Faculty of Science
Department of Statistics

Study Plan for

Bachelor Degree of Science
Statistics

2016/2017

Table of Contents

Vision, Mission and Goals of the Statistics Program

Vision

The program aspires to be a national distinguished statistical leader recognized for the quality in teaching and data analysis.

Mission

The mission of the Statistics Program is as follows:

> "Being the only department in Jordan offering a degree in statistics, we offer educational opportunities for students at both the graduate and undergraduate levels by blending the theoretical and applied statistical aspects. Our goal is to provide a quality education and training to the new generations to be pioneer in research, experimental design, data analysis and consultation".

Resource https://science.yu.edu.jo/index.php/en/depts/department-of-statistics

Program Educational Objectives

The Statistics Program with its various constituents is discussed in successive meetings the essential requirements for the development of the Program Educational Objectives (PEOs) by focusing on main elements of the university's mission such as: knowledge, research and community services. All those elements are the key focus-points of PEOs of the program. Those PEOs will help to envision the future of prospective and current students enrolled in the department. After many departmental meetings, the department with help of its constituents approved the following PEOs, in that the program graduates are prepared to:

1. Use modern knowledge, statistical skills, and communication skills to further advance their careers in statistics domain.
2. Pursue graduate studies, research, and life-long learning in statistics and related fields.
3. Work in multidisciplinary teams to serve the community in accordance with standards and profession ethics.

The Department of Statistics is always aware that the developed program educational objectives (PEOs) serve the mission of the Yarmouk University. The following table shows the matching map between University mission and PEOs. The PEOs of the department are focused on key elements of the University's mission by delivering the students with essential knowledge, tools and skills of science and technology to meet the key requirements of public and private organizations and enhance a knowledge and skill based culture to serve local, regional and global communities. Strong co-relations are developed between the department's PEOs and the elements of the University's mission to improve the social condition through scientific and technological augmentation by providing knowledge and skill based work force willing to handle tasks for innovation, nurturing new knowledge and skills and serving its community by the utmost scientific knowledge available. The programs' PEOs are aligned with "Excellence in Teaching and Research" dimension of the University's mission through having graduates that continue their education by ground-breaking research in renowned higher-educational institutions.

Consistency of PEOs with University's missions

Objective	University Mission		
	Providing creative knowledge	Excellence in teaching and research	Professional services with effective community partnership
Objective 1	√		√
Objective 2	√	√	
Objective 3	√		√

The assessment of the program educational objectives has been performed to handle the need of all constituents (Faculty, Students, Alumni…etc). The PEOs are reviewed continuously with a specific process every 4-5 years. Importantly, each constituent has been contributed to this process significantly.

Student Outcomes

The Statistics program uses the term Program Learning Outcomes (PLOs) instead of Student Outcomes (SOs) within the formal studying plan to cope with the university style. Here in this document, we will use the term SOs, while on the website and other formal documents the term PLOs will be applied.

Graduates of the Statistics program at Yarmouk University will have the ability to:

(SO-1) An ability to identify, formulate, and solve broadly defined technical or scientific problems by applying knowledge of mathematics and science and/or technical topics to areas relevant to the discipline.
(SO-2) An ability to formulate or design a system, process, procedure or program to meet desired needs.
(SO-3) An ability to develop and conduct experiments or test hypotheses, analyze and interpret data and use scientific judgment to draw conclusions.
(SO-4) An ability to communicate effectively with a range of audiences.
(SO-5) An ability to understand ethical and professional responsibilities and the impact of technical and/or scientific solutions in global, economic, environmental, and societal contexts.
(SO-6) An ability to function effectively on teams that establish goals, plan tasks, meet deadlines, and analyze risk and uncertainty.

The student outcomes (SOs) are documented and distributed in both the published study plan and department website as follows:

1. Statistics Study Plan: https://science.yu.edu.jo/index.php/en/study-plans-for-bachelor-4
2. Department of Statistics Website: https://science.yu.edu.jo/index.php/en/depts/department-of-statistics.

Each student outcome, SO, is assessed within the Statistics academic program. Achievement of SOs can lead to the accomplishment of the program educational objectives and are a vital condition for attaining the Program Education Objectives, PEOs as presented in the following table. The results of

the student outcomes assessment and evaluation will be applied to improve, develop, and upgrade the program. The above process is implemented to satisfy clearly the international accreditation requirements.

Mapping Student Outcomes with Program Educational Objectives

Student Outcomes	Program Objectives		
	Objective 1	Objective 2	Objective 3
SO-1	x		
SO-2	x	x	
SO-3	x	x	
SO-4	x		
SO-5		x	x
SO-6	x	x	x

Accreditation Criteria in Statistics Program

According to the Regulations of the Higher Education Accreditation and Quality Assurance Commission, Ministry of Higher Education, Jordan.

A. Obligatory Fields

Field of knowledge	Course Code	Course Name	Credit Hours
Mathematical Statistics The minimum required credits (12 Credits)	Stat 234	Statistical Inference (1)	3
	Stat 334	Statistical Inference (2)	3
	Stat 363	Nonparametric Statistics	3
	Stat462	Bayesian Methods	3
	Stat 464	Multivariate Analysis	3
	Total Credits		**15**
Applied Statistics The minimum required credits (15 Credits)	Stat 101	Principles of Statistics (1)	3
	Stat 201	Principles of Statistics (2)	3
	Stat 272	Time Series	3
	Stat 373	Statistical Demography	3
	Stat 374	Design of Experiments and Analysis of Variance (1)	3
	Stat 375	Regression Analysis	3
	Stat 382	Categorical Data Analysis	3
	Total Credits		**21**
Probability The minimum required credits (9 Credits)	Stat 111	Principles of Probability (1)	3
	Stat 211	Principles of Probability (2)	3
	Stat 312	Probability Theory	3
	Total Credits		**9**
Training The minimum required credits (9 Credits)	Stat 105	Statistics Lab (1)	1
	Stat 205	Statistics Lab (3)	1
	Stat 271	Sampling Methods	3
	Stat 281	Statistical Packages	3
	Stat 483	Case Studies	3
	Total Credits		**11**

B. Supporting Fields

Field of Knowledge	Course Code	Course Name	Credit Hours
Mathematics The minimum required credits (9 Credits)	Math 101	Calculus (1)	3
	Math 102	Calculus (2)	3
	Math 201	Intermediate Analysis (1)	3
	Math 241	Linear Algebra (1)	3
	Total Credits		**12**

Study Plan for Bachelor Degree of Science, Statistics

The Department of Statistics at Yarmouk University offers a Bachelor Degree upon the completion of the following requirements:

1. The fulfillment of the conditions stated in the regulations of awarding the Bachelor Degree at Yarmouk University No. (2) for the year 1991 and its amendments issued in accordance with the bylaws of awarding academic degrees and diplomas at Yarmouk University No. 76 for the year 1976.

2. **University requirements** stated under the above regulations (27 Credit Hrs):

a) Obligatory courses (12 Credit Hrs):

Table (1): Obligatory University Requirements

No.	Course Code	Course Name	Credit Hours
1.	PS 102	National Education	3
2.	MILT 100	Military Science	3
3.	AL 101	Arabic Language (1)	3
4.	EL 101	English Language	3
	EL 099	English Language skills	Remedial course
	AL 099	Arabic Language	Remedial course
	Comp 099	Computer Skills	Remedial course
	Total		**12**

b) Elective courses (15 Credit Hrs.) to be chosen from the following courses:

Table (2): Elective University Requirements

Humanities Courses			
No.	Course Code	**Course Name**	**Credit Hours**
1.	Hum 101	Media Culture	3
2.	Hum102	Citizenship and Belonging	3
3.	Hum 103	Islam Thought and Civilization	3
4.	Hum 104	Art and Behavior	3
5.	Hum 105	Jordan's Contribution to Human Civilization	3
6.	Hum 106	Introduction to the Study of Human Cultures	3
7.	Hum 107	Human Rights	3
8.	Hum 108	Thinking Skills	3
Scientific Courses			
1.	Sci 101	Environment and Public Health	3
2.	Sci 102	Information Technology and Society	3
3.	Sci 103	Physical Fitness for All	3
4.	Sci 104	Communication Skills	3
5.	Sci 105	Renewable Energy	3
6.	Sci 106	Administration and Society Development	3
7.	Sci 107	Scientific Research	3

3. Faculty of Science obligatory requirements (21 Credit Hrs)**:**

Table (3): Faculty of Science Requirements

No.	Course Code	Course Name	Credit Hours
1.	Math 101	Calculus (1)	3
2.	Phys 101	General Physics (1)	3
3.	Chem 101	General Chemistry (1)	3
4.	Bio 101	General Biology	3
5.	Stat 101	Principles of Statistics (1)	3
6.	EES 101	General Geology (1)	3
7.	CS 110	Programming In Selected Language	3
	Total		**21**

4. Department requirements:

I. **Single Major** (86 Credit Hrs.):

a) **Obligatory courses** (62 Credit Hrs.)	Stat 105, Stat 111, Stat 201, Stat 205, Stat 211, Stat 234, Stat 271, Stat 272, Stat 281, Stat 312, Stat 334, Stat 363 , Stat 373, Stat 374, Stat 375, Stat 382, Stat 462, Stat 464, Stat 483, Math 102, Math 201, Math 241.
b**) Elective courses** (24 Credit Hrs.) selected from the following courses	Stat 273, Stat 278, Stat 372, Stat 376, Stat 377, Stat 421, Stat 461, Stat 471, Stat 472, Stat 475, Stat 481, Stat 492, Econ.101, BF.209, BA 101, CS 130, Math 203, Math 204, Math 251, Math 321.

Table (4): Single Major Credit Hours

Requirements	Obligatory	Elective	Total	Percentage
University	12	15	27	20%
Faculty	21	-	21	16%
Department	62	24	86	64%
Total	95	39	134	100%

II. **Major / Minor** (86 Credit Hrs.)

(1) **Major in Statistics** (65 Credit Hrs.):

a) **Obligatory courses** (59 Credit Hrs.)	Stat 105, Stat 111, Stat 201, Stat205, Stat 211, Stat 234, Stat 271, Stat 272, Stat 281, Stat 312, Stat 334, Stat 373, Stat 374, Stat 375, Stat 382, Stat 462, Stat 464, Stat 483, Math 102, Math 201, Math 241.
b) **Elective courses** (6 Credit Hrs.) selected from the following courses	Econ 101, BF 209, BA 101, Math 203, Math 251, CIS 103.

(2) **Minor** (21 Credit Hrs.): To be selected from any department of the following Faculties: Science, Information Technology and Computer Sciences and Economics and Administrative Sciences according to the lists of minor courses of the selected department.

Table (5): Major / Minor Credit Hours

Requirements	Obligatory	Elective	Total
University	12	15	27
Faculty	21	-	21
Department (Major)	59	6	65
Minor			21
Total			134

III. **Minor in Statistics** (21 Credit Hrs)

(1) Mathematical Statistics

a) **Obligatory courses** (15 Credit Hrs.)	Stat 111, Stat 211, Stat 234, Stat 271, Stat 334.
b) **Elective courses** (6 Credit Hrs.)	To be chosen from the courses offered by the Department of Statistics, level 200 and above.

(2) Applied Statistics

a) **Obligatory courses** (15 Credit Hrs.)	Stat 201, Stat 271, Stat 373, Stat 374, Stat 375
b) **Elective courses** (6 Credit Hrs.)	To be chosen from the courses offered by the Department of Statistics, level 200 and above.

Table (6): The Significance of the Second Digit

Num.	Title	Num.	Title
0	General Statistics	5	-----
1	Probability Theory	6	Statistical Methods
2	Stochastic Process	7	Applied Statistics
3	Mathematical Statistics	8	Computational Statistics
4	------	9	Research, Seminar and Special Topics

Table (7)
Courses Offered by Statistics Department for the Bachelor Degree in Statistics

No.	Course No.	Course Name	Cridt hrs	Prerequisites	Course status
1	Stat 101	Principles of Statistics (1)	3		old
2	Stat 105	Statistics Lab (1)	1	Stat 101 or Concurrent	old
3	Stat 111	Principles of Probability (1)	3		old
4	Stat 201	Principles of Statistics (2)	3	Stat 101 or Stat 107	old
5	Stat 205	Statistics Lab (3)	1	Stat 201 or Concurrent	old
6	Stat 211	Principles of Probability (2)	3	Stat 111, Math. 101	old
7	Stat 234	Statistical Inference (1)	3	Stat 211, Math 102	old
8	Stat 271	Sampling Methods	3	Stat 111 or Stat 201	old
9	Stat 272	Time Series	3	Stat 201	old
10	Stat 273	Cluster Analysis	3	Stat 201	old
11	Stat 278	Operation Research (1)	3	Stat 101	old
12	Stat 281	Statistical Packages	3	Stat 201	old
13	Stat 312	Probability Theory	3	Stat 211	old
14	Stat 334	Statistical Inference (2)	3	Stat 234	old
15	Stat 363	Nonparametric Statistics	3	Stat 201	old
16	Stat 372	Applied Biostatistics	3	Stat 201 or Stat 203	old

17	Stat 373	Statistical Demography	3	Stat 201	old
18	Stat 374	Design of Experiments and Analysis of Variance (1)	3	Stat 201	old
19	Stat 375	Regression Analysis	3	Stat 201	old
20	Stat 376	Reliability Theory	3	Stat 234	old
21	Stat 377	Quality Control	3	Stat 201	old
22	Stat 382	Categorical Data Analysis	3	Stat 201	old
23	Stat 421	Stochastic Processes	3	Stat 211	old
24	Stat 461	Sequential Analysis	3	Stat 234	old
25	Stat 462	Bayesian Methods	3	Stat 234	old
26	Stat 464	Multivariate Analysis	3	Stat 234, Math. 241	old
27	Stat 471	Advance Sampling Methods	3	Stat 271	old
28	Stat 472	Survey Designs	3	Stat 271	old
29	Stat 475	Applied Multivariate Data Analysis	3	Stat 464	old
30	Stat 481	Statistical Computations	3	Stat 281	old
31	Stat 483	Case Studies	3	Stat 281	old
32	Stat 492	Special Topics in Statistics	3	Department Approval	old

Table (8)
Courses Offered by Statistics Department for Non Statistics Students

No.	Course No.	Course Name	Cr Hrs	Prerequisite	Course status
1	Stat 107	Statistics (Non science students)	3	---	old
2	Stat 108	Introduction to Statistics (Mass Communications students)		---	new
3	Stat 203	Biostatistics (For non Statistics students)	3	Stat 101	old

Table (9): Table of Equivalent Courses

Course Code and No. in the New Plan	Equivalent Course Code and No. in the Old Plan
Stat 101	Stat 101
Stat 105	Stat 105
Stat 107	Stat 107
Stat 108	---
Stat 111	Stat 111
Stat 201	Stat 201
Stat 203	Stat 203
Stat 205	Stat 205
Stat 211	Stat 211
Stat 234	Stat 234
Stat 271	Stat 271
Stat 272	Stat 272
Stat 273	Stat 273
Stat 278	Stat 278
Stat 281	Stat 281
Stat 312	Stat 312
Stat 334	Stat 334
Stat 363	Stat 363
Stat 372	Stat 372
Stat 373	Stat 373
Stat 374	Stat 374
Stat 375	Stat 375
Stat 376	Stat 376
Stat 377	Stat 377
Stat 382	Stat 382
Stat 421	Stat 421
Stat 461	Stat 461
Stat 462	Stat 462
Stat 464	Stat 464
Stat 471	Stat 471
Stat 472	Stat 472
Stat 475	Stat 475
Stat 481	Stat 481
Stat 483	Stat 483
Stat 492	Stat 492

Guidelines Program for the Department of Statistics Students
(Advisory Plan)
First year

First Semester		Second Semester	
Course	**Credit hours**	**Course**	**Credit hours**
Stat 101	3	Stat 201	3
Stat 105	1	Stat 205	1
Math. 101	3	Stat 111	3
CS 101	3	Math. 102	3
Univ. req.	3	Univ. req.	3
Univ. req.	3	Faculty req.	3
Total	**16 C.H.**	**Total**	**16 C.H.**

Second year

First Semester		Second Semester	
Course	**Credit hours**	**Course**	**Credit hours**
Stat 211	3	Stat 281	3
Stat 271	3	Stat 373	3
Math. 201	3	Stat 234	3
Univ. req.	3	Stat 272	3
Dept. req.	3	Faculty req.	3
Faculty req.	3	Dept. req.	3
Total	**18 C.H.**	**Total**	**18 C.H.**

Third year

First Semester		Second Semester	
Course	**Credit hours**	**Course**	**Credit hours**
Stat 312	3	Stat 334	3
Stat 374	3	Stat 375	3
Math. 241	3	Stat 363	3
Stat 382	3	Univ. req.	3
Dept. req.	3	Univ. req.	3
Dept. req.	3	Dept. req.	3
Total	**18 C.H.**	**Total**	**18 C.H.**

Fourth year

First Semester		Second Semester	
Course	**Credit hours**	**Course**	**Credit hours**
Stat 464	3	Stat 462	3
Stat 483	3	Univ. req.	3
Univ. req.	3	Dept. req.	3
Dept. req.	3	Dept. req.	3
Dept. req.	3	Dept. req.	3
Total	**15 C.H.**	**Total**	**15 C.H.**

Course Description of the Department of Statistics Courses for Bachelor Degree

Stat 101 - Introduction to Statistics (1) (3 credit hrs.)

Collecting data, census and sampling survey, Bias, Types of data. Sampling methods. Describing data using graphical methods, Measures of location and variability. Correlation coefficient and simple linear regression, Probability, Random variables and sampling distributions. Point and interval estimation and hypothesis testing for a single population parameter.

The learning outcomes of the course are:

1. Recognize measures of central tendency and dispersion;
2. Construct discrete probability distributions: Binomial and Poisson;
3. Understand continuous probability distributions and implement the central limit theorem;
4. Construct confidence intervals and apply hypothesis testing for a single population parameters;
5. Apply simple linear regression on real data.

Stat 105 - Statistics Lab (1) (1 credit hr.)

Display the data using graphs of frequency tables, Calculating some statistical measures (mean, standard deviation, percentiles), Compute probabilities for distributions of random variables (Binomial, Normal), Verifying the Central Limit Theorem, estimation (point and interval) and testing hypothesis for one population mean. All above to be implemented using statistical package MINITAB.

The learning outcomes of the course are:

1. Use the suitable package commands to get statistical graphs and tables;
2. Use the suitable package commands to calculate some descriptive statistics;
3. Use the suitable commands to study the linear relationship between two quantitative variables
4. Use the suitable package commands to calculate probabilities and generate random data from Binomial and Normal distributions;
5. Use the suitable package commands to conduct a statistical inference for one population mean (a large sample).

Stat 107 - Statistics (Non-science Students) (3 credit hrs.)

Collecting data, Census survey and sampling survey. Types of data. Sampling methods. Descriptive statistics. Probability, Discrete and continuous random variables, Sampling distributions, Statistical estimation (point and interval), Hypothesis testing, Simple linear regression, Correlation coefficient, Index numbers.

The learning outcomes of the course are:

1. Identify the meaning of statistics and its applications;
2. Present the data graphically and identify all descriptive statistics;
3. Understand probability and some of its applications;
4. Understand the correlation concept and simple linear regression approach;
5. Recognize the importance of index numbers and its applications;
6. Understand the estimation methods and hypotheses testing of single population parameter.

Stat 111 - Introduction to Probability (1) (3 credit hrs.)

Sets and sample space, Methods of enumeration. Axioms of probability, Conditional probability, Independent events, Bayes theorem, Random variables and probability distribution. Expectation, Chebyshev's Inequality, Moment generating function. Binomial, Poisson, Normal, Gamma, and other distributions.

The learning outcomes of the course are:

1. Recognize sets, sample space, methods of enumeration, Axioms of probability;
2. Construct discrete probability distributions (Geometric, Negative Binomial, Binomial, and Poisson);
3. Understand continuous probability distributions (Normal, Gamma, Exponential, Uniform and Chi-square) and its applications.

Stat 201 – Introduction to Statistics (2) (3 credit hrs.)

Inferences concerning the parameters of two populations, Inference about Simple linear regression. Design and analysis of experiment (one way and two-way), Contingency tables, Chi-square tests for goodness of fit and independence. Introduction to nonparametric tests.

The learning outcomes of the course are:

1. Familiarize students with the use of Normal table, t-table, Chi-square table and F-table;
2. Recognize small-sample inference regarding some of the population parameters;
3. Understand one and two ways designs of experiments;
4. Apply the linear regression model on bivariate data;
5. Familiarize students with contingency tables and Chi-square tests;
6. Recognize some nonparametric methods.

Stat 203 - Biostatistics (For non Statistics students) (3 credit hrs.)

Biological data and measures, Parametric and non parametric tests for proportions, Categorical data analysis (cross-sectional, prospective, retrospective) and relative risks measure, Evaluation of laboratory Tests (specificity, sensitivity and related tests), Efficiency of vaccine, Survival functions, Tests for difference in survival curves using clinical life tables, Dose-Response curve and estimating Effective Doses ED_p .

The learning outcomes of the course are:

1. Describing the medical and biological data sets;
2. Recognize conditional probability and compute sensitivity, specificity and other related concepts;
3. Understand the discrete and continuous random variables and their probability density functions;
4. Conduct one sample inference about the population parameters.

Stat 205 - Statistics Lab (3) **(1 credit hr.)**

Statistical inference concerning one and two populations' parameters. Analysis of variance and Experimental designs, correlation and regression analysis, Analysis of categorical data (one-way, two-way contingency tables), Chi-square tests for goodness of fit and independence. All above to be implemented using statistical package MINITAB or R or any other suitable statistical package suggested by the department.

The learning outcomes of the course are:

1. Write the suitable commands to get statistical inference for one or two population parameters;
2. Write the suitable commands to implement the (one and two ways) ANOVA methods ;
3. Write the suitable commands to implement the regression and correlation;
4. Write the suitable commands to carry out categorical data analysis.

Stat 211 – Introduction to Probability (2) **(3 credit hrs.)**

Multivariate distributions, Marginal and conditional distributions, Moments of linear combinations of R.V., Conditional expectation, Multinomial distribution, Multivariate hypergeometric distribution, Bivariate normal distribution, function of random variables (methods of distribution function, transformation, moment generating), Sampling distributions, t-distribution, F-distribution and Chi-square distribution.

The learning outcomes of the course are:

1. Understand moment generating function, sampling distribution, t, F and Chi-square distributions;
2. Construct bivariate discrete probability distributions, their marginal and conditional distributions;
3. Construct bivariate continuous probability distributions, their marginal and conditional distributions;
4. Conduct the transformation of some discrete and continuous random variables.

Stat 234 - Statistical Inference (1) **(3 credit hrs.)**

Review of methods for determining probability distributions, Order statistics, convergence in distribution, Convergence in probability, Limits of moment generating functions, Central limit theorem, Methods of estimation, Properties of estimators, Interval estimation, Pivotal method, Confidence intervals using large samples.

The learning outcomes of the course are:

1. Understanding the probability distributions of functions of random variables;
2. Find the limiting distributions of random variables;
3. Find estimators for parameters of distributions using different methods;
4. Study different methods of interval estimation.

Stat 271 - Sampling Methods **(3 credit hrs.)**

Census and sample surveys. Population and sample design. Data collection methods, Sampling techniques. (simple random sample, systematic, and stratified). Ratio and regression estimators. Estimation of the population mean, total and the proportion. Required Sample size, estimation of the population size. Bound of errors. Other related applications and topics.

The learning outcomes of the course are:

1. Define the meaning of statistical sampling and why is statistical sampling & Distinguish between random (probability) and non-random sampling with focusing on most popular random samples
2. Distinguish between different sampling techniques;
3. Understanding the differences between sampling methods;
4. Summarize the collected data to obtain estimators of desired quantities of interest (parameters);
5. Curry out a small survey that involves selecting a sample from the target population then summarizing data to make inference and submit a report via team-work.

Stat 272 - Time Series (3 credit hrs.)

Classical decomposition models, Time series regression models, Exponential smoothing models, Stationary time series. The autocorrelation and partial autocorrelation functions. Ordinary and seasonal ARMA models. Steps of model building: Identification, estimation and diagnostic checking. Forecasting.

The learning outcomes of the course are:

1. Recognize main components of time series model;
2. Fit and analyze various time series regression models;
3. Understand various smoothing techniques of time series data;
4. Build suitable ARMA models for time series data;
5. Forecast future values of time series data based on several methods.

Stat 273 - Cluster Analysis (3 credit hrs.)

The rule of cluster analysis, Similarity measures, Relation between distances, k-means measures. Methods of division of data into groups, Linkage methods, Descriptive methods (histograms and trees). Statistical testing analysis for cluster, Problems of clustering.

The learning outcomes of the course are:

1. Conduct hierarchical cluster analysis and k-means clustering in multivariate data;
2. Apply normalization for the data to identify clusters;
3. Identify the assignment of cases to clusters;
4. Apply descriptive methods to identify clusters;
5. Use statistical packages for various cluster analysis methods using real data sets.

Stat 278 - Operation Research (1) (3 credit hrs.)

Formulation of LP problems: Solution by graphical method for the case of two variables, Sensitivity analysis, , Algebraic solution of LP problems, Simplex method, Duality of LP problems and sensitivity analysis, Transportation and assignment problems, Game theory.

The learning outcomes of the course are:

1. Distinct and understand the difference between the general mathematical model and the LP model;
2. Formulate and Solve the LP model using the graphical method and simplex method;
3. Conduct the sensitive analysis;
4. Construct the dual model from the primal LP model and recognize the relationship between them;
5. Formulate LP models of the transportation and assignment problems and solve them;
6. Solve problems using game theory.

Stat 281 – Statistical Packages **(3 credit hrs.)**

The importance of statistical packages in data analysis, Using one statistical package among SAS, SPSS, R to do statistical analysis according to different statistical methods. The course includes preparing a term paper using real data to be collected by students.

The learning outcomes of the course are:

1. Recognize successfully the fundamental principles and working knowledge of statistical software;
2. Comprehend the different concepts of statistics;
3. Conduct a simple design of surveys and data collection;
4. Conduct a complete analysis of the data;
5. Report and interpret findings in a scientific and concise manner;
6. Write a comprehensive report.

Stat 312 - Probability Theory **(3 credit hrs.)**

Measure theory approach to probability, Sets, fields and -fields. Probability distribution, Mathematical expectation, Different types of convergence. Moment generating function, Some limit theorems for distributions.

The learning outcomes of the course are:

1. Understand standard theorems in probability;
2. Verify whether a collection of events is a field or -filed;
3. Verify that a function on the sample space is a random variable;
4. Verify that a function of random variables is a probability distribution function.;
5. Recognize the distribution, the moment generating function and expectation of a random variable;
6. Recognize limits and the convergence of sequences of random variables.

Stat 334 - Statistical Inference (2) **(3 credit hrs.)**

Testing hypothesis, Neyman-Pearson Lemma, Most powerful tests, Likelihood ratio tests, Chi-square test of independence, Sufficient statistics, Rao-Blackwell theorem, Uniqueness and completeness, Exponential families, Cramer-Rao inequality, UMVUE.

The learning outcomes of the course are:

1. Understand different methods of testing statistical hypotheses;
2. Obtain complete sufficient statistics for known probability distributions;
3. Obtain Uniformly Minimum Variance Unbiased Estimators.

Stat 363 - Nonparametric Statistics **(3 credit hrs.)**

Examples of nonparametric statistical methods. Statistical inference for one and two samples problems. Nonparametric measures of association. Some nonparametric goodness of fit tests, Kolomogrov and Simirnov tests.

The learning outcomes of the course are:

1. Recognize successfully the principles of nonparametric statistics;

2. Comprehend the differences between parametric and nonparametric statistics;
3. Conduct a simple inferential statistical analysis using one or more samples;
4. Conduct a simple inferential statistical analysis using dependent samples;
5. Design and test the independence and the homogeneity of populations;
6. Understand dispersion, association and Kolomogrov and Simirnov tests.

Stat 372 - Applied Biostatistics (3 credit hrs.)

Types of data and measurements in biostatistics, Epidemiological studies, Biostatistical methods for categorical data analysis, Measures of association between risk and response factors, Clinical trails implementation, Clinical life tables and related survival functions, Chi-square test for comparing survival curves, Dose-response curves and EDp estimation methods.

The learning outcomes of the course are:

1. Recognize the importance of Epidemiological studies and the Biostatistical methods;
2. Analyze clinical trial data;
3. Analyzing clinical trial data using clinical life tables and related survival functions;
4. Comprehend the survival curves and dose-response curves.

Stat 373 - Statistical Demography (3 credit hrs.)

Age-sex composition, Rates, Population growth models, Mortality rates (crude and specific), Direct and indirect methods for rates adjustment, Life tables construction. Migration, natality, marriage and divorce rates and proportions, Census in Jordan, Vital statistics.

The learning outcomes of the course are:

1. Recognize the appropriate sources of demographic data collection;
2. Recognize the population composition according to characteristics such as age and sex;
3. Recognize Rates and proportions of mortality, natality, marriage, and migration;
4. Construct and analyze life-tables;
5. Understand different population growth models.

Stat 374 - Design of Experiments and Analysis of Variance (1) (3 credit hrs.)

One way analysis of variance, Multiple comparison, Model adequacy checking. Randomized block design, Latin square design, Graeco-Latin square design. Incomplete block design, Factorial designs (2^k and 3^k designs).

The learning outcomes of the course are :

1. Recognize the methods to design proper experiments;
2. Determine the design based on the model;
3. Construct the one-way and two-way ANOVA;
4. Checking both model adequacy and model assumptions;
5. Understand and analyze different advanced designs of experiments.

Stat 375 - Regression Analysis (3 credit hrs.)

Simple linear regression (least square method, testing and estimation), Residuals analysis (model checking), Matrix formulation, Multiple regression, Polynomial regression. Selection of independent variables (model building).

The learning outcomes of the course are:

1. Understand the concept of linear regression and correlation;
2. Develop the understanding of the theoretical background of the regression models;
3. Linear Regression using matrix formulation;
4. Building Linear Regression models.

Stat 376 - Reliability Theory (3 credit hrs.)

Concept of reliability, Component and system reliability, Reliability of series and parallel systems. Repairable systems, Concept of availability. Failure time distributions (exponential, Weibull, log-normal etc), Hazard functions, Complete and censored data, Statistical methods of estimation and inference. Accelerated life testing. Computer simulation.

The learning outcomes of the course are:

1. Understand the main features of reliability theory;
2. Use reliability concept properly;
3. Recognize reliability statistical analysis methods efficiently and effectively using computer.

Stat 377 - Quality Control (3 credit hrs.)

The concept of quality and causes of quality variation. Shewhart control charts for attributes and variables, Operating characteristic functions. Control charts for sample average and range. Exponentially weighted moving average. Acceptance sampling plans for attributes and variables.

The learning outcomes of the course are:

1. Recognize main components of quality control;
2. Sketch and analyze various control charts for variables and attributes;
3. Evaluating the out-of-control status of the process in view of control charts;
4. Compute and interpret ARL and ATS measures of the process;
5. Being able to use the OC-curves;
6. Compute process capability measures and interpreting them;
7. Understand EWMA charts and the acceptance sampling and apply them in real situations;
8. Using statistical packages to draw main conclusions for real data.

Stat 382 - Categorical Data Analysis (3 credit hrs.)

Types of variables, 2×2 and r×c contingency tables, Measures of association , Partitioning of Chi-square, Statistical models for binary data, Generalized linear model, logistic model and loglinear model for multi-dimensional, Contingency tables analysis.

The learning outcomes of the course are:

1. Understand measures of association for categorical variables including relative risk and odds ratio;
2. Examine association in contingency tables;
3. Fit and analyze binary and multinomial data using various statistical models;

4. Apply logistic and log-linear models to analyze categorical dataset;
5. Analyze categorical data analysis using some statistical packages.

Stat 421- Stochastic Processes (3 credit hrs.)

Random walk, Markov chains, Classification of states and processes, Transition matrices, Renewal processes, Expected size of the population, Birth and death processes, Simple and general effect of migration.

The learning outcomes of the course are:

1. Understand the definition of a stochastic process and in particular a Markov process;
2. Calculate the distribution of a Markov chain at a given time;
3. Classify the states of a Markov chain;
4. Describe a Markov chain and its transition matrix;
5. Determine the stationary and equilibrium distributions of a Markov chain;
6. Understand the definition and derive some basic properties of a Poisson process.

Stat 461 - Sequential Analysis (3 credit hrs.)

Sequential tests of statistical hypotheses, Intervals for the sample size and sequential tests, SPRT, Wald identity, Termination with probability one of SPRT, Confidence bands for sample size and SPRT.

The learning outcomes of the course are:

1. Understand the basic concept of sequential statistics and its applications;
2. Conduct traditional sequential tests and estimate the sample size;
3. Understand Wald identity and other concept in sequential literature.

Stat 462 - Bayesian Methods (3 credit hrs.)

Review the principles of probability and Bayes theory, Prior and posterior distributions, Loss functions, Bayesian estimates and testing methods, Credible regions. Decisions and payoff tables, Maximin and Minimax principle, Optimal decision using experimental data.

The learning outcomes of the course are:

1. Distinguish between Bayesian and Non-Bayesian techniques ;
2. Find the posterior distribution and explain its properties;
3. Make inference about the parameters using Bayesian methods;
4. Use a suitable loss function to measure the accuracy of the inferences;
5. Find the suitable prior distribution based on the available information.

Stat 464 - Multivariate Analysis (3 credit hrs.)

Some basic concepts of statistics. Matrices and vectors. The multivariate normal distribution, Estimation and tests for the mean vector and covariance matrix. Analysis of variance in case of multivariate data.

The learning outcomes of the course are:

1. Understand the main concepts of multivariate data;
2. Use exploratory and confirmatory multivariate statistical methods;

3. Understand matrices in multivariate analysis.;
4. Recognize multivariate statistical techniques and methods efficiently and effectively.

Stat 471 - Advance Sampling Methods (3 credit hrs.)

Review the main sampling methods including simple and stratified random samples. Other Theoretical properties of main Sampling methods. Estimating the mean, total and proportion of the population and their properties. Other Sampling method (two and three stages cluster sampling, Double sampling, proportional sampling, Unequal probability sampling, Distance sampling). Other related topics

The learning outcomes of the course are:

1. Recognize the properties of the main sampling techniques;
2. Obtain the inclusion probability of the elements of the population in the chosen sample;
3. Estimate the parameters and obtain the accuracy and precision of the estimators;
4. Study the theoretical properties of the estimators.

Stat 472 - Survey Designs (3 credit hrs.)

Types of statistical studies, sampling design and survey design, data collection techniques, Types of errors in surveys, Steps of planning and implementation of a survey, Selection and non-response biases, Questionnaire design, Sensitive questions and Randomized response, Estimation of rare events, Postal, telephone surveys and other methods of measurements, Web. page and email based surveys, Report writing. Oral presentation and discussion of students' projects.

The learning outcomes of the course are:

1. Recognize various methods of surveys and sampling;
2. Recognize various types of errors in surveys;
3. Conduct a real life data collection using one or more methods;
4. Write a comprehensive report and discuss the findings in class.

Stat 475 - Applied Multivariate Data Analysis (3 credit hrs.)

Summery and examples of multivariate data. Principle component analysis. Classification and discrimination, Canonical correlation analysis, Factor analysis. MANOVA, Multivariate regression.

The learning outcomes of the course are:

1. Determine the multivariate methods that are appropriate for the given case study;
2. Understand the basic logic behind each multivariate method;
3. Diagnosing the agreement between the data and the model assumptions;
4. Using statistical packages to analyze a multivariate data set;
5. Interpret the output for each method.

Stat 481 - Statistical Computations (3 credit hrs.)

The concepts and methodology of simulation, Methods of generating uniform random numbers. Calculating the probability and percentiles. Methods of generating non-uniform random numbers. Monte Carlo integrations. All pervious concepts will be implemented using a statistical package such as R or SAS.

The learning outcomes of the course are:

1. Understand the meaning of simulation in statistics and why are simulation studies;
2. Generate uniform and non- uniform random numbers;
3. Implement pseudo-random numbers to generate random variables;
4. Own a reasonable insight into the construction of a statistical model;
5. Approximate integrals numerically using Monte Carlo methods;
6. Estimate probabilities and quintiles using simulation.

Stat 483 - Case Studies (Project) (3 credit hrs.)

Students are required to complete a capstone experience, which expose them to real-world data analysis challenges and bearing in mind their professional responsibilities and the impact of scientific solutions. This course includes two parts: First part consist of reading some papers on statistical application and different case studies and discuss it in the class in terms of the scientific research rules. The second part consists of submitting a complete statistical project that includes comprehensive methodology of achieving real life survey with all parts of statistical analysis. Students MUST show their projects via presentations that evaluated by the instructor (also assign a committee faculty members to do evaluation).

The learning outcomes of the course are:

1. Recognize the importance of scientific research, statistical applications of data specially for important topics from local or global economic, environmental, and societal contexts from ethical & professional prospective;
2. Perform statistical surveys and analyze a real life data (case study) & analyze risk;
3. Presenting the statistical analysis of the case study maintaining scientific research rules.

Stat 492 - Special Topics in Statistics (3 credit hrs.)

This course aims at introducing some advanced special topics in Statistics with emphasis on a specific area, including: Inferential or Applied Statistics, Linear or Non-Linear Models, and Parametric or Non-Parametric Methods. It may also cover advanced topics in Probability or Mathematical Statistics.