



THE UNIVERSITY OF BRITISH COLUMBIA

Department of Computer Science, Mathematics, Physics and Statistics
Okanagan Campus

MATH 116 - 002
Calculus I for Management and Economics
W2021 T-1
Course Outline

Course Information

Instructor: Dr. Paul Tsopméné

E-mail: paul.tsopmene@ubc.ca

Classroom Schedule: Monday, Wednesday, Friday: 12:00 – 1:00 PM

Mode of Delivery (Course and Tutorials): Online

Requires In-Person Attendance: No

Location: On-line through Zoom. Here is the Zoom link:

<https://ubc.zoom.us/j/63772504024?pwd=YjhLRlFICZWtUWVUrZ3ArN0RGZ2hzZz09>

Office Hours: Monday and Thursday: 10:00 AM – 11:30 AM. These will be conducted on Zoom. Here is the link:
<https://ubc.zoom.us/j/65512164169?pwd=ZGo1cVJnNINaWVlteEhQdGpteFR5QT09>

I am also available by email or by appointment if these times do not work for you.

Course Website: Course material on our [Canvas](#) learning management system. My primary method of communication is through Canvas messages/emails. Make sure you check this website regularly.

Textbooks and Calculators

Textbook (optional): *Calculus with Applications*, by Margaret L. Lial, Raymond N. Greenwell, and Nathan P. Ritchey, 11th edition, Pearson. It is available in the bookstore.

Textbook Solutions Manual: *Calculus I for Management and Economics*, by Paul Tsopméné. This is free and it is available on Canvas.

Calculators: The use of a scientific calculator (non-graphing, non-programmable) is permitted.

Calendar Course Description

MATH 116 (3) Calculus I for Management and Economics

The derivative; limits; rate of change; derivatives of algebraic, logarithmic, trigonometric and exponential functions; applications to marginal analysis; elasticity of demand; optimization and curve-sketching, Newtons Method and Taylor polynomials. Credit will be granted for only one of MATH 116 or MATH 100. [3-0-1]

Prerequisite: Either (a) a score of 67% or higher in one of MATH 12, PREC 12 or (b) a score of 60% or higher in one of MATH 125, MATH 126.

Equivalency: MATH 100.

Course Format

Lectures and tutorials.

- **Lecture Format:** Each week (excepting holidays) there will be three lectures delivered online via Zoom. During a typical lecture, the instructor will present one or more concepts, cover examples, and answer questions. The focus will be on applications of the concepts, rather than proofs. **Our first class will hold on Wednesday, September 08.**

Note: The lectures will be delivered synchronously, and will be recorded and posted on Canvas. So, if you can't attend live, you can watch the lecture later. Even though we are doing this remotely, questions are highly encouraged during lecture! Please feel free to ask whatever questions you like in the chat or aloud.

- **Tutorial Format:** Most weeks students will meet with their tutorial section online via zoom. And the Teaching Assistant will answer their questions and/or review and practice course material. The zoom links for the tutorials will be sent to students by email and/or posted on Canvas. **Tutorial sessions start on Monday, September 20** (not September 13 as initially announced).

Note: The attendance is not mandatory. But **every student must be registered in one of the tutorial sections.**

Course Overview, Content and Objectives

Course Overview: This course will focus on single variable differential calculus and its applications. While the list of topics aligns well with a general calculus course, most of the concepts will be presented through applications in Business and Economics. The course will start off with linear functions. In this chapter we will learn how to find the slope between two points and the equation of a line. We will also learn how to find the equilibrium quantity, the equilibrium price, and the break-even quantity. In the second chapter, we will learn how to sketch the graph of a quadratic function and find the maximum profit/revenue, solve exponential and logarithmic equations, and solve (continuous) compound amount/interest problems. Calculus really starts in the third chapter with the concept of limits. We will learn how to find limits using rules and show that a function is continuous/discontinuous using limits. Then we will define the core concept of this course: the derivative. And we will learn how to find it using the limit definition, interpret the derivative geometrically (as the slope of the tangent line), interpret the derivative as the instantaneous rate of change, and sketch the graph of the derivative of a function defined by a graph. In the fourth chapter, we will learn how to find derivatives using rules (constant rule, power rule, constant multiple rule, sum/difference rule, product rule, quotient rule, chain

rule). We will also learn how to find and interpret the marginal cost, revenue, profit, average cost, average revenue, average profit by using the concept of derivatives. In the fifth chapter, we will cover some applications of the derivative. We will learn how to find the intervals where a function is increasing/decreasing, find the relative extrema, find the intervals where a function is concave upward/downward, find the point of diminishing returns, and sketch the graph of a function. We will also learn how to maximize the profit/revenue function and minimize the cost function. The last chapter will cover more applications of the derivative. We will learn how to find the absolute maximum and minimum of a function on a closed interval, solve optimization problems, use implicit differentiation to solve related rate problems, find and interpret the elasticity of demand, use differentials to approximate the change in cost, revenue, and profit, and use Newton's method to approximate solutions of algebraic equations.

Contents: Topics include

- **Linear Functions:** Slopes, Equations of Lines and Applications.
- **Nonlinear Functions:** Quadratic, Exponential and Logarithmic Functions.
- **The Derivative:** Limits, Continuity, Rates of Change, Definition of the Derivative, and Graphical Differentiation.
- **Calculating the Derivative:** Techniques for Finding Derivatives, Product, Quotient, and Chain Rules Derivatives of Exponential and Logarithmic Functions.
- **Graphs and the Derivative:** Increasing and Decreasing Functions, Relative Extrema, Concavity, the Second Derivative Test, and Curve Sketching.
- **Applications of the Derivative:** Absolute Extrema, Optimization, Implicit Differentiation, Related Rates, Elasticity of Demand, Differentials, and Newton's Method.

Course Objectives: To enable the student to:

- Understand the fundamental concepts of differential calculus and applications to marginal analysis and elasticity of demand.
- Learn the most important techniques for calculating derivatives.
- Practice how to apply these techniques to model and solve various problems.

Learning Outcomes

After completing this course, students will be able to:

- Understand the basic idea of differential calculus: finding the slope of a tangent line to a curve.
- Evaluate limits both algebraically and geometrically. In particular, students should be able to find "limits of the form $0/0$ " and limits at infinity.
- Determine whether a function is continuous or not. And find the points of discontinuity (if any).
- Find derivatives by using the limit definition.
- Find derivatives graphically.
- Find derivatives by using rules (constant rule, power rule, constant multiple rule, sum/difference rule, product rule, quotient rule, chain rule).
- Find the slope of a tangent line to a curve.



- Find the equation of the tangent line to a curve at a given point.
- Find the (instantaneous) rate of change of a quantity.
- Find and interpret the marginal X , where X could be the cost, revenue, profit, average cost, average revenue, or average profit.
- Find the intervals where a function is increasing and where it is decreasing.
- Find the local or relative extrema.
- Find the maximum profit/revenue and the minimum cost.
- Find the intervals where a function is concave upward and where it is concave downward.
- Find the point of diminishing returns.
- Sketch the graph of a function.
- Find the absolute maximum and minimum of a function on a closed interval.
- Solve optimization problems. That is, problems where it is asked to maximize or minimize a quantity.
- Find the derivative of implicit functions by using the implicit differentiation method.
- Solve related rates problems. That is, problems where there two quantities are involved and the rate of change of one quantity is given, and it is asked to find the rate of change of the other quantity.
- Calculate and interpret the elasticity of demand.
- Find the differential of a function. And use differentials to approximate the change in cost or revenue or profit.
- Use Newton's method to approximate the solution to an equation.

Devices and Invigilation

Devices: This course is being offered in an online format only. You must have all of the following items to participate in this course.

1. A working laptop or desktop computer.
2. A working microphone.
3. A working webcam – external or integrated.
4. A working smartphone or similar device capable of taking a Zoom call and uploading files to Canvas.
5. A tripod or other type of apparatus you can use to put your smartphone or secondary device in a variety of positions.
6. A stable internet connection with enough bandwidth to be connected to Zoom and Canvas simultaneously.

Invigilation: This course uses **Respondus Lockdown Browser and Zoom for invigilation of the midterms and final exam**. These tools are chosen in order to address accreditation requirements and maintain academic integrity for tracking academic progress of individual students. **More information can be found in the document titled "ONLINE TEST INFORMATION", which is posted on Canvas.**

Evaluation

| | |
|---|-------|
| Assignments (Due Friday 11:59 PM) | 20% |
| Midterm 1 (Friday, October 8 at 12:00 PM in class) | 17.5% |
| Midterm 2 (Friday, November 19 at 12:00 PM in class) | 17.5% |
| Final Exam (Cumulative – TBA) | 45% |

Final grades will be based on the evaluations listed above and the final grade will be assigned according to the standardized grading system outlined in the UBC Okanagan Calendar.

Note:

- **You MUST attain a grade of at least 40% on the Final Exam in order to pass the course.** In the event you do not get at least 40% on the final exam AND your final grade is less than 50%, your final grade will be recorded. If you receive less than 40% on the final exam, but course grade is more than 50%, your final course grade will be your final exam percentage score.
- In the event you do not attain at least 40% on the final exam AND your final grade is greater than or equal to 50%, your final exam percentage will be recorded.
- The final exam will be given during the regularly scheduled examination period (Dec. 11 – 22, 2021).
- **Passing Criteria:** In order to pass the course, you must attain a grade of at least 40% on the final exam AND your overall final grade has to be greater than or equal to 50%.
- **Mode of Delivery for Exams:** Online

Practice Problems, Assignments, Midterms, and Final Exam

- **Practice Problems:** Problems from the textbook solutions manual will be regularly assigned for **practice**. While completion of these problems is essential for your success in this course, **you do not hand them in for grading.**
- **Assignments:** There will be 6 assignments throughout the semester. These will be posted on Canvas on Fridays and the **due date will be on the next Friday at 11:59 PM. To submit your assignment, you will have to upload the assignment as a single .pdf file on Canvas.** Once you submit your work on Canvas, **make sure to go back** to the submission box on Canvas and check that your submission is uploaded properly and confirm no missing pages. Try to complete and submit your work at least 12 hours before the due date. **Remember:** Always start the assigned work early. Do not leave things until the last minute. I will be available for help during my office hours or by emails.
Late Policy: Late submissions won't be considered. No extensions or make up assignments. If an assignment/notes is missed for a valid reason (e.g., religious, medical or compassionate reasons, with documentation), the final exam will be weighted more heavily to compensate.



Your worst assignment grade will be dropped from the total.

| Assignment # | Will be released on | Due date |
|--------------|---------------------|--------------|
| 1 | September 17 | September 24 |
| 2 | September 24 | October 1 |
| 3 | October 15 | October 22 |
| 4 | October 22 | October 29 |
| 5 | October 29 | November 5 |
| 6 | November 26 | December 3 |

- **Midterms:** There will be 2 midterm exams (40 minutes each).

| | |
|------------------|--|
| Midterm 1 | Friday, October 8 at 12:00 PM (during the class time) |
| Midterm 2 | Friday, November 19 at 12:00 PM (during the class time) |

I will send you the midterm topics by email about a week before the date of each midterm. The midterms will be written during the class time. **No make-up midterms will be given. If a midterm is missed for a valid reason (e.g., religious, medical or compassionate reasons, with documentation), the other midterm and/or final exam will be weighted more heavily to compensate.** Travel or work are usually not acceptable excuses.

- **Final Exam:** There is a 2.5-hours comprehensive final exam during the final examination period December 11 – 22. Date: TBA. This is a cumulative final exam. **You MUST attain a grade of at least 40% on the final exam in order to pass the course.**

Important Dates

| | |
|------------------------|--|
| Tuesday, September 7 | Term 1 of Winter 2021 semester starts |
| Monday, September 20 | Last day for withdrawal without receiving a “W” standing |
| Thursday, September 30 | National Day for Truth and Reconciliation (no classes) |
| Monday, October 11 | Thanksgiving Day (no classes) |
| November 8 – 12 | Winter session term 1 midterm break (no classes) |
| Friday, November 12 | Last day for withdrawal with a “W” standing |
| Tuesday, December 7 | Last day of classes |
| December 11 – 22 | Final examination period |

Other calendar dates can be found at <http://okanagan.students.ubc.ca/calendar/>

Course Schedule

Tentative course schedule (this is subject to change).

| Lecture # | Subjects, Assignments, Midterms, and Holidays | Date |
|-----------|--|----------------------|
| 0 | Course Outline | Wed, Sept. 8 |
| 1 | Slopes and Equations of Lines | Fri, Sept. 10 |
| 2 | Linear Functions and Applications (Supply and Demand) | Mon, Sept. 13 |
| 3 | Quadratic Functions | Wed, Sept. 15 |
| 4 | Exponential Functions | Fri, Sept. 17 |
| | Release Assignment 1 | Fri, Sept. 17 |
| 5 | Logarithmic Functions | Mon, Sept. 20 |
| 6 | Limits – Tables & Graphics | Wed, Sept. 22 |
| 7 | Limits – Indeterminate Form 0/0 | Fri, Sept. 24 |
| | Release Assignment 2 | Fri, Sept. 24 |
| 8 | Limits – Indeterminate Forms 0/0 and k/0 | Mon, Sept. 27 |
| 9 | Limits – At Infinity | Wed, Sept. 29 |
| 10 | Continuity | Fri, Oct. 1 |
| 11 | Continuity and Rates of Change | Mon, Oct. 4 |
| 12 | Definition of the Derivative | Wed, Oct. 6 |
| | Midterm 1 (40 minutes, this will be held during the class time) | Fri, Oct. 8 |
| | Thanksgiving Day (no classes) | Mon, Oct. 11 |
| 13 | Graphical Differentiation | Wed, Oct. 13 |
| 14 | Techniques for Finding Derivatives | Fri, Oct. 15 |
| | Release Assignment 3 | Fri, Oct. 15 |
| 15 | Product and Quotient Rules | Mon, Oct. 18 |
| 16 | The Chain Rule | Wed, Oct. 20 |
| 17 | The Chain Rule (continued) | Fri, Oct. 22 |
| | Release Assignment 4 | Fri, Oct. 22 |
| 18 | Derivatives of Exponential Functions | Mon, Oct. 25 |
| 19 | Derivatives of Logarithmic Functions | Wed, Oct. 27 |
| 20 | Marginal Analysis | Fri, Oct. 29 |
| | Release Assignment 5 | Fri, Oct. 29 |
| 21 | Increasing, Decreasing Functions, and Critical Numbers | Mon, Nov. 1 |
| 22 | Relative Extrema | Wed, Nov. 3 |
| 23 | Concavity and the Second Derivative Test | Fri, Nov. 5 |
| | Midterm Break (no classes) | Nov. 8 – 12 |

| | | |
|----|--|---------------------|
| | | |
| 24 | Curve Sketching | Mon, Nov. 15 |
| 25 | Absolute Extrema | Wed, Nov. 17 |
| | Midterm 2 (40 minutes, this will be held during the class time) | Fri, Nov. 19 |
| | | |
| 26 | Optimization | Mon, Nov. 22 |
| 27 | Optimization (continued) | Wed, Nov. 24 |
| 28 | Implicit Differentiation | Fri, Nov. 26 |
| | Release Assignment 6 | Fri, Nov. 26 |
| 29 | Related Rates | Mon, Nov. 29 |
| 30 | Elasticity of Demand | Wed, Dec. 1 |
| 31 | Differentials and Linear Approximations | Fri, Dec. 3 |
| | | |
| 32 | Newton's Method | Mon, Dec. 6 |

Grading Practices

Faculties, departments, and schools reserve the right to scale grades in order to maintain equity among sections and conformity to University, faculty, department, or school norms. Students should therefore note that an unofficial grade given by an instructor might be changed by the faculty, department, or school. Grades are not official until they appear on a student's academic record.

<http://www.calendar.ubc.ca/okanagan/index.cfm?tree=3,41,90,1014>

Final Examinations

The examination period for **W2021 T-1 is December 11 - 22, 2021**. Except in the case of examination clashes and hardships (three or more formal examinations scheduled within a 27-hour period) or unforeseen events, students will be permitted to apply for out-of-time final examinations only if they are representing the University, the province, or the country in a competition or performance; serving in the Canadian military; observing a religious rite; working to support themselves or their family; or caring for a family member. Unforeseen events include (but may not be limited to) the following: ill health or other personal challenges that arise during a term and changes in the requirements of an ongoing job.

Further information on **Academic Concession** can be found under **Policies and Regulation in the Okanagan Academic Calendar** <http://www.calendar.ubc.ca/okanagan/index.cfm?tree=3,48,0,0>

Academic Integrity

The academic enterprise is founded on honesty, civility, and integrity. As members of this enterprise, all students are expected to know, understand, and follow the codes of conduct regarding academic integrity. At the most basic level, this means submitting only original work done by you and acknowledging all sources of information or ideas and attributing them to others as required. This also means you should not cheat, copy,



or mislead others about what is your work. Violations of academic integrity (i.e., misconduct) lead to the breakdown of the academic enterprise, and therefore serious consequences arise and harsh sanctions are imposed. For example, incidences of plagiarism or cheating may result in a mark of zero on the assignment or exam and more serious consequences may apply if the matter is referred to the President's Advisory Committee on Student Discipline. Careful records are kept in order to monitor and prevent recurrences.

A more detailed description of academic integrity, including the University's policies and procedures, may be found in the Academic Calendar at: <http://okanagan.students.ubc.ca/calendar/index.cfm?tree=3,54,111,0>.

Cooperation vs. Cheating

Working with others on assignments is a good way to learn the material and we encourage it. However, there are limits to the degree of cooperation that we will permit. Any level of cooperation beyond what is permitted is considered cheating.

When working on programming assignments, you must work only with others whose understanding of the material is approximately equal to yours. In this situation, working together to find a good approach for solving a programming problem is cooperation; listening while someone dictates a solution is cheating. You must limit collaboration to a high-level discussion of solution strategies, and stop short of actually writing down a group answer. Anything that you hand in, whether it is a written problem or a computer program, must be written by you, from scratch, in your own words. If you base your solution on any other written solution, you are cheating. If you provide your solution for others to use, you are also cheating.

Copyright Disclaimer

Diagrams and figures included in lecture presentations adhere to Copyright Guidelines for UBC Faculty, Staff and Students <http://copyright.ubc.ca/requirements/copyright-guidelines/> and UBC Fair Dealing Requirements for Faculty and Staff <http://copyright.ubc.ca/requirements/fair-dealing/>. Some of these figures and images are subject to copyright and will not be posted to **Canvas**. All material uploaded to **Canvas** that contain diagrams and figures are used with permission of the publisher; are in the public domain; are licensed by Creative Commons; meet the permitted terms of use of UBC's library license agreements for electronic items; and/or adhere to the UBC Fair Dealing Requirements for Faculty and Staff. Access to the **Canvas** course site is limited to students currently registered in this course. Under no circumstance are students permitted to provide any other person with means to access this material. Anyone violating these restrictions may be subject to legal action. Permission to electronically record any course materials must be granted by the instructor. Distribution of this material to a third party is forbidden.

Grievances and Complaints Procedures

A student who has a complaint related to this course should follow the procedures summarized below:

- The student should attempt to resolve the matter with the instructor first. Students may talk first to someone other than the instructor if they do not feel, for whatever reason, that they can directly approach the instructor.
- If the complaint is not resolved to the student's satisfaction, the student should e-mail the Associate Head, Dr. Sylvie Desjardins at sylvie.desjardins@ubc.ca or the Department Head (PRO TEM), Dr. Andrew Jirasek at andrew.jirasek@ubc.ca

Student Service Resources

Disability Assistance

The Disability Resource Centre ensures educational equity for students with disabilities, injuries or illness. If you are disabled, have an injury or illness and require academic accommodations to meet the course objectives, e-mail us or visit our website for more information.

Web: <http://students.ok.ubc.ca/drc/welcome.html> **E-mail** DRC at: drc.questions@ubc.ca

Equity, Human Rights, Discrimination and Harassment

UBC Okanagan is a place where every student, staff and faculty member should be able to study and work in an environment that is free from human rights-based discrimination and harassment. If you require assistance related to an issue of equity, discrimination or harassment, please contact the Equity Office, your administrative head of unit, and/or your unit's equity representative. **UBC Okanagan Equity Advisor: ph. 250-807-9291**

Web: <https://equity.ok.ubc.ca/> **E-mail:** equity.ubco@ubc.ca

Health & Wellness - UNC 337

At UBC Okanagan health services to students are provided by Health and Wellness. Nurses, physicians and counsellors provide health care and counselling related to physical health, emotional/mental health and sexual/reproductive health concerns. As well, health promotion, education and research activities are provided to the campus community. If you require assistance with your health, please contact Health and Wellness for more information or to book an appointment.

Web: www.students.ok.ubc.ca/health-wellness **Email:** healthwellness.okanagan@ubc.ca

Sexual Violence Prevention and Response Office (SVPRO)

A safe and confidential place for UBC students, staff and faculty who have experienced sexual violence regardless of when or where it took place. Just want to talk? We are here to listen and help you explore your options. We can help you find a safe place to stay, explain your reporting options (UBC or police), accompany you to the hospital, or support you with academic accommodations. You have the right to choose what happens next. We support your decision, whatever you decide. Visit sypro.ok.ubc.ca or call us at 250-807-9640

Independent Investigations Office (IIO)

If you or someone you know has experienced sexual assault or some other form of sexual misconduct by a UBC community member and you want the Independent Investigations Office (IIO) at UBC to investigate, please contact the IIO. Investigations are conducted in a trauma informed, confidential and respectful manner in accordance with the principles of procedural fairness. You can report your experience directly to the IIO by calling 604-827-2060.

Web: <https://investigationsoffice.ubc.ca/> **E-mail:** director.of.investigations@ubc.ca

The Hub

The Student Learning Hub (LIB 237) is your go-to resource for free math, science, writing, and language learning support. The Hub welcomes undergraduate students from all disciplines and year levels to access a range of supports that include **tutoring in math, sciences, languages, and writing, as well as help with study skills and learning strategies.** **Web:** (<https://students.ok.ubc.ca/student-learning-hub/>) **Ph:** 250-807-9185.

SAFEWALK - Download the UBC SAFE – Okanagan app.

Don't want to walk alone at night? Not too sure how to get somewhere on campus?

Call Safewalk at 250-807-8076 For more information: <https://security.ok.ubc.ca/safewalk/>