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.

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.

OBJECTIVES	STANDARDS
Statement of the Competency To analyze phenomena using the statistical method. (01Y3)	**General Performance Criteria** • 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.
Elements of the Competency 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.	**Specific Performance Criteria** *[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 . . . ".]*

Specific Performance Criteria	Intermediate Learning Objectives
1. *Description of a data set*	
1.1 Description of a Population, Sample, Parameter, Statistic	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 Description of a variable	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 Description of data collection methods	1.3.1. State the definition of Sampling. 1.3.2. State the definition of an experiment. 1.3.3. Describe other date collection methods.
1.4 Description of types of Samples	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 Graphical description of data	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 Calculation of measures of central tendency (raw data)	1.6.1. Define mean, median, mode, midquartile and midrange. 1.6.2. Calculate the mean, median, mode, midquartile and midrange.
1.7 Calculation of measures of dispersion (raw data)	1.7.1. State definitions of and compute the range, mean absolute deviation, variance, standard deviation (std.), coefficient of variation and interquartile range
1.8 Computation of measures of location	1.8.1. Compute percentiles, deciles and quartiles. 1.8.2. Calculate the std. score (z-score).
1.9 Computations with grouped data	1.9.1. Approximate (estimate) the std. deviation of a sample.
1.10 Calculation of the least squares (regression) equation (bivariate data)	1.10.1. Plot a scatter diagram. 1.10.2. Calculate the regression equation. 1.10.3. Plot a graph of the regression equation. 1.10.4. Use the regression equation to predict a value of the dependent variable. 1.10.5. Analyze the residuals.
1.11 Calculation of the linear correlation coefficient (r)	1.11.1. State the definition of the linear correlation coefficient r . 1.11.2. Calculate the linear correlation coefficient.
1.12 Calculation of measures for a linear function of a variable	1.12.1. Define a linear function of a variable. 1.12.2. Calculate the mean of a linear function of a variable. 1.12.3. Calculate the variance and std. deviation of a linear function of a variable.
2. *To calculate the probability of an event*	
2.1 Definition of basic terminology	2.1.1. State the definition of probability. 2.1.2. Differentiate between classical, relative frequency and subjective probabilities. 2.1.3. Define outcomes, sample space and events.
2.2 Use of counting methods	2.2.1. State and apply the fundamental counting principle. 2.2.2. State and apply the Permutation and Combination rules.
2.3 Probability 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. *Computation of Probabilities using random variables and their distributions*	
3.1 Description of a random variable	3.1.1. State the definition of a discrete random variable. 3.1.2. State the definition of a continuous random variable.
3.2 Computation of probabilities using a discrete random variable.	3.2.1. Define and compute the probability of a discrete random variable.
3.3 Computation and interpretation of the mean, variance and std. deviation of a discrete random variable (r.v.).	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 Determination of a mean, variance and std. deviation of a linear function 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.

Specific Performance Criteria	Intermediate Learning Objectives
3.5 Explanation and application of Tchebychev's Theorem.	3.5.1. State and prove Tchebychev's Theorem. 3.5.2. Apply Tchebychev's Theorem to any arbitrary data set.
3.6 Calculation of probabilities, mean and variance of a binomial r.v.	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 Determination of probabilities, mean and variance of a hypergeometric 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 Determination of probabilities, mean and variance of a Poisson 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.
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.
4. *Derivation and analysis of sampling distributions.*	
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.
5. *Estimation of Parameters*	
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
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. *Test of Hypothesis*	
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. *Integration, Comprehensive Assessment and Exit Profile Goals*	
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.

Required Text. None

Course Content.

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

Other Resources.

Math Website.
http://departments.johnabbott.qc.ca/departments/mathematics

Math Lab. Located in H-203 and open from 9:00 to 16:00 (weekdays) as a study area, and from 11:30 to 16:00 for borrowing course materials or using the computers and printers for math assignments.

Math Help Centre. Located in H-200A; 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.

Departmental Attendance Policy. Regular attendance is expected. Missing six classes is grounds for automatic failure in this course. Many of the failures in this course are due to students missing classes.

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

Course Costs. A scientific calculator ($15–$25) will be essential.

According to departmental policy, only the following models of calculators may be used for quizzes, tests, and the final exam.

Sharp EL531WB-BK
TI-30XIIS
Casio FX-300MS Plus
VICTOR 930-2

College Policies. Article numbers refer to the IPESA (Institutional Policy on the Evaluation of Student Achievement), which can be found at the college website. Students are encouraged to consult the IPESA to learn more about their rights and responsibilities.

Changes to Evaluation Plan in Course Outline (Article 4.3). Changes to the evaluation plan, during the semester, require unanimous consent of students.

Mid-Semester Assessment MSA (Article 3.3). Students will receive an MSA in accordance with College procedures.

Religious Holidays (Article 3.2). Students who wish to observe religious holidays must inform their teacher of their intent, in writing, within the first two weeks of the semester.

Grade Reviews (Article 3.2, item 19). It is the responsibility of students to keep all assessed material returned to them in the event of a grade review. (The deadline for a Grade Review is 4 weeks after the start of the next regular semester.)

Results of Evaluations (Article 3.3, item 7). Students have the right to receive the results of evaluation, for regular day division courses, within two weeks. For evaluations at the end of the semester/course, the results must be given to the student by the grade submission deadline.

Cheating and Plagiarism (Articles 8.1 & 8.2). Cheating and plagiarism are serious infractions against academic integrity, which is highly valued at the College; they are unacceptable at John Abbott College. Students are expected to conduct themselves accordingly and must be responsible for all of their actions.