credits hours from the Islamic Culture courses

Compulsory Requirements from the Department (59 credits)				
Course Code and Number	Title	Credit Hours	Pre-requisite(s)	Co-requisite(s)
OPER 100	Introduction to Operations Research	4	MATH 150	STAT 100
OPER 213	Linear Programming	4	OPER 100	MATH 244
OPER 322	Inventory Control	3	OPER 213 + MATH 207	
OPER 331	Non-Linear Optimization	4	OPER 213 + MATH 207	
OPER 351	Network Analysis	3	OPER 213 + CSC 202	
OPER 382	Decision and Game Theory	4	OPER 213	
OPER 435	Numerical Methods in Operations Research (E)	3	OPER 331 + OPER 351	
OPER 441	Modeling and Simulation (E)	4	STAT 215 + CSC 202	
OPER 472	Stochastic Processes and Queuing Theory (E)	4	OPER 213 + STAT 215	
OPER 497	Graduation Project (1) (E)	1	OPER 351	OPER 435OPER 441OPER 472
OPER 498	Graduation Project (2) (E)	2	OPER 497	
STAT 100	Introduction to Statistics	3	MATH 150	
STAT 105	Statistical Methods (E)	4	STAT 100	
STAT 215	Probability (1)	4	STAT 100 + MATH 111	
STAT 223	Theory of Statistics (1)	3	STAT 215	
STAT 328	Statistical Packages (E)	3	STAT 105	
STAT 332	Regression Analysis	3	STAT 328 + MATH 244	
STAT 436	Time Series and Forecasting	3	STAT 332	
Total		59		

Compulsory Requirements from other Departments (17 credits)				
Course Code and Number	Title	Credit Hours	Pre-requisite(s)	Co-requisite(s)
MATH 111	Integral Calculus (E)	4	MATH 150	
MATH 207	Advanced Integral and Differential Calculus (E)	3	MATH 111	
MATH 244	Linear Algebra (E)	3	MATH 111	
CSC 201	Computer Programming (E)	4		
CSC 202	Computer Programming using MATLAB (E)	3	CSC 201	
Total		17		

Elective Requirements From the Department (12 credit hours) Group A (The student selects 4 courses one of which should be an Operations Research course)				
Course Code and Number	Title	Credit Hours	Pre-requisite(s)	Co-requisite(s)
OPER 313	Integer Programming	3	OPER 213	
OPER 453	Scheduling and Sequencing (E)	3	OPER 213	
OPER 490	Special Applications in Operations Research (E)	3	OPER 331 + OPER 351	
OPER 492	Prices and Revenue Management (E)	3	OPER 331 + STAT 215	
STAT 315	Probability (2) (E)	3	STAT 215 + MATH 207	
STAT 319	Theory of Statistics (2) (E)	3	STAT 223 + MATH 207	STAT 315
STAT 325	Decisions Theory (E)	3	STAT 223	
STAT 333	Nonparametric Statistical Methods	3	STAT 105	
STAT 331	Sampling Techniques	3	STAT 223	
STAT 362	Reliability Theory	3	STAT 223	
STAT 401	Econometrics (E)	3	STAT 332	
STAT 430	Insurance Methods (E)	3	STAT 319	
STAT 434	Linear Models	3	MATH 244	
STAT 437	Design and Analysis of Experiments	3	STAT 328	
STAT 441	Quality Control	3	STAT 319	

Elective Requirements From other Departments Group B (The student selects 9 credit hours from this group)				
Course Code and Number	Title	Credit Hours	Pre-requisite(s)	Co-requisite(s)
MATH 160	Computational Mathematics	2	CT 140 + MATH 111	
MATH 225	Introduction to Differential Equations	4	MATH 207	
MATH 352	Numerical Analysis	4	MATH 160 + MATH 244	
MATH 382	Real Analysis (1)	4	MATH 207	
MGT 101	Principles of Management and Business	3		
MGT 102	Human Resources Management	3	MGT 101	
MGT 103	Entrepreneurship	3	MGT 101	
MGT 104	Principles of Public Administration	3		
MGT 319	Management of Small and Medium Size Businesses	3	MGT 101	
MGT 371	Operations Management	3	MGT 101	
MIS 201	Management Information Systems	3	MGT 101	
ACCT 201	Principles of Accounting and Financial Reporting	3		
ACCT 202	Principles of Cost Managerial Accounting	3	ACCT 201	

Elective Requirements From other Departments Group B (The student selects 9 credit hours from this group)				
Course Code and Number	Title	Credit Hours	Pre-requisite(s)	Co-requisite(s)
ACCT 311	Accounting for Government and Non-Profit Organizations	3	ACCT 201	
ACCT 317	Intermediate Accounting (1)	3	ACCT 201	
ACCT 318	Intermediate Accounting (2)	3	ACCT 317	
ECON 101	Principles of Microeconomics	3		
ECO N 102	Principles of Macroeconomics	3	ECON 101	
ECO N 201	Microeconomics Analysis	3	ECON 102	
ECON 202	Macroeconomics Analysis	3	ECON 102	
ECON 211	Money and Banking	3	ECON 102	
ECON 314	Islamic Economics	3	ECON 102	
ECON 317	Managerial Economics	3	ECON 102	
ECON 318	Transportation and Insurance Economics	3	ECON 102	
MKT 201	Principles of Marketing	3	MGT 101 + Econ 101	
FIN 200	Principles of Finance	3	ACCT 201	
FIN 210	Corporate Finance	3	FIN 200	
FIN 220	Investment Essentials	3	FIN 200	
FIN 230	Financial markets and institutions	3	FIN 200	
FIN 240	Principles of Risk & Insurance	3	FIN 200	
FIN250	International Finance	3	FIN 200	
QUA 127	Mathematics of Finance	3	MATH 140	

Recommended Study Plan

Level I				
Course Code and Number	Title	Pre-requisite(s)	Co-requisite(s)	Credit Hours
ENG 140	English Language (1)			8
MATH 140	Introduction to Mathematics			2
CI 140	Learning, Thinking and Research Skills			3
CHS 150	Health and Fitness			1
ENT 101	Entrepreneurship			1
Total				15

Level II				
Course Code and Number	Title	Pre-requisite(s)	Co-requisite(s)	Credit Hours
ENG 150	English Language (2)			8
MATH 150	Differential Calculus			3
CT 140	Computer Skills			3
MC 150	Communica-tion Skills			2
Total				16

Level III				
Course Code and Number	Title	Pre-requisite(s)	Co-requisite(s)	Credit Hours
OPER100	Introduction to Operations Research	MATH 150	STAT 100	4
STAT 100	Introduction to Statistics			3
MATH 111	Integral Calculus (E)	MATH 150		4
CSC 201	Computer Programming (E)			4
	University Requirement			2
Total				17

Level IV				
Course Code and Number	Title	Pre-requisite(s)	Co-requisite(s)	Credit Hours
OPER 213	Linear Programming	OPER 100	MATH 244	4
STAT 105	Statistical Methods (E)	STAT 100		4
MATH 244	Linear Algebra (E)	MATH 111		3
CSC 202	Computer Programming Using MATLAB (E)	CSC 201		3
	University requirement			2
	University requirement			2
Total				18

Level V				
Course Code and Number	Title	Pre-requisite(s)	Co-requisite(s)	Credit Hours
OPER 351	Network Analysis	OPER 213+ MATH 207		3
OPER 382	Decision and Game Theory	OPER 213		4
STAT 215	Probability (1)	STAT 100+ MATH 111		4
STAT 328	Statistical Packages	STAT 105		3
MATH 207	Advanced Integral and Differential Calculus (E)	MATH 111		3
Total				17

Level VI				
Course Code and Number	Title	Pre-requisite(s)	Co-requisite(s)	Credit Hours
OPER 322	Inventory Control	OPER 213 + MATH 207		3
OPER 331	Non-Linear Optimization	OPER 213+ MATH 207		4
STAT 223	Theory of Statistics (1)	STAT 215		3
STAT 332	Regression Analysis	STAT 328 + MATH244		3
	Optional courses outside the Department			3
	University Requirement			2
Total				18

Level VII				
Course Code and Number	Title	Pre-requisite(s)	Co-requisite(s)	Credit Hours
OPER 435	Numerical Methods in Operations Research (E)	231 OPER + OPER 351		3
OPER 441	Modeling and Simulation (E)	STAT 215 + CSC 202		4
OPER 472	Stochastic Processes and Queuing Theory (E)	OPER 213 + STAT 215		4
OPER 497	Graduation Project (1) (E)	OPER 351	OPER 435 + OPER 441 + OPER 472	1
	Optional courses within the Department			3
	Optional courses outside the Department			3
Total				18

Level VIII				
Course Code and Number	Title	Pre-requisite(s)	Co-requisite(s)	Credit Hours
OPER 498	Graduation Project (2) (E)	OPER 497		2
STAT 436	Time Series and Forecasting	STAT 332		3
	Optional courses within the Department			3
	Optional courses within the Department			3
	Optional courses within the Department			3
	Optional courses outside the Department			3
Total				17

Analyzing the Operations Research Curriculum

Course Type		Credit Hours		Percentage	
Preparatory Year			31		23%
University Requirements			8		6%
Required Courses Inside Dept.	Operations Research	36	59	26%	43%
	Statistics	23		17%	
Required Courses Outside Dept.	Mathematics*	10	17	7%	12%
	Comp. Programming	7		5%	
Elective Courses Inside Dept.	Operations Research	12	12		9%
	Statistics	30			
Elective Courses Outside Dept.			9		7%
Total			136		100%

* In addition to two courses given in the Preparatory Year.

Operations Research Courses Description

• Compulsory Courses from the Department:

OPER 100: Introduction to Operations Research	Credit hours : 4 (3+0+1)

History and nature of Operations Research. Introduction to system analysis. Problem investigation and formulation. Linear programming models and graphical solutions . Sensitivity analysis. Transportation problem. Assignment problem. Introduction to graph theory and optimization in networks: The shortest path problem. Introduction to stochastic models in operations research.

Prerequisite: MATH 150 - Co-requisite : STAT 100

OPER 213: Linear Programming	Credit hours : 4 (3+0+1)

Definitions and formulation of linear programs. Graphical solution. Review of linear algebra and convex analysis. Algebra of the simplex method. The simplex method. The revised simplex method. Duality theory and economic interpretation of duality. Sensitivity analysis. Some applications of linear programming

Prerequisite: OPER 100 - Co-requisite : MATH 244

OPER 322: Inventory Control	Credit hours : 3 (2+0+1)

Definitions and models of inventory control. The simple economic order quantity (EOQ) model. The EOQ model with shortages. The economic production quantity (EPQ) model. The (EPQ) model with shortages. Single or multiple items constrained inventory control models. Some dynamic inventory control models with deterministic or probabilistic demand. Inventory control models with continuous demand rate. Some probabilistic inventory control models.

Prerequisite: OPER 213 and MATH 207 - Co-requisite : None

OPER 331: Nonlinear Optimization	Credit hours : 4 (3+0+1)

Models of nonlinear optimization. Basic concepts of optimization. Optimality conditions for unconstrained problems. Optimality conditions for constrained problems: Lagrange Multipliers, KKT conditions. Quadratic Programming: Wolf's method. Computational methods for unconstrained problems: Optimal search algorithms for univariate and multivariate problems. Computational methods for constrained problems: Graphical method, Feasible directions methods, Gradient projection methods, Penalty and Barrier function methods.

OPER 213 and MATH 207 - Co-requisite : None

OPER 351: Network Analysis	Credit hours : 3 (2+0+1)

Introduction to Graph theory. Network models. Mathematical formulation of network problems. Shortest path problem: Bellman algorithm, Dijkstra's algorithm, Bellman-Ford algorithm. Maximum Flow Problem: Ford and Fulkerson algorithm, Max-flow min-cut theorem. Minimum cost flow problem. Project scheduling: CPM and PERT.

Prerequisite : OPER 213 and CSC 202 - Co-requisite : None

OPER 382: Decision and Game Theory	Credit hours : 4 (3+0+1)

Introduction to Decision theory. Utility and expected utility. Decision under risk seeking and risk averse. Dynamic Programming (Principle of Optimality, Dynamic Programming and Decision Theory, various applications). Concepts and terminology of Game theory. Zero sum games. Solutions of two persons zero sum games. Two persons nonzero sum games. Solutions of two persons nonzero sum games. N-person games

Prerequisite : OPER 213 - Co-requisite : None

OPER 435: Computational Methods in Operations Research	Credit hours : 3 (2+0+1)

This course provides a comprehensive introduction to the standard numerical techniques commonly used in obtaining solutions to operations research problems such as: Solving single variable equations and multi-variable equations. Numerical integration. Solving differential equations. Solving systems of nonlinear equations. Iterative techniques in matrix algebra. Implementation of numerical techniques for solving various types of problems using computing software.

Prerequisite : OPER 331 and OPER 351 - Co-requisite : None

OPER 441: Modeling and Simulation	Credit hours : 4 (3+0+1)

Random number generators. Monte Carlo techniques. Simulation design. Input modeling. Model validation. Analysis of simulation output. Evaluation of alternatives. Applications to various operations research models using simulation languages such as SLAM, GPSS and Arena.

Prerequisite : STAT 215 and CSC 202 - Co-requisite : None

OPER 472: Stochastic Processes and Queuing Models	Credit hours : 4 (3+0+1)

Definition of stochastic processes. Finite Markov chains. One step and multi-steps transition probability matrices. Chapman-Kolmogorof equation. State classification. Long run distribution of Markov chains. Continuous-time Markov processes (Birth-and-death processes, Poisson process). Queuing theory and models: Cumulative diagrams of queues. Performance measures. Basic Markovian queuing models (single server queue, multi-server queue, finite capacity queues). Some Non-Markovian queues. Some Non-Markovian queues with bulk arrival and service

Prerequisite : OPER 213 and STAT 215 - Co-requisite : None

OPER 497: Graduation Project (1)	Credit hours : 1 (1+0+0)

Recognition of the problem, chosen from real - world problems, under study. Gathering references and collecting data needed to investigate the problem under the supervision of a faculty member.

Prerequisite : OPER 351 - Co-requisite : OPER 435, OPER 441, and OPER 472

OPER 498: Graduation Project (2)	Credit hours : 2 (2+0+0)

Under the supervision of a faculty member, the student studies and models a solution to the problem previously investigated in OPER 497, and presents a report of his work.

Prerequisite : OPER 497 - Co-requisite : None

STAT 100: Introduction to Statistics	Credit hours : 3 (2+0+1)

Descriptive statistics - Measures of central tendency - Measures of dispersion - Basic probability concepts - Conditional probability, Expectation - Variance - Bayes law- Random variables - Probability distribution - Binomial distribution - Poisson distribution - Hypergeometric distribution - Normal distribution – Applications by Excel.

Prerequisite : MATH 150 - Co-requisite : None

STAT 105: Statistical Methods	Credit hours : 4 (3+0+1)

Some Statistical distributions - Sampling distributions - Central limit theorem - Chebychev's inequality - Interval estimation - Testing hypotheses (two populations case) - Introduction to experimental designs (CRD and RBD)- Analysis of variance (one and two ways) - Regression (simple) - Correlation (Pearson and Spearman) - Chi square tests and application - Some nonparametric tests.

Prerequisite : STAT 100 - Co-requisite : None

STAT 215: Probability (1)	Credit hours : 4 (3+0+1)

Random variables and probability distributions (Discrete and continuous) - Famous discrete and continuous probability distributions – Random vectors - Expectation and variation - Discrete bivariate probability distributions - Marginal and conditional probability distributions - Independence, correlation and covariance - Moments and moment generating function - Distributions of Function of one and two random variable

Prerequisite : STAT 100 and MATH 111 - Co-requisite : None

STAT 223: Theory of Statistics (1)	Credit hours : 4 (3+0+1)

Sampling distributions - Central limit theorem - Point Estimation - Properties of estimator: unbiasedness, mean square error, consistency, sufficiency, minimal sufficiency - Exponential family - Uniformly Minimum Variance Unbiased Estimator - Cramer-Rao inequality - Fisher's information - Rao-Blackwell theorem - Sufficiency and Completeness - Lehmann-Sheffe theorem - Methods of Estimation: Method of Moments - Maximum Likelihood estimators and their properties including asymptotic properties - The Baysian Approach: Use of a prior density - Bayes estimators - Bayes estimators with mean square error loss function - invariant methods: Location invariant and scale invariant classes of estimators - Interval estimation (one population case): Confidence interval estimators, Pivotal methods - Bayesian credible intervals.

Prerequisite : STAT 215 - Co-requisite : None

STAT 319: Theory of Statistics (2)	Credit hours: 3 (2+0+1)

Interval estimation (two population cases): Confidence interval estimators, Pivotal methods - Hypotheses Testing: Type I and Type II error, power of the tests - Most powerful test, Neymann-pearson lemma, asymptotic tests - unbiased test - uniformly most powerful test. Monotone tests – Neymann Pearson theorem - power curves - Likelihood ratio tests - asymptotic distribution of likelihood ratio statistics - The Sequential Probability Ratio Test - Goodness of-fit Tests - Bayesian testing hypotheses

Prerequisite: STAT 223 and MATH 207 - Co-requisite : None

STAT 328: Statistical Packages	Credit hours : 3 (2+0+1)

Using program code in a statistical software package (Excel – Minitab – SAS – SPSS - R - Maple - Matlab) to write a program for data and statistical analysis. Topics include creating and managing data files, graphical presentation - and Monte Carlo simulations.

Prerequisite : STAT 105 - Co-requisite : None

STAT 332: Regression Analysis	Credit hours : 3 (2+0+1)

Simple linear regression model - Multiple linear regression - Analysis of residuals and predictions. - Stepwise regression - Some nonlinear regression models and data transformations - Student will use statistical computer packages such as SAS, SPSS, Minitab, etc.

Prerequisite : STAT 328 and MATH 244 - Co-requisite : None

STAT 436: Time Series and Forecasting	Credit hours : 3 (2+0+1)

Data sources: Historical data - the Web. Checking time series components: trend, seasonality, cyclical. Transformation: Differences method - Seasonal adjustment - Forecasting: How to forecast future - adequacy of a forecast - regression forecasting against time series forecasting - some adequacy measures (MAD, MSE, MAPE) - Decomposition and smoothing of times series: moving averages - exponential smoothing. Box-Jenkins models ARIMA(p,d,q): Autocorrelation and partial autocorrelation functions - identification of appropriate model - dealing with seasonal time series - fitting models to real and simulated data sets. Diagnostic checks on the residuals. Case studies: training on how to analyze real life data sets using the statistical package MINITAB - write reports.

Prerequisite : STAT 332 - Co-requisite : None

MATH 140: Introduction to Mathematics	Credit hours : 2 (2+0+0)

Linear equations and applications - linear inequalities - Absolute value in equations and inequalities - Complex numbers - Quadratic equations and applications – Functions - Odd and even functions - Operations on functions - Inverse functions - Exponential and logarithmic functions - Trigonometric functions - Conic sections - systems of equations and inequalities – Matrices - Matrix operations.

Prerequisite : None - Co-requisite : None

MATH 150 : Differential Calculus	Credit hours : 3 (3+0+0)

The concept of limit, computation of limits, continuity and its consequences, limits involving infinity, formal definition of limit, the concept of derivative, computation of derivatives (power rule, higher order derivatives, acceleration), the product and quotient rules, the chain rule, derivatives of exponential and logarithmic functions, implicit differentiation and inverse trigonometric functions, the mean value theorem, indeterminate forms and L'Hopital's rule, maximum and minimum values, increasing and decreasing functions, concavity and the second derivative test, optimization, related rates.

Prerequisite : None - Co-requisite : None

MATH 111: Integral Calculus	Credit hours : 4 (3+0+1)

Definition of Definite Integral and its Properties, The Anti-derivative, Indefinite Integral and the Fundamental Theorem of Calculus. Change of Variables. Integrals of natural and general exponential functions. Integrals of natural and general Logarithmic functions. Derivatives and Integrals of Hyperbolic and Inverse-Hyperbolic functions. Techniques of Integration: by parts, Trigonometric substitutions, Completing the square, Integrals of rational functions, Miscellaneous Substitutions. Indeterminate forms, Improper Integrals. Applications of Integration: Area, Solids of Revolutions, Arc length and Surface of Revolution, Linear Motion, Work, Momentum and Center of Mass. Numerical Integration. Polar coordinates, relation between polar and Cartesian coordinates, Graphs of polar curves, Area in polar coordinates. Parametric Equations.

Prerequisite : MATH 150 - Co-requisite : None

MATH 207: Advanced Differential and Integral Calculus	Credit hours : 3 (2+0+1)

Cartesian coordinates, functions of two or several variables, limits and continuity, partial derivatives, chain rule, maxima and minima for functions of two and several variables, Lagrange multipliers, double integrals and their applications, triple integrals and their applications, sequences, infinite series, geometric series, convergence tests, alternative series, absolute convergence, conditional convergence, functions representation by power series, Taylor' series, Maclaurin' series, Binomial series, first order differential equation

Prerequisite : MATH 111 - Co-requisite : None

MATH 244: Linear Algebra	Credit hours : 3 (3+0+0)

Matrices and their operations, types of matrices. Elementary transformations. Determinants, elementary properties. Inverse of a matrix. Linear systems of equations. Vector spaces, linear independence, finite dimensional spaces, linear subspaces. Inner product spaces. Linear transformations, kernel and image of a linear transformation. Eigen values and Eigen vectors of a matrix and of a linear operator.

Prerequisite : MATH 111 - Co-requisite : None

CSC 201: Computer Programming	Credit hours : 4 (3+0+1)

Introduction to computer programming, algorithms, variables and data types, concepts of object oriented programming, classes, objects and methods, basic control structures (sequence, if /else, looping), arrays , strings, file processing, interfaces, inheritance and polymorphism, GUI (graphical user interface).

Prerequisite : None - Co-requisite : None

CSC 202: Computer Programming Using MATLAB	Credit hours : 3 (2+0+1)

Interacting with MATLAB, program design and algorithm development, M-files, designing GUI (graphical user interface), calculus with MATLAB, vectors and matrices, strings, functions, 2-D and 3-D graphics, MATLAB programming, data analysis operations, errors, applications: (randomness, simulation, Markov process, linear equations, some numerical methods), integrating MATLAB based algorithms with external applications and languages, such as C, C++, Fortran, Java, COM, and Microsoft Excel.

Prerequisite : CSC 201 - Co-requisite : None

Elective Courses from the Department

OPER 313: Integer Programming	Credit hours : 3 (2+0+1)

Introduction to integer programming. Examples of integer programming problems. Some applications of integer programming. Optimality of integer programming. Branch and bound methods. Implicit enumeration methods. Cutting plane method.

Prerequisite : OPER 213 - Co-requisite : None

OPER 453: Sequencing and scheduling	Credit hours : 3 (2+0+1)

Introduction to sequencing and scheduling: concepts and examples. Optimality in sequencing and scheduling. Basic results of single machine sequencing and scheduling. Algorithms for general Job-Shop and Flow-Shop problems. Dynamic programming models for sequenced decisions using the principle of optimality. Use of dynamic programming in solving sequencing and scheduling problems.

Prerequisite : OPER 213 - Co-requisite : None

OPER 490: Special Applications in Operations Research	Credit hours : 3 (2+0+1)

Topics in Supply Chain Management. Traveling Salesman Problem. Vehicle Routing Problem. Facility Location Problem. Multi-objective Programming. Goal Programming

Prerequisite : OPER 331 and OPER 351 - Co-requisite : None

OPER 492: Pricing and Revenue Management	Credit hours : 3 (2+0+1)

Pricing and revenue management concepts. Basic price optimization. Price differentiation. Pricing with constrained supply. Revenue management. Capacity allocation. Network management. Overbooking. Markdown management. Customized pricing.

Prerequisite : OPER 331 and STAT 215 - Co-requisite : None

STAT 315: Probability (2)	Credit hours : 3 (2+0+1)

Sequence of Events – Continuous random vector - Joint probability distribution - marginal and conditional probability functions - Conditional expectation and variation - Joint probability distributions of functions of random variables - Joint moment generating functions - Order statistics - Probability inequalities - Sequences of random variables and modes of convergences - Central limit theorem and proof - normal approximation

Prerequisite : STAT 215 and MATH 207 - Co-requisite : None

STAT 325: Decision Theory	Credit hours : 3 (3+0+0)

The elements of making decision problem without data: Utility, Actions Space, State of nature space - Pure actions - MinMax and Bayes actions - MinMax mixed actions - Using data for making decisions (Decision Rule)- MinMax pure and mixed decision rules- Bayes decision rule - Estimation as a decision problem: for instance Bayes Estimate - Testing hypothesis as a decision problem: for instance: Most powerful , MinMax and Bayes tests - Comparing tests.

Prerequisite : STAT 223 - Co-requisite : None

STAT 326: Theory of Statistics (2)	Credit hours : 3 (2+0+1)

Interval estimation (two population cases): Confidence interval estimators, Pivotal methods - Hypotheses Testing: Type I and Type II error, power of the tests - Most powerful test, Neymann-pearson lemma, asymptotic tests - unbiased test - uniformly most powerful test. Monotone tests – Neymann Pearson theorem - power curves - Likelihood ratio tests - asymptotic distribution of likelihood ratio statistics - The Sequential Probability Ratio Test - Goodness of-fit Tests - Bayesian testing hypotheses

Prerequisite : STAT 223 and MATH 207 - Co-requisite : None

STAT 333: Nonparametric Statisticel Methods	Credit hours : 3 (2+0+1)

Concept of nonparametric statistics -Statistical tests based on the binomial distribution (binomial test and estimation of ratio - quantile test - tolerance limits) - Contingency tables in (median tests - measures of dependence - chi-square tests - Cochran test for related observations) - Some nonparametric tests that depend on ranks: (two independent samples -several independent samples - test for equal variances - measures of rank correlations-nonparametric regression methods - several related samples - tests of randomization) -Tests of the Kolmogorov-Smirnov type (the Kolmogorov goodness of fit tests - goodness of fit tests for families of distributions).

Prerequisite : STAT 105 - Co-requisite : None

STAT 331: Sampling Techniques	Credit hours : 3 (2+0+1)

Definition of Population and Sample - Types of surveys - Sampling Methods - Parameters Estimation - Estimation of: (population mean - population ratios - population total). Confidence intervals for population parameters - Selecting the sample size for estimating population mean and total number.

Prerequisite : STAT 223 - Co-requisite : None

STAT 362: Theory of reliability	Credit hours : 3 (3+0+0)

Concept of reliability - Structural properties of Coherent systems - Reliability of coherent systems - Joint Structural and Reliability importance - Some parametric lifetime models (continuous and discrete) - Classes of lifetime distributions (notions of aging) - Reliability operation - Specialized models (competing risks, accelerated models, ..) - Life data analysis.

Prerequisite : STAT 223 - Co-requisite : None

STAT 401: Econometrics	Credit hours : 3 (3+0+0)

Simple and Multiple regression models - Non-Linear regression models - Dummy Variables - Multicollinearity Problem-Identification Errors - Generalized Least Square Method – Heteroscedasticity Problem - Autocorrelation Problem - Time series models - Simultaneous Equations - Errors in variables.

Prerequisite : STAT 332 - Co-requisite : None

STAT 431: Insurance Methods	Credit hours : 3 (2+0+1)

Survival Distributions: Future lifetime, life tables; fundamental theorems for calculating moments of actuarial functions - Other actuarial functions; 3 assumptions for fractional ages; analytical laws of mortality - Net Single Premiums for Life Insurance Contracts: Definition using a stochastic approach - Distribution of the actuarial - Present value function for different insurance contracts - Life Annuities: Actuarial accumulation function; aggregate payment and current payment techniques - life annuities with monthly payments - complete annuities (immediate), apportionable annuities (due) - recursive equations - Net Annual Premiums: Actuarial equivalence principle; basic contracts; monthly premiums; life insurance with accumulation type benefits - Reserves: Definition of prospective loss - Basic contracts - Monthly premiums reserves: recursive equations for discrete reserves, reserves at fractional durations, allocation of the loss to the policy years.

Prerequisite : STAT 319 - Co-requisite : None

STAT 434: Linear Models	Credit hours : 3 (3+0+0)

Review of necessary concepts of matrix algebra - Normal distribution with n-variables - Quadratic forms and their distributions - The general linear model of full rank - Estimation and hypothesis testing in the full rank model - Estimation and hypothesis testing in the less than full rank model - Computational methods - Applications in regressions - Experimental design and ANOVA using statistical packages.

Prerequisite : STAT 332 and MATH 244 - Co-requisite : None

STAT 437: Design and Analysis of Experiments	Credit hours : 3 (2+0+1)

Introduction: Review of statistical inference - Main principals of experimental design: Replication – Randomness – Blocks – Simple comparisons experiments: t-test and alike tests. Single Factor Experiments: Completely randomized design – Model adequacy checking – Contrasts and orthogonal contrasts – Comparing pairs of treatment means - Block designs: Randomized complete block design – Latin square design – Graeco-Latin square design - Factorial designs: Two-Factor factorial design, Three-Factor factorial design, General factorial designs - Designs with two-level factors: Two factors with two levels designs, Three factors with two levels designs, General two-level factors designs. Confounding. Fractional factorial designs.

Prerequisite : STAT 328 - Co-requisite : None

STAT 441: QUALITY CONTROL	Credit hours : 3 (2+0+1)

Historical background of Quality Control - What is Quality? - the formation of Quality Control, Quality Planning, Quality Improvement - Quality Assurance and Total Quality Management - Modeling Process Quality - Review of statistical distributions used in Quality Control - Statistical inference and test of hypotheses - Statistical Process Control (SPC) - Magnificent Seven - Introduction of Control Charts - Statistical process in Quality Improvement - Pareto Chart - Cause and Effect Diagram - Scatter Diagram - Types of control charts - Control Charts for Variables - Process Capability Ratios - Process Capability Cpk - Control Charts for Attribute data - Acceptance Sampling - Operating Characteristic Curve.

Prerequisite : STAT 223 - Co-requisite : None

Master's Degrees

• Programs' Objectives

1. To offer a high training in statistics and operations research for distinguished students holding a Bachelor's degree in Statistics, Operations Research, Mathematics or any other related fields.
2. To provide society with statisticians and operations research experts who are highly qualified in the areas of statistical analysis, computing, statistical software packages where they can offer consultation services and lead activities working with large data sets; exploratory data analysis; graphical methods.
3. To provide a strong background for students who wish to continue for Ph. D. in Statistics and in Operations Research.

• Majors and Fields

1. Statistics.
2. Operations Research.

• Admission

1. To satisfy the admission requirements stipulated in the Unified Graduate Studies Statutes for Saudi universities.
2. To pass the Entrance Exam arranged by the Department.

• Requirements

1. The student must successfully complete 24 credit hours of courses included in the M. Sc. Academic Calendar (in accordance with the regulations of the Graduate Studies Deanship). These courses are divided into 15 compulsory credit hours, and 9 optional credit hours.
2. The student must submit a thesis satisfying the regulations, guidelines and specifications of the Graduate Studies Deanship.

M. Sc. Curriculum in Statistics

The study plan for the Department of Statistics and Operations Research
Specialization: Statistics
Degree: Master of Science

Compulsory courses		
Course No.	Name of course	Unit
STAT 520	Theory of statistics I	3
STAT 531	Analysis of variance	3
STAT 533	Regression analysis	3
STAT 559	Theory of statistics II	3
STAT 570	Stochastic processes I	3

Optional courses		
Course No.	Name of course	Unit
STAT 523	Special topics in Statistics	3
STAT 532	Analysis of biomedical categorical data	3
STAT 534	Design of experiments	3
STAT 536	Nonparametric statistics	3
STAT 556	Linear models	3
STAT 557	Order Statistics	3
STAT 558	Time Series Analysis	3
STAT 574	Survival analysis	3
STAT 576	Sample survey	3
STAT 578	Applied multivariate Analysis	3
OPER 563	Theory of reliability and life testing	3

Statistics Courses Description:

STAT 520: Theory of Statistics (I)	Credit hours : 3

Theory of probability - Probability spaces - Continuous and discrete distributions - Functions of random variables - Multivariate distributions - Expectation - Conditional expectation - Characteristic functions - Central limit theorem - Useful convergence results - Sampling distributions of order statistics - Empirical distribution function.

STAT 523: Special Topics in Statistics	Credit hours : 3

This course offers either some important topics which are not included in other listed courses or some special research topics of current research interest.

STAT 531: Analysis of Variance	Credit hours : 3

Analysis of variance for one-way, two-way and higher-way classification models - Analysis of standard designs and factorial experiments - Multiple comparisons - Orthogonal contrasts - Regression - Analysis using concomitant information - Some consideration of non-orthogonal data.

STAT 532: Analysis of Biomedical Categorical Data	Credit hours : 3

Categorical response data - Methods for rats and proportions - Describing two-way contingency tables - Models for binary response variable - Loglinear models - Fitting loglinear and logit models - Building and applying loglinear models - Loglinear - logit models for ordinal variables - Multi-nominal response models - Models for matched pairs - Analysis of repeated categorical response data.

STAT 533: Regression Analysis	Credit hours : 3

Multiple linear regression - Residual analysis - Polynomial regression - Indicator variables - Model building and variable selection - Non-linear and robust regression.

STAT 534: Design of Experiments	Credit hours : 3

Basic concepts - Blocking as a method of improving precision - RCB designs - LS and GLS designs (construction) - Factorial experiments - 2n factorial experiments - Confounding and fractional replications - 3n factorial experiments - BIB designs - Youden & Lattice designs - PBIB designs - Response surface designs.

STAT 536: Non-parametric Statistics	Credit hours : 3

Classes of distribution-free statistics - linear rank statistics and their applications to location, scale, scale and location problems - One, two- and multiple-sample problems - Non-parametric estimation - Asymptotic distributions - Goodness of fit tests.

STAT 556: Linear Models	Credit hours : 3

Generalized inverse of matrices - Distribution of quadratic forms - Non-full rank models - Estimable functions - General linear hypothesis - One-way and two-way classifications (nested & crossed) - Some aspects of random effects and mixed-effects models.

STAT 557: Order Statistics	Credit hours : 3

Basic theory of distributions of order statistics and their applications in quantile confidence intervals and in tolerance limits - Moments of order statistics - Application of order statistics in estimation and hypothesis testing.

STAT 558 : Time Series Analysis	Credit hours : 3

Time series as a stochastic process - Stationarity - Orthogonal decomposition of time series (Wald's decomposition) - Ergodic theorems in time series (estimation of the series moments) - auto-correlation and auto-covariance functions and their properties - Hilbert spaces [projection theorem, m. s. convergence, conditional expectation and best linear prediction in L2, P Fourier series] stationary ARMA processes, spectral representation of stationary process.

STAT 559: Theory of Statistics (II)	Credit hours : 3

Methods of point estimation - Properties of estimators - Confidence intervals - Hypothesis testing - Uniformly most powerful tests - Likelihood ratio tests - Univariate normal inference - Some aspects of sequential testing, decision theory and analysis of categorical data.

OPER 563: Reliability and Life Testing	Credit hours : 3

Structural properties of coherent systems - Reliability of coherent systems - Classes of life distributions based on ageing notions - Concepts of positive and negative dependence - Point and interval estimation procedure for life testing distributions - Testing reliability hypothesis.

STAT 574: Survival Analysis	Credit hours : 3

Survival data and distributions - Survival data models - Inference in parametric models - The proportional hazards model - Statistical computer packages for survival analysis - Likelihood construction - Inference based on ranks in the accelerated failure time model.

STAT 576: Sample Survey	Credit hours : 3

Theory and application of commonly used sampling techniques - Simple and stratified random sampling - Cluster, multistage and systematic sampling - Estimation of parameters: ratios, regression coefficients, and correlation linearization - Jackknife and bootstrap - Selected topics: model-based estimation, regression analysis from complex survey data - Relevant computer packages.

STAT 578 Applied Multivariate Analysis	Credit hours : 3

The multivariate normal distribution - Estimation of the mean vector and the covariance matrix - The distribution of the sample covariance matrix and the sample generalized variance - Techniques for analyzing multivariate data - Emphasis on MANOVA and tests on the structure of the dispersion matrix - Topics will include discriminant, factor, profile, and cluster analysis. Data analysis will be done using relevant computer packages

M. Sc. in Curriculum Operations Research

The study plan for the Department of Statistics and Operations Research
Specialization: Operations Research
Degree: Master of Science

Compulsory courses		
Course No.	Course Title	Unit
STAT 520	Theory of statistics I	3
STAT 559	Theory of statistics II	3
OPER 530	Theory of nonlinear programming (I)	3
OPER 554	Network flows	3
OPER 574	Stochastic models in O. R. (I)	3

Optional courses		
Course No.	Name of course	Unit
OPER 534	Nonlinear programming methods (II)	3
OPER 537	Integer and combinatorial optimization	3
OPER 543	Simulation and modeling	3
OPER 553	Sequencing and scheduling	3
OPER 563	Theory of reliability and life testing	3
OPER 521	Advanced forecasting	3
OPER 579	Special topics in O. R.	3

Operations Research Courses Description:

STAT 520: Theory of Statistics (I)	Credit hours : 3

Theory of probability- Probability spaces - Continuous and discrete distributions - Functions of random variables - Multivariate distributions - Expectation - Conditional Expectation - Characteristic functions - Central limit theorem - Useful convergence results - Sampling distributions of order statistics - Empirical distribution function.

STAT 559: Theory of Statistics (II)	Credit hours : 3

Methods of point estimation - Properties of estimators - Confidence intervals - Hypothesis testing - Uniformly most powerful tests - Likelihood ratio tests - Univariate normal inference - Some aspects of sequential testing - Decision theory and analysis of categorical data.

OPER 521: Advanced Forecasting Methods	Credit hours : 3

ARIMA modeling and the Box-Jenkins methodology of forecasting - Non-seasonal and seasonal models - Transfer function analysis - Intervention analysis - State space forecasting - Adaptive filtering.

OPER 530: Nonlinear Programming (I)	Credit hours : 3

Elements of convex analysis including convex sets and convex functions - Necessary and sufficient conditions for unconstrained and constrained optimization - Lagrangean duality theory.

OPER 534: Nonlinear Programming (II)	Credit hours : 3

Theoretical and practical aspects of nonlinear optimization - Development and application of optimization techniques used for unconstrained and constrained problems - Sequential search procedure - Gradient methods - Newton's methods and conjugate directions - Quadratic programming - Geometric programming - Penalty and Barrier methods - Projection methods.

OPER 537: Integer and Combinatorial Optimization	Credit hours : 3

Study of techniques for solving discrete-valued and combinatorial optimization problems - Topics that include enumeration and cutting plane methods - Application of these methods to integer and combinatorial models - Special treatment of Knapsack problems, routing and spanning tree problems - Covering problems.

OPER 543: Simulation and Modeling	Credit hours : 3

A comprehensive course in formulation, implementation and application of simulation models - Topics that include data structures, simulation languages statistical analysis - Pseudo-random number generation and design of simulation experiments. (Students will apply simulation modeling methods to problems of their own design).

OR 553: Sequencing and Scheduling	Credit hours : 3

Scheduling problems - Optimality of scheduling - Algorithms for flow shops and job-shops - Dynamic programming approach - Branch and bound method - Integer programming formulations - Hard problems (The classes P and NP) NP completeness - Heuristic methods.

OPER 554: Network Flows	Credit hours : 3

Theory of flows in capacity constrained network - Maximal flow - Feasibility criteria - Scheduling problems - Matching and covering problems,. Minimum length and minimum cost - Associated combinatorial problems - Extension of max-flow - Min cut theorem to some Min-Max results in combinatorial optimization.

OPER 563: Reliability and Life Testing	Credit hours : 3

Structural properties of coherent systems - Reliability of coherent systems - Classes of life distributions based on ageing notions - Concepts of positive and negative dependence - Point and interval estimation procedure for life testing distributions - Testing reliability hypothesis.

OPER 574: Stochastic Model in O.R. (1)	Credit hours : 3

Design and decision problems under uncertainty - Markovian decision making - Reliability, maintenance and renewal theory of stochastic systems. Queuing, inventory production planning, computer network and information system.

OPER 579: Special Topics in O. R.	Credit hours : 3

Design and decision problems under uncertainty. Markovian decision making - Reliability, maintenance and renewal theory of stochastic systems - Queuing and inventory production planning – Other computer network and information systems.

■ Ph. D. Program in Statistics

• Program's Objectives:

1. To provide the students with a broad knowledge of Statistics and to gain mastery of the skills in a chosen area.
2. To equip the students with the ability for independent research in an active area of Statistics.
3. To meet the needs of higher educational institutions and research centers for highly qualified statisticians.

• Admission Requirements:

An applicant for admission into the Ph.D. program must:

1. Hold an M.Sc. degree in Statistics from King Saud University or its equivalent.
2. Pass the TOEFL examination with a score of at least 450.
3. Pass an interview held by a committee designated by the Department.

• Degree Requirements:

The Ph.D. program involves three stages: preparation for research (course requirement), certification that the preparation is adequate (comprehensive examination), and submission of a research thesis.

• Course requirements:

1. The student must successfully complete 18 credit hours of courses of which a maximum of 9 credit hours to be chosen from the M.Sc. courses which he/she has not taken previously.
2. Comprehensive examination:

   The student must pass a comprehensive examination to he held subject to the regulations and guidelines of the Graduate Studies Deanship and those of the College of Science.
3. The students must present a research thesis reflecting creativity and originality on a chosen topic in Statistics.

The study plan for the Department of Statistics and Operations Research
Specialization: Statistics
Degree: Ph. D. degree

Compulsory courses		
Course No.	Course Title	Unit
STAT 611	Probability theory I	3
STAT 621	Statistical Inference I	3
STAT 622	Statistical Inference II	3

Optional courses		
Course No.	Name of course	Unit
STAT 612	Probability theory II	3
STAT 613	Stochastic Process II	3
STAT 623	Survival analysis	3
STAT 624	Theory of nonparametric statistics	3
STAT 625	Advanced topics in experimental design	3
STAT 626	Theory of time series	3
STAT 627	Generalized linear models	3
STAT 628	Multivariate analysis	3
STAT 629	Special topics in statistics	3

Course Description:

STAT 611 Probability theory I	Credit hours : 3

Probability spaces in the framework of measure theory - Random variables as measurable function - Modes of convergence - Dominated convergence theorem - Distribution functions - Decomposition of a distribution function - Convergence of distribution functions - Weak compactness theorem and Helly-Bray lemma.

STAT 612 Probability theory II	Credit hours : 3

Summability of independent random variable - laws of large numbers - Convergence in distribution - Characteristic functions Uniqueness and continuity theorems - The Lindeberg-Feller central limit theorem - Degenerate convergence criterion.

STAT 613 Stochastic Processes	Credit hours : 3

Continuous time Markov processes - The Poisson and allied processes - The kolmogorow equations - Renewal theory.

STAT 621 Statistical inference I	Credit hours : 3

Sufficiency - Completeness likelihood - Multiparameter estimation - linear estimation - maximum likelihood estimation - Bayesian estimation - large sample properties and procedures.

STAT 622 Statistical inference II	Credit hours : 3

Testing statistical composite hypotheses - Invariance principles - Bayesian statistics - large sample properties and procedures.

STAT 623 Survival analysis	Credit hours : 3

Theory of analysis of randomly right censored failure time data: failure time models - Inference in parametric models - The proportional hazards model - Likelihood construction of failure time data - Rank analysis in accelerated failure time models.

STAT 624 Theory of nonparametric statistics	Credit hours : 3

Theoretical foundations of nonparametric statistics: Theory of U-statistics - Noether's theorem and Pitman asymptotic relative efficiently - Estimation and hypothesis testing with one and two sample location (scale) models - Theory of linear rank statistics - Applications to general linear models analyses.

STAT 625 Advanced topics in experimental design	Credit hours : 3

The general pn factorial stem - Split-plot experiments, blocking - Fractional replication - Quasi factorial or lattice designs - Incomplete block designs - constructions and analysis - Response surface designs: objective, models and criteria - Continuous design theory - Optimal design measure and some simple equivalence results - Multiresponse experiments - Designs for non-linear models.

STAT 626 Theory of time series	Credit hours : 3

The ITO calculus and stochastic differential equations - stochastic integrals - Ergodic theorems - Non-stationary time series and evolutionary spectra - Prediction, filtering and control of non-stationary processes - Nonlinear (bilinear, threshold, and exponential autoregressive) time series models - Special topics in recent time series research.

STAT 627 Generalized linear models	Credit hours : 3

Theory of generalized linear models - Quasi-likelihood models - Higher order asymptotic - Generalized estimating equations - GLIM computer package.

STAT 628 Multivariate analysis	Credit hours : 3

Singular transformations and the generalized Jocobian - The multivariate normal distribution - Wishart distribution - The U distribution - Distribution of the latent roots of one Wishart matrix in the metric of another - Noncentral counterparts of these distributions - Introduction of zonal polynomials.

STAT 629 Special topics in Statistics	Credit hours : 3

This course offers either some important topics which are not included in other enlisted courses or some special research topics of current research interest.

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http://colleges.ksu.edu.sa/CollegeofScinces/StatisticsOperationsDepartment/Pages/FacultyMembers.aspx

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The Study System at the College of Science

- Teaching at the College of Science is subject to the following scheme:

1. The school year consists mainly of two regular semesters and a summer semester, if available.
2. The stage of academic progress is indicated by the academic level since the number of levels to graduate is at least eight levels in conformity with the approved Study Plan.
3. The duration of the level is a full semester (not less than 15 weeks) and this period does not include the periods of registration and final exams.
4. The duration of the summer semester is not less than eight weeks where the teaching time allocated for each course is doubled.
5. A number of courses (subjects) are taught during each academic level according to the program of each specialty in the different departments.
6. Students have to study 136 class units (credit hours) to obtain a Bachelor's Degree as follows:
   - *A. The student studies a number of 31 credit hours during the Preparatory Year (two semesters in one academic year).*
   - *B. The student studies 97 credit hours (optional + compulsory) in the Program of Specialization in the various College departments throughout the six semesters following the Preparatory Year (beginning with the third semester).*
   - *C. University Requirements: The student selects 8 credit hours of the requirements of the University out of 22 optional credit hours during the period of study at the College.*
7. The student chooses the specialty department before the end of the Preparatory Year based on the conditions set by each department.

1. The New Academic System (e-Register)

Registration is the cornerstone of the academic system, the center of the educational process, and the first step to start university life. The new Academic System (e-Register) offers new students the following opportunities:

1. To create an e-mail through the site of the Deanship of Electronic Transactions and Communications:

http://www.ksu.edu.sa/sites/KSUArabic/Deanships/Computer/Pages/.

2. To have an access to the academic system by using the link: http://edugate.ksu.edu.sa; then, entering a user name and a password.
3. Online Registration (registration, adding, and dropping): a student can register, in person, from any location during the periods of registration and dropping plus an additional period specified in the academic calendar; thus, without having to visit the College or the Department. The student can perform the following:
    - *Registration: Registration of courses and deciding the required number of credit hours.*
    - *Adding and dropping: The student may drop and add courses during the first week of teaching provided that the study load does not go above , or lower than, the allowed course load.*
4. To view the course schedule of the College and the available/closed groups.
5. To view the study schedule and print it.
6. To view the Academic Record and print a copy (an unofficial copy).
7. To view the results of the final exams as soon as they are put online.
8. To view the Study Plan, the courses passed by the student, and the ones remaining to be studied.
9. To know about the penalties imposed upon the student.
10. To view the financial rewards.
11. To make suggestions and submit complaints.
12. To write the academic performance evaluation of faculty members.
13. To exchange electronic messages and change the password.

* In case of any problem while registering, a student may consult the College Registration Office (room 1A7 - Building 4).

2. Rules and Mechanisms for Registration of Courses

- The Course is a module that meets the needs of the level specified in the approved Study Plan in each specialty (Program). The Course has a number, a code, a title, and a description depending on the different departments (see the Department's Manual Guide).
- The Course is divided into a set of theoretical lectures and practical lessons (study units) taught weekly during the academic level.
- The Credit Hour is a weekly theoretical lecture that is not less than fifty minutes, or a practical lesson which is not less than one hundred minutes.
- The registration of the courses for all students is done automatically through the website: http://edugate.ksu.edu.sa
- The academic levels vary in the number of the units of study, from 12 units to 20 units, for each level.
- The Courses are registered automatically at the beginning of the following semester for the student's convenience. Then, the student can modify the course schedule by adding or dropping.
- The following table shows the student's study load corresponding to the cumulative average:

GPA	2	2.5	3	3.5	4	4.5	5
Hours allowed for registration	14	15	16	17	18	19	20

- The Processes of dropping and adding are performed by the student electronically in the first week of the semester through accessing the gate of the academic system of the University Deanship of Admission and Registration (http://edugate.ksu.edu.sa).
- No student has the right to register a course without passing its pre-requisite course.
- Students, who pass all courses without failures, are registered in the courses of the level beginning gradually with the lower levels according to the study plans approved.
- Students, who fail in some courses, are registered in courses that ensure their minimum study load in each semester taking into account the following points:
    - *No conflict in the course study schedule.*
    - *Satisfying the previous requirements of the course or courses to be registered.*

- Calculating the Average and Cumulative GPA:

The Average and cumulative GPA are calculated every semester for the student automatically by the system. To know how to calculate the averages, you should follow the following steps:

- Calculating the Semester Average:

The GPA is calculated considering the following points:

1. Knowing the number of hours of the courses.
2. knowing the mark obtained in each course.
3. Knowing the corresponding grade of each mark.
4. Knowing the value of each grade.
5. Knowing the points = number of hours of the course × value of the grade.
6. Determining the total points obtained in all courses of the semester.
7. Determining the total number of hours registered in the semester.
8. The average is calculated every semester according to the following equation:

$$\text{GPA} = \frac{\text{Total points (item 6)}}{\text{Number of hours registered in the semester (item 7)}}$$

The following table shows the percentage of marks, grade and value obtained by the student in each course, which is used to calculate the points:

Mark	Grade	Letter of Grade	Value of Grade
From 95 to 100	Excellent +	A+	5.00
From 90 to less than 95	Excellent	A	4.75
From 85 to less than 90	Very Good+	B+	4.50
From 80 to less than 85	Very Good	B	4.00
From 75 to less than 80	Good +	C+	3.50
From 70 to less than 75	Good	C	3.00
From 65 to less than 70	Pass +	D+	2.5
From 60 to less than 65	Pass	D	2.00
Less than 60	Failure	E	1.00
Absence from lectures (25% or more)	Debarred	H	1.00

■ Calculating the Average Cumulative

The GPA semester average is calculated as follows:

1. The grand total of points (for all semesters that have been studied).
2. The grand total of credit hours (for all semesters that have been studied).
3. The cumulative average is calculated according to the following equation:

$$GPA = \frac{\text{Grand total of points}}{\text{Grand total of credit hours}}$$

Here is an example of how to calculate the grades above:

- Calculating the grade of the first semester:

Course	Credit Hours	Mark	Grade	Grade Value	Points
Phys 101	4	67	D+	2.5	4 × 2.5 = 10
Chem101	4	73	C	3	4 × 3 = 12
Eng 121	3	77	C+	3.5	3 × 3.5 = 10.5
Arab 101	2	81	B	4	2 × 4 = 8
	13				40.5
GPA = Total points ÷ No. of hours registered in semester = 40.5 ÷ 13 = 3.12					

Calculating the grade of the second semester:

Course	Credit Hours	Mark	Grade	Grade Value	Points
Math 101	3	61	D	2	3 × 2 = 6
Stat 101	3	73	C	3	3 × 3 = 9
Computer Science 206	3	80	B	4	3 × 4 = 12
Arab 103	3	88	B+	4.5	3 × 4.5 = 13.5
Islam 101	2	92	A	4.75	2 × 4.75 = 9.5
Eng 122	3	97	A+	5	3 × 5 = 15
	17				65
GPA = Total points ÷ No. of hours registered in semester = 65 ÷ 17 = 3.82					

Calculating the average cumulative:

GPA = Total points ÷ Total hours of the semester = 105.5 ÷ 30 = 3.52

Dropping and adding of a course:

- The process of dropping and adding is performed through portal (http://edugate.ksu.edu.sa) during the first week of the semester only; but the number of credit hours registered has to be at least 12 hours.
- The student may drop only one course due to an excuse acceptable to the Dean of the College. This procedure should occur at least five weeks before the final exams begin. The student has the right to apply for such a procedure at a maximum of four courses during the whole period of study at the College.

Attendance, postponing and dropping out of College:

- The student must be regular in attendance attending at least 75% of the lectures and the practical classes.
- If any student has a percentage of absence of 25% , or more, in any course, he is denied access to the final exam of this course and his result is F.
- A student may apply for postponement of the study before the beginning of the semester for an excuse accepted by the College Board. The postponement should not exceed two consecutive semesters or three intermittent semesters as a maximum limit while studying at the College.
- The University Council may, in case of necessity, exempt the applicant from the previous provision.
- If a student drops out of College for one semester without requesting the postponement of his registration, the University has the right to dismiss his registration. The University Council has the right to do this for a lesser period of time.
- The student is not considered as dropping out of College if he is a visiting student at another university.

Visiting Student:

The Visiting Student is a student who studies some courses at another university, or at a branch of the university to which he belongs without being transferred. The courses he studied are accredited according to the following regulations:

- The student has to have a transcript (including a grade point average) for, at least, two semesters at his college before he applies as a visiting student.
- The student must obtain a prior approval from his college permitting him to study as a visiting student while specifying the courses that will be studied. The College has the right to require a specific grade to be achieved by the student to offset the course. The student should obtain an official letter from the Deanship of Admission and Registration directing him to study as a visiting student.
- The student has to join a college or a university officially recognized.
- The courses, under consideration by the student to be studied outside the University, must be equivalent in their description to the University courses, and their course units should be no less than the units of any of the courses contained in the graduation requirements.
- The maximum of the total units of study that can be calculated from outside the University is twenty percent (20%) of the total units required for graduation at King Saud University.
- The courses that are studied by the visiting student are not included in the cumulative average. These courses are recorded in his academic record.
- The student must provide the Deanship of Admission and Registration with the results he obtained during the first two weeks of study in the semester following the period of study as a visitor. If not reported within that period, the student is considered as dropping out of College during those semesters.

Dismissal from the University:

The student is dismissed from the University in the following cases:

- If he receives three consecutive warnings due to a cumulative average below a minimum of 2.
- The student may be given a fourth opportunity by the Council of the University based upon the recommendation of the College Council to raise his cumulative GPA by studying the available courses.
- The University Council may give the dismissed students, due to warnings, an opportunity that does not exceed two semesters as a maximum.
- If the student does not fulfill his graduation requirements at the College in a period of up to half of the period prescribed for graduation in addition to the duration of the Program.

- The student is given an exceptional opportunity by the University Council to meet the graduation requirements during a maximum period not exceeding twice the original term specified for graduation.
- The University Council may allow dismissed students, due to the exhaustion of failure times, to attend twice the duration of the Program. This extension should not exceed a maximum of two semesters.

Examinations and Grades:

- Based on a proposal from the Department Council, the College Council specifies a mark for the student's semester work, varying from 40% to 60% of the final grade of the course.
- The mark of the course's semester work is calculated by one of the following two methods:
  - *Oral, practical tests, research, or other forms of classroom activity, or from all the above or some of them, in addition to at least one written exam.*
  - *Two written exams at least.*
- Based on the recommendation of the course teacher, it is permissible for the Council of the Department, that teaches the course, to allow the student to complete the requirements of any course in the following semester and to give the student a grade of I (incomplete) in his academic record. Only the grades achieved by the student are included in the GPA or cumulative after the completion of the requirements of that course.
- If one semester passes without changing the grade incomplete (I), the student is given an F which is calculated in the GPA and cumulative.
- The grades obtained by the student in each course are calculated according to the schedule mentioned above.

Restrictions of the Final Examination:

- No student may be tested in more than two courses in one day.
- The student is not allowed to enter the final exam after half an hour of its beginning, and is not allowed to leave the exam room before half an hour after its beginning.
- Based on a recommendation from the relevant Department Council, the College Council specifies the duration of the final written exam to be within a period not less than one hour, and not more than three hours.
- Cheating in the exam, initiating it, or violating the instructions and rules of examination procedures are actions punishable in accordance with the Regulations of the Students' Discipline issued by the University Council.

- In cases of necessity, the College Council, in charge of teaching a course, has the right to approve re-marking of the answer sheets in a period of time not later than the beginning of the following semester in accordance with the following rules:
  - *A student may apply for re-marking the answer sheets of only one course per semester.*
  - *The student, who wishes to re-mark his answer sheets, may apply for re-marking to the department, that teaches this course, not later than one month after taking the final exam.*
  - *A student, who has already applied for re-marking and proved the invalidity of his application, should never apply for re-marking his answer sheets in any exam in the future.*

Transferring:

1. Transferring from one college to another within the University:

- It is permissible, with the consent of the respective deans of the colleges, to transfer from one college to another in accordance with the conditions approved by the College Council to which the student wishes to transfer.
- The student's college academic record has to show all courses previously studied, including grades, semester and cumulative averages throughout the study at the college from which he is transferred.

2. Transferring from one major to another within the College:

- The student may, after the approval of the Dean, transfer to another specialty within the College according to the guidelines established by the College Council.
- The student's college academic record has to show all courses previously studied, including grades, semester and cumulative averages throughout the study at the college from which he is transferred.

Graduation:

The student graduates after completing successfully the graduation requirements in accordance with the study plan, provided that his cumulative average is no less than 2 (Pass) .