

Dawson College
Mathematics Department
Probability and Statistics
201-BZS-05

- Ponderation:** 3-2-3
Prerequisite: Calculus II (201-NYB) or equivalent
Text: *STAT* by Johnson & Kubly (ISBN-10: 0-538-73503-1)
References: *Statistics for the Sciences* by Buntinas & Funk
Understanding Basic Statistics (2nd Edition) by Brase & Brase
Calculator: A scientific calculator with statistical mode, which has no text storage or graphing capabilities, is required for class tests and the final exam.
Methodology: Lectures, problem solving sessions, excel computer labs.
Evaluation: *Term Work (assignments, computer labs, quiz and tests):* 60%
Final Examination: 40%
Termwork: Class tests consist of a minimum of 4.5 hours of testing.
Lab Report Requirements:
All text must be word-processed.
All graphs should be computer-generated.
Complicated formulas may be hand-written, but computer is preferred.

Comprehensive Assessment:

If a Science (200.xx) student elects to do the Comprehensive Assessment in this course, the above evaluation scheme represents 90% of his/her final grade. The Comprehensive Assessment makes up the other 10%. *IF A STUDENT FAILS THE ASSESSMENT (i.e. obtains less than 60%), HE/SHE CANNOT GRADUATE.*

Literacy Policy:

Problem solving is an essential component of this course. Students will be expected to analyze problems stated in words, to present their solutions logically and coherently, and to display their answers in a form corresponding to the statement of the problem, including appropriate units of measurement. Marks will be deducted for work which is inadequate in their respects, even though the answers may be numerically correct.

Policy on Cheating and Plagiarism:

Cheating in Examinations, Tests, and Quizzes:

Cheating includes any dishonest or deceptive practice relative to formal final examinations, in-class tests, or quizzes. Such cheating is discoverable during or after the exercise in the evaluation process by the instructor. Such cheating includes, but is not limited to

- a. copying or attempting to copy another's work.
- b. obtaining or attempting to obtain unauthorized assistance of any kind.
- c. providing or attempting to provide unauthorized assistance of any kind.
- d. using or possessing any unauthorized material or instruments which can be used as information storage and retrieval devices.
- e. taking an examination, test, or quiz for someone else.
- f. having someone take an examination, test, or quiz in one's place.

Unauthorized Communication:

Unauthorized communication of any kind during an examination, test, or quiz is forbidden and subject to the same penalties as cheating.

Plagiarism on Assignments and the Comprehensive Assessment:

Plagiarism is the presentation or submission by a student of another person's assignments or Comprehensive Assessment as his or her own. Students who permit their work to be copied are considered to be as guilty as the plagiarizer.

Obligation of the Teacher:

Every instance of cheating or plagiarism leading to a resolution that impacts on a student's grade must be reported by the teacher, with explanation, in writing to the Chair of Mathematics and to the Dean of Pre-University Studies. A copy of this report must also be given to the student.

Penalties:

Cheating and plagiarism are considered extremely serious academic offences. Action in response to an incident of cheating and plagiarism is within the authority of the teacher. Penalties may range from zero on a test, to failure of the course, to suspension or expulsion from the college.

Students' Obligations:

- a. Students have an obligation to remain informed about what takes place in their regularly scheduled classes. Absence from class does not excuse students from this responsibility.
- b. Students have an obligation to arrive on time and remain for the duration of scheduled classes and activities.
- c. Students have an obligation to write tests and final examinations at the times scheduled by the teacher or the College. Students have an obligation to inform themselves of, and respect, College examination procedures.
- d. Students have an obligation to show respectful behavior and appropriate classroom deportment. Should a student be disruptive and/or disrespectful, the teacher has the right to exclude the disruptive student from learning activities (classes) and may refer the case to the Director of Student Services under the Student Code of Conduct.
- e. Cellular phones, pagers and musical listening devices have the effect of disturbing the teacher and other students. All these devices should be turned off. Students who do not observe these rules will be asked to leave the classroom.
- f. Cell phones must also be put away. Text messaging is not allowed in class.

Religious Holidays:

Students who wish to observe religious holidays must inform each of their teachers in writing within the first two weeks of each semester of their intent to observe the holiday so that alternative arrangements convenient to both the student and the teacher can be made at the earliest opportunity. The written notice must be given even when the exact date of the holiday is not known until later. Students who make such arrangements will not be required to attend classes or take examinations on the designated days, nor be penalized for their absence. It must be emphasized, however, that this College policy should not be interpreted to mean that a student can receive credit for work not performed. It is the student's responsibility to fulfill the requirements of the alternative arrangement.

General Objective:

The purpose of this course is to demonstrate to students the role of statistics in the natural and social sciences. Using statistics to solve problems in the natural sciences will be emphasized. The course also introduces the students to the use of Minitab/Excel as an aid in solving statistical problems.

Specific Objectives:

Upon completion of this course the students should, in particular, be able to:

1. Collect data and summarize it using numeric measures.
2. Organize and present data using tables and graphs.
3. Determine the strength of linear relationship between 2 variables.
4. Develop the least squares regression equation.
5. Calculate probabilities of events. (discrete and continuous)
6. Calculate the expected value and variance of probability distributions. (discrete and continuous)
7. Use the Binomial, Hypergeometric or Poisson probability distribution to calculate probabilities of discrete events.
8. Use the Normal Distribution tables to calculate probabilities of certain continuous random variables.
9. Use sampling distributions to see how chance variations affect sample averages and proportions.
Central limit theorem.
10. Estimate the population average or proportion.
11. Test hypotheses about the population average or proportion.
12. Conduct inferences concerning the difference between the averages in two populations.
13. Conduct inferences concerning the difference between the proportions in two populations.
14. Test to determine if two variables are statistically independent.
15. Test to determine if data fits a theoretical model.
16. Test to determine if a significant linear relationship exists between 2 variables.
17. Use Excel to do the statistical operations mentioned above.

Course Content:

DESCRIPTIVE STATISTICS:

DESCRIPTIVE STATISTICS (*Chapters 1, 2*)

Elements of Competency: Descriptive Analysis and Presentation of Single Variable Data

Specific Objectives: 1 to 2

SECTION & Topics	HOMEWORK
1.1 WHAT IS STATISTICS? <i>Measurements, Levels of Measurement</i>	p.18 #1.2 abc, 1.4, 1.6, 1.8, 1.10, 1.18
2.1 GRAPHS, PARETO DIAGRAMS AND STEM-AND-LEAF DISPLAYS <i>Dot plots, Stem-and-leaf displays</i>	p.50 #2.1 - 2.5
2.2 FREQUENCY DISTRIBUTIONS AND HISTOGRAMS <i>Histograms, Ogives, Frequency distribution tables, Classes, Class width, Class boundaries, Class marks, Relative frequency, Cumulative frequency</i>	p.50 #2.6 - 2.11
2.3 MEASURES OF CENTRAL TENDENCY <i>Mean, Median, Mode</i>	p.51 #2.13 - 2.17
2.4 MEASURES OF DISPERSION <i>Range, Sample variance, Sample standard deviation</i>	p.51 #2.18 - 2.25
2.5 MEASURES OF POSITION <i>Quartiles, Percentiles, Standard Scores, Five number summaries, Box-plots</i>	p.52 #2.26 - 2.31
2.6 INTERPRETING AND UNDERSTANDING STANDARD DEVIATION <i>Empirical Rule, Chebyshev's Theorem</i>	p.52 #2.32 - 2.35, 2.36b-g, 2.37b-g

DESCRIPTIVE STATISTICS (*Chapter 3*)

Elements of Competency: Descriptive Analysis and Presentation of Bivariate Data

Specific Objectives: 1 to 4

SECTION & Topics	HOMEWORK
3.1 BIVARIATE DATA <i>Bivariate data, Scatter diagrams</i>	
3.2 LINEAR CORRELATION <i>Coefficient of linear correlation, coefficient of determination</i>	p.71 #3.13b-e, 3.17c, 3.18c-e, 3.19
3.3 LINEAR REGRESSION <i>Line of best fit, Making predictions</i>	p.72 #3.23, 3.24, 3.28bc, 3.32b-e

PROBABILITY:

PROBABILITY (*Chapter 4*)

Elements of Competency: Probability

Specific Objectives: 5

SECTION & Topics	HOMEWORK
4.1 PROBABILITY OF EVENTS <i>Theoretical (expected) probability, Empirical probability, Sample space</i>	p.95 #4.1 - 4.4
4.2 CONDITIONAL PROBABILITY OF EVENTS <i>Conditional probability</i>	p.95 #4.9 - 4.14
4.3 RULES OF PROBABILITY <i>Complementary events, Addition rules, General Multiplication rule, Conditional probability</i>	p.97 #4.15 - 4.25
4.4 MUTUALLY EXCLUSIVE EVENTS <i>Mutually exclusive events, Addition rule for independent events</i>	p.97 #4.26 - 4.33
4.5 INDEPENDENT EVENTS <i>Independent events, Dependent events, Multiplication rule for independent events</i>	p.98 #4.35 - 4.44
4.6 ARE MUTUAL-EXCLUSIVENESS AND INDEPENDENCE RELATED? <i>Using conditional probability to determine independence</i>	p.99 #4.46 - 4.51
ADDITIONAL SECTION I: BAYES' THEOREM <i>Bayes' Theorem, Tree diagrams</i>	Exercises distributed in class
ADDITIONAL SECTION II: COUNTING TOOLS <i>Fundamental Counting Principle, Permutations, Combinations, Combining the rules of probability, Venn diagrams</i>	Exercises distributed in class

PROBABILITY DISTRIBUTIONS (*Chapter 5*)

Elements of Competency: Probability distributions and Discrete Variables

Specific Objectives: 5, 6, 7

SECTION & Topics	HOMEWORK
5.1 RANDOM VARIABLES <i>Random variables</i>	p.113 #5.3 - 5.6
5.2 PROBABILITY DISTRIBUTIONS OF A DISCRETE RANDOM VARIABLE <i>Probability distribution, Probability function</i>	p.113 #5.7 - 5.11
5.3 MEAN AND VARIANCE OF A DISCRETE PROBABILITY DISTRIBUTION <i>Mean (expected value), variance, standard deviation</i>	p.114 #5.19 - 5.24
5.4 THE BINOMIAL PROBABILITY DISTRIBUTION <i>Binomial probability experiments, Binomial probability function</i>	p.115 #5.27, 5.30, 5.35 - 5.41
5.5 MEAN AND STANDARD DEVIATION OF THE BINOMIAL DISTRIBUTION <i>Mean, standard deviation of binomial distribution</i>	p.116 #5.47 - 5.49, 5.50a-g
ADDITIONAL SECTION III: POISSON DISTRIBUTION <i>Poisson distribution, Mean of Poisson Distribution</i>	Exercises distributed in class
ADDITIONAL SECTION IV: THE HYPERGEOMETRIC DISTRIBUTION <i>Hypergeometric distribution (sampling without replacement), Comparison of binomial and hypergeometric distributions</i>	Exercises distributed in class

CONTINUOUS PROBABILITY DISTRIBUTIONS (*Chapter 6*)

Elements of Competency: Continuous probability distributions, Normal probability distributions

Specific Objectives: 8

SECTION & Topics	HOMEWORK
ADDITIONAL SECTION V: PROBABILITY DENSITY FUNCTIONS <i>Probability functions, definite and improper integrals, expected value and variance</i>	Exercises distributed in class
ADDITIONAL SECTION VI: EXPONENTIAL DISTRIBUTIONS <i>Mean and variance of exponential distributions</i>	Exercises distributed in class
6.1 NORMAL PROBABILITY DISTRIBUTION <i>Normal probability distribution function</i>	
6.2 STANDARD NORMAL DISTRIBUTION <i>Properties of standard normal distribution, Finding area under standard normal curve</i>	p.132 #6.5 - 6.14
6.3 APPLICATIONS OF NORMAL DISTRIBUTION <i>Probabilities, Percentiles</i>	p.132 #6.18 - 6.26
6.4 NOTATION <i>z-scores, z_α</i>	p.133 #6.28, 6.29, 6.32 - 6.35
6.5 NORMAL APPROXIMATION OF THE BINOMIAL <i>Normal approximation to the binomial, continuity correction factor</i>	p.135 #6.40 - 6.46

SAMPLE VARIABILITY (*Chapter 7*)

Elements of Competency: Sample Variability

Specific Objectives: 9

SECTION & Topics	HOMEWORK
7.1 SAMPLING DISTRIBUTIONS <i>Sampling distribution of a sample statistic, Creating a sampling distribution of sample means</i>	p.148 #7.2, 7.3
7.2 THE SAMPLING DISTRIBUTION OF SAMPLE MEANS <i>Mean and variance of sampling distribution of sample mean, Central Limit Theorem</i>	p.149 #7.12 - 7.16
7.3 APPLICATIONS OF THE SAMPLING DISTRIBUTION OF SAMPLE MEANS <i>Calculating probabilities for the mean</i>	p.150 #7.21 - 7.29

INFERENCEAL STATISTICS:

INTRODUCTION TO STATISTICAL INFERENCE (Chapter 8)

Elements of Competency: Introduction to Statistical Inferences

Specific Objectives: 10

SECTION & Topics	HOMEWORK
8.1 THE NATURE OF ESTIMATION <i>Point estimate, Interval estimate, Level of confidence, Confidence interval</i>	p.178 #8.6 - 8.11
8.2 ESTIMATION OF MEAN μ (σ KNOWN) <i>Point estimate, Confidence interval, Sample size</i>	p.178 #8.17 - 8.23
8.3 THE NATURE OF HYPOTHESIS TESTING <i>Statistical hypothesis test, Null Hypothesis, Alternative Hypothesis, Type I and II errors</i>	p.179 #8.24 - 8.35
8.4 HYPOTHESIS TEST OF MEAN μ (σ KNOWN): A PROBABILITY VALUE APPROACH <i>Probability value hypothesis test (p-value approach), One-tailed and Two-tailed tests</i>	p.180 #8.36, 8.43 - 8.45
8.5 HYPOTHESIS TEST OF MEAN μ (σ KNOWN): A CLASSICAL APPROACH <i>Critical values, One-tailed and Two-tailed tests</i>	p.181 #8.47, 8.49 - 8.51

INFERENCE INVOLVING ONE POPULATION (*Chapter 9*)

Elements of Competency: Inferences Involving One Population

Specific Objectives: 11

SECTION & Topics	HOMEWORK
9.1 INFERENCE ABOUT THE MEAN μ (σ UNKNOWN) <i>Properties of the t-Distribution, Confidence Intervals, Hypothesis Testing (p-value and classical approach)</i>	p.204 #9.2 - 9.14
9.2 INFERENCE ABOUT THE BINOMIAL PROBABILITY OF SUCCESS <i>Confidence Interval for a Proportion, Hypothesis Test for a Proportion (p-value and classical approach)</i>	p.206 #9.20 - 9.22, 9.25 - 9.32

INFERENCES INVOLVING TWO POPULATIONS (*Chapter 10*)

Elements of Competency: Inferences Involving Two Populations

Specific Objectives: 12, 13

SECTION & Topics

10.2 INFERENCES CONCERNING THE MEAN DIFFERENCE

Dependent samples, Confidence intervals and hypothesis testing of paired differences

10.3 INFERENCES CONCERNING THE DIFFERENCE BETWEEN MEANS

Independent samples, Confidence intervals and hypothesis testing for difference of means

ADDITIONAL SECTION V: DEGREES OF FREEDOM FOR INFERENCES CONCERNING DIFFERENCE BETWEEN MEANS

Independent samples, Confidence intervals and hypothesis testing for difference of means

10.4 INFERENCES CONCERNING THE DIFFERENCE BETWEEN PROPORTIONS

Independent samples, Confidence intervals and hypothesis testing for difference of proportions

HOMEWORK

p.233 #10.8 - 10.10, 10.16

p.234 #10.17 - 10.23
(See Additional Section V before beginning 10.3 exercises)

p.234 #10.17 - 10.23
(See Additional Section V before beginning 10.3 exercises)

p.235 #10.24, 10.26 - 10.29

APPLICATION OF CHI-SQUARE (*Chapter 11*)

Elements of Competency: Application of Chi-Square

Specific Objectives: 14, 15, 16

SECTION & Topics

11.1 CHI-SQUARE STATISTIC

Observed and Expected Values, Test Statistic for Chi-Square

11.2 INFERENCES CONCERNING MULTINOMIAL EXPERIMENTS

Multinomial experiments, Degrees of freedom for multinomial experiments

11.3 INFERENCES CONCERNING CONTINGENCY TABLES

Test of Independence, Contingency Tables

ADDITIONAL SECTION VI: TESTING FOR NORMALITY

Chi-Square test for normality

ADDITIONAL SECTION VII (OPTIONAL): LINEAR CORRELATION

Testing for significance

HOMEWORK

p.252 #11.3 - 11.5

p.252 #11.9 - 11.17

p.254 #11.20 - 11.27

Exercises distributed in class

Exercises distributed in class

USING MODERN TECHNOLOGY:

USING EXCEL

Elements of Competency: Using Modern Technology

Specific Objectives: 17

SECTION & Topics

ADDITIONAL SECTION VIII: USING EXCEL

Statistical and graphing software

HOMEWORK

Exercises distributed in class