

General Information.

Discipline: Mathematics *Course code:* 201-AS3-AB

Ponderation: 2-2-2 *Credits:* 2

Prerequisite: 201-AS2 (or equivalent)

Objective: To analyze phenomena using the statistical method (01Y3).

Students are strongly advised to seek help promptly from their teacher if they encounter difficulties in the course.

Introduction. Statistics is the third of the required mathematics courses in the Arts and Sciences program, and is usually taken in the third semester. A branch of mathematics in its own right, it introduces students to the collection, description and analysis of data. The primary purpose of the course is the attainment of objective 01Y3 (“To analyze phenomena using the statistical method”). To achieve this goal, the course will instruct the student how to apply the techniques of descriptive and inferential statistics to analyse data. The student will be introduced to grouped and ungrouped frequency distributions, and probability and sampling distributions. This will lead to the two main areas of inference, estimation, and tests of hypothesis. Statistical methods are used in almost every discipline. Emphasis will be placed on applications to the disciplines in which the student is currently taking courses.

This course can contribute to the Environmental Studies certificate. For more information, talk to the teacher or contact the [certificate coordinator](#).

Teaching Methods. This course will be 60 hours, meeting three times per week for a total of four hours per week. It relies mainly on the lecture method, although some of the following techniques are also used: question-and-answer sessions, labs, problem-solving periods, class discussions, and assigned reading for independent study. In general, each class begins with a question period on previous topics, then new material is introduced, followed by worked examples. No marks are deducted for absenteeism (however, see below). Failure to keep pace with the lectures results in a cumulative inability to cope with the material and a failure in the course. A student will generally succeed or fail depending on how many problems have been attempted and solved successfully. It is entirely the student’s responsibility to complete suggested homework assignments as soon as possible following the lecture. This allows the student the maximum benefit from any discussion of the homework (which usually occurs in the following class). Answers to a selected number of problems can be found in the back of the text.

Course Objectives. See below.

Course Outline Change. Please note that course outlines may be modified if health authorities change the access allowed on-site.

Departmental Attendance Policy. Due to the COVID-19 health crisis, attendance policies may need to be adjusted by your teacher. Regular attendance is expected, and your teacher will inform you of any details or modifications as needed. Please note that attendance continues to be extremely important for your learning, but your teacher may need to define it in different terms based on the way your course is delivered during the semester.

Additional Software. In addition to LEA, Teams and Moodle, additional software may be used for the submission of essays or projects or for testing. Further details will be provided if applicable.

Class Recordings. Classes on Teams or other platforms may be recorded by your teacher and subsequently posted on Teams and/or LEA to help for study purposes only. If you do not wish to be part of the recording, please let your teacher know that you wish to not make use of your camera, microphone or chat during recorded segments. Any material produced as part of this course, including, but not limited to, any pre-recorded or live video is protected by copyright, intellectual property rights and image rights, regardless of the medium used. It is strictly forbidden to copy, redistribute, reproduce, republish, store in any way, retransmit or modify this material. Any contravention of these conditions of use may be subject to sanction(s) by John Abbott College.

Course Content.

- (1) Descriptive Statistics
- (2) Correlation and Regression
- (3) Probability
- (4) Random Variables
- (5) Probability Distributions
- (6) Sampling Distributions
- (7) Point Estimators and Confidence Intervals
- (8) Hypothesis Testing

Required Text. None.

Course Costs. A scientific, non-graphing, non-programmable calculator (\$15–\$25) is necessary.

Evaluation Plan. The Final Grade is a combination of the Class Mark and the mark on the Final Exam. The Class Mark will include 2 to 3 tests (worth a total of 70% of the Class Mark), and 5 to 8 assignments (worth a total of 30% of the Class Mark).

The Final Grade will be the better of:

50% Class Mark and 50% Final Exam Mark

or

25% Class Mark and 75% Final Exam Mark

A student *choosing not to write* the Final Exam will receive a failing grade of 50% or their Class Mark, whichever is less.

Students must be available until the end of the final examination period to write exams.

Other Resources.

Math Website.

<http://departments.johnabbott.qc.ca/departments/mathematics>

Math Study Area. Located in H-200A and H-200B; the common area is usually open from 8:30 to 17:30 on weekdays as a quiet study space. Computers and printers are available for math-related assignments. It is also possible to borrow course materials when the attendant is present.

Math Help Centre. Located in H-216; teachers are on duty from 9:00 until 16:00 to give math help on a drop-in basis.

Academic Success Centre. The Academic Success Centre, located in H-117, offers study skills workshops and individual tutoring.

College Policies.

Policy No. 7 - IPESA, Institutional Policy on the Evaluation of Student Achievement: <http://johnabbott.qc.ca/ipesa>.

Religious Holidays (Article 3.2.13 and 4.1.6). Students who wish to miss classes in order to observe religious holidays must inform their teacher of their intent in writing within the first two weeks of the semester.

Student Rights and Responsibilities: (Article 3.2.18). It is the responsibility of students to keep all assessed material returned to them and/or all digital work submitted to the teacher in the event of a grade review. (The deadline for a Grade Review is 4 weeks after the start of the next regular semester.)

Student Rights and Responsibilities: (Article 3.3.6). Students have the right to receive graded evaluations, for regular day division courses, within two weeks after the due date or exam/test date, except in extenuating circumstances. A maximum of three (3) weeks may apply in certain circumstances (ex. major essays) if approved by the department and stated on the course outline. For evaluations at the end of the semester/course, the results must be given to the student by the grade submission deadline (see current Academic Calendar). For intensive courses (i.e.: intersession, abridged courses) and AEC courses, timely feedback must be adjusted accordingly.

Academic Procedure: Academic Integrity, Cheating and Plagiarism (Article 9.1 and 9.2). Cheating and plagiarism are unacceptable at John Abbott College. They represent infractions against academic integrity. Students are expected to conduct themselves accordingly and must be responsible for all of their actions.

College definition of Cheating: Cheating means any dishonest or deceptive practice relative to examinations, tests, quizzes, lab assignments, research papers or other forms of evaluation tasks. Cheating includes, but is not restricted to, making use of or being in possession of unauthorized material or devices and/or obtaining or providing unauthorized assistance in writing examinations, papers or any other evaluation task and submitting the same work in more than one course without the teacher's permission. It is incumbent upon the department through the teacher to ensure students are forewarned about unauthorized material, devices or practices that are not permitted.

College definition of Plagiarism: Plagiarism is a form of cheating. It includes copying or paraphrasing (expressing the ideas of someone else in one's own words), of another person's work or the use of another person's work or ideas without acknowledgement of its source. Plagiarism can be from any source including books, magazines, electronic or photographic media or another student's paper or work.

OBJECTIVES	STANDARDS
<p>Statement of the Competency</p> <p>To analyze phenomena using the statistical method. (01Y3)</p> <p>Elements of the Competency</p> <ol style="list-style-type: none"> 1. To choose the statistical analysis techniques in accordance with the phenomena being studied. 2. To describe the characteristics of the phenomena being studied. 3. To calculate the probability of events. 4. To deduce the characteristics of a population on the basis of sample data. 5. To interpret the results. 	<p>General Performance Criteria</p> <ul style="list-style-type: none"> • Appropriate use of concepts. • Correct algebraic operations. • Correct choice and application of statistical techniques. • Correct interpretation of results. • Accurate calculations. • Proper justification of steps in a solution. • Appropriate use of terminology. • Appropriate use of series of real data. • Appropriate use of formulæ, statistical tables and data processing software. <p>Specific Performance Criteria</p> <p><i>[Specific performance criteria for each of these elements of the competency are shown below with the corresponding intermediate learning objectives. For the items in the list of learning objectives, it is understood that each is preceded by: "The student is expected to ...".]</i></p>
<p>Specific Performance Criteria</p> <ol style="list-style-type: none"> 1. <i>Description of a data set</i> <ol style="list-style-type: none"> 1.1 Description of a Population, Sample, Parameter, Statistic 1.2 Description of a variable 1.3 Description of data collection methods 1.4 Description of types of Samples 1.5 Graphical description of data 1.6 Calculation of measures of central tendency (raw data) 1.7 Calculation of measures of dispersion (raw data) 	<p>Intermediate Learning Objectives</p> <ol style="list-style-type: none"> 1.1.1. State the definition of a Population. 1.1.2. State the definition of a Sample. 1.1.3. State the definition of a Parameter. 1.1.4. State the definition of a Statistic. 1.2.1. State the definition of a variable. 1.2.2. Differentiate between a discrete and a continuous variable. 1.2.3. Differentiate between a dependent variable and an independent variable. 1.2.4. Differentiate between a qualitative variable and a quantitative variable. 1.3.1. State the definition of Sampling. 1.3.2. State the definition of an experiment. 1.3.3. Describe other data collection methods. 1.4.1. Describe a simple random Sample. 1.4.2. Describe a stratified Sample 1.4.3. Describe a systematic Sample. 1.4.4. Describe a cluster Sample. 1.5.1. Construct – in tabular form – the distribution of a data set. 1.5.2. Construct a stem and leaf plot. 1.5.3. Construct a box plot. 1.5.4. Construct a frequency and relative frequency histogram. 1.5.5. Construct frequency, relative frequency and cumulative frequency polygons. 1.5.6. Construct Bar and Pie graphs. 1.6.1. Define mean, median, mode, midquartile and midrange. 1.6.2. Calculate the mean, median, mode, midquartile and midrange. 1.7.1. State definitions of and compute the range, mean absolute deviation, variance, standard deviation (std.), coefficient of variation and interquartile range

Specific Performance Criteria	Intermediate Learning Objectives
1.8 Computation of measures of location	1.8.1. Compute percentiles, deciles and quartiles.
1.9 Computations with grouped data	1.8.2. Calculate the std. score (z-score).
1.10 Calculation of the least squares (regression) equation (bivariate data)	1.9.1. Approximate (estimate) the std. deviation of a sample.
1.11 Calculation of the linear correlation coefficient (r)	1.10.1. Plot a scatter diagram.
1.12 Calculation of measures for a linear function of a variable	1.10.2. Calculate the regression equation.
<i>2. To calculate the probability of an event</i>	1.10.3. Plot a graph of the regression equation.
2.1 Definition of basic terminology	1.10.4. Use the regression equation to predict a value of the dependent variable.
2.2 Use of counting methods	1.10.5. Analyze the residuals.
2.3 Probability Rules	1.11.1. State the definition of the linear correlation coefficient r .
<i>3. Computation of Probabilities using random variables and their distributions</i>	1.11.2. Calculate the linear correlation coefficient.
3.1 Description of a random variable	1.12.1. Define a linear function of a variable.
3.2 Computation of probabilities using a discrete random variable.	1.12.2. Calculate the mean of a linear function of a variable.
3.3 Computation and interpretation of the mean, variance and std. deviation of a discrete random variable (r.v.).	1.12.3. Calculate the variance and std. deviation of a linear function of a variable.
3.4 Determination of a mean, variance and std. deviation of a linear function of a discrete r.v.	2.1.1. State the definition of probability.
3.5 Explanation and application of Tchebychev's Theorem.	2.1.2. Differentiate between classical, relative frequency and subjective probabilities.
3.6 Calculation of probabilities, mean and variance of a binomial r.v.	2.1.3. Define outcomes, sample space and events.
3.7 Determination of probabilities, mean and variance of a hypergeometric r.v.	2.2.1. State and apply the fundamental counting principle.
3.8 Determination of probabilities, mean and variance of a Poisson r.v.	2.2.2. State and apply the Permutation and Combination rules.
	2.3.1. State and apply the conditional probability rule.
	2.3.2. State and apply the multiplication rule.
	2.3.3. State and apply the addition rule.
	2.3.4. State and apply Bayes' Rule.
	3.1.1. State the definition of a discrete random variable.
	3.1.2. State the definition of a continuous random variable.
	3.2.1. Define and compute the probability of a discrete random variable.
	3.3.1. Define and calculate the mean of a discrete random variable.
	3.3.2. Define and calculate the expected value of a discrete random variable.
	3.3.3. Define and calculate the variance and std. deviation of a discrete r.v.
	3.4.1. Define a linear function of a discrete r.v.
	3.4.2. Calculate and interpret the mean and variance of a linear function of a discrete r.v.
	3.5.1. State and prove Tchebychev's Theorem.
	3.5.2. Apply Tchebychev's Theorem to any arbitrary data set.
	3.6.1. Define a binomial r.v.
	3.6.2. Define a binomial probability mass function (p.m.f.).
	3.6.3. Calculate probabilities using the binomial p.m.f.
	3.6.4. Compute the mean and variance of the binomial r.v.
	3.7.1. Define a hypergeometric r.v.
	3.7.2. Define a hypergeometric p.m.f.
	3.7.3. Compute probabilities using the hypergeometric p.m.f.
	3.7.4. Compute the mean and variance of a hypergeometric r.v.
	3.8.1. Define a Poisson r.v.
	3.8.2. Define a Poisson p.m.f.
	3.8.3. Calculate probabilities using the Poisson p.m.f.
	3.8.4. Compute the mean and variance of the Poisson r.v.

Specific Performance Criteria	Intermediate Learning Objectives
3.9 Determination of probabilities, mean and variance of a continuous r.v.	3.9.1. Define and compute the mean of a continuous r.v.
	3.9.2. Define and compute the variance of a continuous r.v.
	3.9.3. Calculate the probability of an event described in terms of a continuous r.v.
3.10 Calculation and application of probabilities for a normal distribution.	3.10.1. State the probability density function (p.d.f.) of a normal r.v.
	3.10.2. State the mean, std. deviation and resulting p.d.f.
	3.10.3. Use the std. normal tables to compute probabilities for a normal r.v.
	3.10.4. Use the normal distribution to solve science-related problems.
	3.10.5. State the conditions under which the normal distribution can be used as an approximation of the binomial/Poisson distributions.
	3.10.6. Calculate probabilities using the normal approximation.
<i>4. Derivation and analysis of sampling distributions.</i>	
4.1 Determination of probabilities for a sampling distribution.	4.1.1. State the Central Limit Theorem (C.L.T.).
	4.1.2. Determine – intuitively – the results of the C.L.T.
	4.1.3. Use the C.L.T. to calculate probabilities of an event described in terms of the distribution of the sample means.
	4.1.4. State the distribution of sample proportions.
	4.1.5. Calculate the probability of an event described in terms of the distribution of sample proportions.
	4.1.6. Use the t–distribution to calculate the probability of an event described in terms of the distribution of sample means calculated from small samples (population std. deviation unknown).
	4.1.7. Use the chi–squared distribution to calculate the probability of an event described in terms of the distribution of the chi–squared statistic.
<i>5. Estimation of Parameters</i>	
5.1 Determination of point estimators.	5.1.1. State the definition of a consistent estimator.
	5.1.2. State the definition of an unbiased minimum variance estimator (U.M.V.).
5.2 Calculation of a point estimate (single population).	5.2.1. Compute a point estimate for the mean of a population.
	5.2.2. Compute a point estimate for the proportion of successes in a binomial population.
	5.2.3. Compute point estimates for the variance and std. deviation of a population.
5.3 Calculation of a point estimate (two populations).	5.3.1. Determine a point estimate for the difference of two population means.
	5.3.2. Determine a point estimate for the difference of two population proportions.
	5.3.3. Determine a point estimate for a quotient of two population variances.
5.4 Determination of confidence interval estimates (one population).	5.4.1. State the definition of the level of confidence $(1 - \alpha)$.
	5.4.2. Determine a confidence interval estimate for the population mean.
	5.4.3. Determine a confidence interval estimate for the population proportion.
	5.4.4. Determine a confidence interval estimate for the population variance.
5.5 Determination of confidence interval estimates (two populations).	5.5.1. Calculate a confidence interval estimate for the difference of two population means.
	5.5.2. Calculate a confidence interval estimate for the difference of two population proportions.
	5.5.3. Calculate a confidence interval estimate for a quotient of two population variances.

Specific Performance Criteria	Intermediate Learning Objectives
5.6 Determination of sample size.	5.6.1. Calculate the margin of error.
	5.6.2. Compute the minimum sample size required to estimate the population mean.
	5.6.3. Calculate the minimum sample size required to estimate the population proportion.
6. <i>Test of Hypothesis</i>	
6.1 Definition of basic terms.	6.1.1. Define the following terms – used in a test of hypothesis: Null hypothesis ; Alternative hypothesis ; Type I and Type II errors ; Test criteria ; Test statistic ; Level of significance P -value
6.2 Test of hypothesis about the population mean.	6.2.1. Perform a hypothesis test about the population mean (population std. deviation known).
	6.2.2. Perform a hypothesis test about the population mean (population std. deviation unknown).
6.3 Test of hypothesis about the proportion of successes in a binomial population.	6.3.1. Perform a test of hypothesis about the population proportion (small sample).
	6.3.2. Perform a test of hypothesis about the population proportion (large sample).
6.4 Test of hypothesis concerning the population variance/std. deviation.	6.4.1. Perform a test of hypothesis about the variance of a normal population.
	6.4.2. Perform a hypothesis test concerning the std. deviation of a normal population.
6.5 Test of hypothesis about the difference of two population means.	6.5.1. Perform a hypothesis test about the difference of two population means – using two independent random samples.
	6.5.2. Perform a hypothesis test about the difference of two population means – using two dependent samples.
6.6 Test of hypothesis about the quotient of two population variances.	6.6.1. Perform a hypothesis test concerning the quotient of two population variances – using independent random samples.
6.7 Test of hypothesis about the difference of two population proportions.	6.7.1. Perform a hypothesis test about the difference in two population proportions – using large independent random samples.
6.8 Test of hypothesis concerning multinomial proportions.	6.8.1. Perform a test of hypothesis about population proportions – using independent random samples.
6.9 Test of hypothesis about the regression coefficients.	6.9.1. Perform a hypothesis test about the slope of the regression line.
	6.9.2. Perform a test of hypothesis about the intercept of the regression line.
6.10 Test of hypothesis about the linear correlation coefficient.	6.10.1. Perform a test of hypothesis about the linear correlation coefficient.
7. <i>Integration, Comprehensive Assessment and Exit Profile Goals</i>	
7.1 Recognition of the links between science, technology and the evolution of society.	7.1.1. Discuss the application of Statistical Methods to a relevant problem from science.
7.2 Development of a personal system of values.	7.2.1. Discuss any social or ethical aspect of the specific problem used in your Comprehensive Assessment.
7.3 Application of acquired knowledge to a new situation.	7.3.1. Demonstrate clearly the specific statistical techniques used in some problem from science.
7.4 Clear demonstration of the links between Statistics and at least one other science discipline.	7.4.1. Apply knowledge or skills that have been acquired to topic(s) in Physics, Chemistry or Biology.