ALES 291/ Math 120

MATHEMATICS FOR THE LIFE SCIENCES

In Winter 2022, Math 120, *Mathematics for the Life Sciences*, is being offered at Yukon University concurrent with the University of Alberta's ALES 291, *Mathematics for the Life Sciences*, as part of the Northern Environmental and Conservation Sciences, B.Sc. Program. All students registered in Math 120 or ALES 291 must adhere to requirements outlined in this course syllabus. University of Alberta students must also be aware of, and adhere to, the University's Code of Student Behaviour, referenced in the outline; Yukon University students must be aware of, and adhere to, Yukon University's Academic Regulations, also referenced in the outline.

INSTRUCTOR:	Dr. Tim Topper, PhD, Professor Emeritus
OFFICE HOURS:	Immediately before or after class, or by appointment.
OFFICE LOCATION:	N.A.
E-MAIL:	ttopper@yukonu.ca

CLASS DAYS & TIMES:	Mondays, Wednesdays and Fridays 9:00 am – 10:30 am
	January 5 – April 11
CLASS LOCATION:	A2204

COURSE DESCRIPTION

This course provides a survey of finite mathematics and calculus focussing on the concepts and modelling techniques used in the life sciences. To this end it covers common families of functions (polynomial, logarithmic and exponential) and their derivatives and integrals, linear programming, simple and conditional probability and Bayes theorem, and network analysis. The topics are illustrated using problems drawn from the life sciences.

COURSE REQUIREMENTS

For students taking the course as Math 120:
Prerequisite(s): Pre-Calculus 12 **or** Foundations of Mathematics 12 **or** MATH 060.

For students taking the course as ALES 291:
Registration in Yukon University/University of Alberta B.Sc. in Environmental and Conservation Sciences degree program, **and** one of Pre-Calculus 12 or Foundations of Mathematics 12 or MATH 060.

EQUIVALENCY OR TRANSFERABILITY

Receiving institutions determine course transferability. Find further information at: https://www.yukonu.ca/admissions/transfer-credit.

Students in the B.Sc. ENCS program should contact an ENCS advisor if they have questions about equivalency or transferability of this course.

LEARNING OUTCOMES

Upon successful completion of this course, students will be able to:

- Take everyday situations, translate them into mathematical representations (equations, graphs, tables, or network diagrams), manipulate these representations, and interpret the results in terms of the original situation.
- Solve linear programming problems graphically and using the simplex method.
- Categorize quantities' variations as being polynomial, exponential, logarithmic or 'other'.
- Find the derivatives and integrals of polynomial, exponential and logarithmic functions and solve problems requiring their application.
- Apply Bayes theorem.
- Solve a variety of networking problems, e.g. critical path, shortest route, maximal flow, using both graphical and matrix network representations.

COURSE FORMAT

Delivery format

The plan as of December 15, 2021 is to deliver the course face-to-face. However, Covid continues to surprise and frustrate, and the course **may** be required to pivot to an online offering.

Weekly breakdown of instructional hours

The course content is covered through lectures and tutorials. Class time will be roughly divided 2:1 between lectures and tutorials. *Students with a sound mathematical background*

can expect to spend between one and three hours in preparation and study for each hour spent in class.

EVALUATION

The course grade will be determined as follows:

	Percent
Quizzes	30%
Assignments	30%
Final Exam	40%
Total	100%

Homework

Mathematics can only be learned by doing it. To this end, problems will be assigned in most classes and solutions to them will be made available. Students should be certain to do these problems promptly or they risk being unable to understand the material in the next class.

Quizzes (30%)

There will be a brief 10-15 minute quiz *most* weeks. Most questions on the quizzes will be drawn from the homework problems, thus completing the homework should lead to good quiz results. *Missed quizzes cannot be made up*, but your lowest quiz mark will be discarded. Quiz results are worth 30% of the final mark in the course.

Assignments (30%)

There will be weekly assignments over the course of the term worth 30% of the final mark. *Late assignments are not accepted, but the lowest assignment mark will be discarded*. Where the homework problems are intended to assist the student in *learning* new material and are not marked, the assignments are meant to reinforce and *extend* the student's understanding of material that has already been *learned* (i.e. they are more interesting!).

Final Examination (40%)

A final examination which will cover the entire course, and be worth 40% of the final mark, will be held during the examination period at the end of the semester. The date and time will be announced as soon as it is set. **The exam could be as last as April 23rd, so don't make any plans to be away until then before the exam date is announced.**

Students taking the course as ALES 291 must ensure that they are familiar with the University of Alberta's Academic Regulations governing missed and deferred final exams (http://www.registrar.ualberta.ca/calendar/Regulations-and-Information/Academic-Regulation/23.5.html#23.5)

Assignment of grades

The total numerical score will be converted to a grade on Yukon University's letter grading system.

COURSE WITHDRAWAL INFORMATION

Students registered in Math 120 should refer to the YukonU website for important dates (https://www.yukonu.ca/admissions/important-dates) especially the last date on which you may withdraw without academic penalty.

Students registered in ALES 291 should refer to the UAlberta calendar for important dates (https://calendar.ualberta.ca).

TEXTBOOKS AND LEARNING MATERIALS

A variety of online resources will be used instead of a printed textbook.

Course Website

This course will use two websites.

The course Moodle site (https://moodle.yukonu.ca/course/view.php?id=11488) will be used for administration and logistics, e.g. the course calendar will show you upcoming events and deadlines, and the gradebook will show you your marks.

Course materials like notes, pictures of the blackboards, exercises and assignments will be found at https://www.timtopper.com/Math120.W22 .

The sites are carefully linked together, so you should usually be unaware of their duality.

ACADEMIC INTEGRITY

Yukon University Academic Standards and Regulations

Students are expected to contribute toward a positive and supportive environment and are required to conduct themselves in a responsible manner. Academic misconduct includes all forms of academic dishonesty such as cheating, plagiarism, fabrication, fraud, deceit, using the work of others without their permission, aiding other students in committing academic offences, misrepresenting academic assignments prepared by others as one's own, or any other forms of academic dishonesty including falsification of any information on any Yukon University document.

Please refer to YukonU Academic Regulations & Procedures for further details about academic standing and student rights and responsibilities.

University of Alberta Academic Integrity and Code of Student Behaviour

The University of Alberta is committed to the highest standards of academic integrity and honesty. Students are expected to be familiar with these standards regarding academic honesty and to uphold the policies of the University in this respect. Students are particularly urged to familiarize themselves with the provisions of the Code of Student Behaviour (online at www.governance.ualberta.ca) and avoid any behaviour which could potentially result in suspicions of cheating, plagiarism, misrepresentation of facts and/or participation in an offence. Academic dishonesty is a serious offence and can result in suspension or expulsion from the University.

All students at the University of Alberta are subject to the Code of Student Behaviour, as outlined at: http://www.governance.ualberta.ca/en/CodesofConductandResidenceCommunityStandards/CodeofStudentBehaviour.aspx Please familiarize yourself with it and ensure that you do not participate in any inappropriate behavior as defined by the Code. Key components of the code include the following statements.

30.3.2(1) No Student shall submit the words, ideas, images or data of another person as the Student's own in any academic writing, essay, thesis, project, assignment, presentation or poster in a course or program of study.

30.3.2(2) c. No Student shall represent another's substantial editorial or compositional assistance on an assignment as the Student's own work.

PROFESSIONALISM AND CLASSROOM RULES OF ENGAGEMENT

Students are expected to attend all lectures, be engaged and courteous in all course activities, and to be on time for class.

ELECTRONIC DEVICES

Electronic devices are powerful tools that can assist in learning and we will make use of several in this course.

Students will **require** a scientific *calculator*, but it must **not** include graphing or programming capabilities. More detail will be provided in the first week of class.

Cell phones can be useful for looking information up during class, but please do not speak on or to them during class.

Laptops are encouraged for note taking and in-class work. The guiding principle regarding their use in the classroom is that you are responsible for your own learning, but also responsible not to interfere with your classmates' learning.

We will use several *online software tools* during the course to assist us in our mathematical analyses so having a laptop with internet access will be helpful (a phone screen is too small to use them effectively). If you don't have both you will want to plan your work time carefully to ensure you can use the computer labs at YukonU.

Use of electronic devices during tests and exams is prohibited with the sole exception of an approved non-graphing, non-programmable calculator.

RECORDING OF LECTURES, LABS, ETC.

Audio or video recording, digital or otherwise, of lectures, labs, seminars or any other teaching environment by students is allowed only with the prior written consent of the instructor or as a part of an approved accommodation plan. Student or instructor content, digital or otherwise, created and/or used within the context of the course is to be used solely for personal study, and is not to be used or distributed for any other purpose without prior written consent from the content author(s).

ACADEMIC ACCOMMODATION

Reasonable accommodations are available for students requiring an academic accommodation to fully participate in this class. These accommodations are available for students with a documented disability, chronic condition or any other grounds specified in section 8.0 of the Yukon University Academic Regulations (available on the Yukon University website). It is the student's responsibility to seek these accommodations by contacting the Learning Assistance Centre (LAC): LearningAssistanceCentre@yukonu.ca.

TOPIC OUTLINE AND TENTATIVE SCHEDULE

Week	Content
1	**Linear Models: Introduction**
2	**Linear Models: Systems of Equations** Solving systems of linear equations and inequalities algebraically, graphically and using matrices.
3	**Linear Models for Optimization** Linear programming: Graphical Solution
4	Linear programming: The Simplex Method
5	**Nonlinear Models** Quadratic, Exponential and Sinusoidal models.
6	**Modelling change: Derivatives** Average rate of change. Instantaneous rate of change. Rules for differentiation: basic, products, quotients, the chain rule.
7	Applications of the Derivative: Function sketching Optimization problems
8	*Reading Week*
9	**Modelling Accumulation: Integrals**
10	**Modelling Uncertainty: Probability** Simple and conditional probability. Combinatorics.
11	Bayes' Theorem.
12	**Modelling Structure: Graph theory** Diagrammatic representation of graphs. Matrix representation of graphs. Euler circuits and paths; minimal spanning trees.
13	Hamiltonian circuits and paths; shortest routes. Shortest route algorithm. Maximal flow.
14	**Synthesis** Matrix multiplication applied to graphs. Markov processes.
15	**Review and Exam Preparation**
15-16	**Examination Period**