

MATH-110: TECHNIQUES OF CALCULUS I  
Fall 2021

Calculus works by making visible the  
infinitesimally small.

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*Keith Devlin, 2003*

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<b>Professor:</b>	Thomas R. Cameron	<b>Time:</b>	M T W F 12:20 – 1:10 pm
<b>Email:</b>	<a href="mailto:trc5475@psu.edu">trc5475@psu.edu</a>	<b>Place:</b>	Nick 169
<b>Office:</b>	Prischak P18		

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**Course Page:** [https://www.thomasrcameron.com/courses/Math-110/math\\_110.html](https://www.thomasrcameron.com/courses/Math-110/math_110.html)

**Canvas Page:** <https://psu.instructure.com/courses/2144889>

**Office Hours:** M W F 10:00 - 11:00 am, T Th 3:00 - 4:00 pm

**Textbook:** Larson, *Brief Calculus, An Applied Approach*, (10e), 2013, ISBN-10: 1-305-86092-6, ISBN-13: 978-1-305-86092-6

**Technology:** You may use technology on homework and lab assignments. However, the use of any technology is prohibited on exams and quizzes.

**Prerequisite:** Math 22, Math 40, Math 41, or satisfactory performance on the mathematics placement examination.

**Course Format:** As Paul Halmos noted, “The only way to learn mathematics is to do mathematics”. Hence, we will spend the majority of our in-person class time doing mathematics. In particular, there will be a short quiz at the beginning of each class, which usually covers important definitions and concepts related to the current material. The quiz is turned in during the first 5 minutes of class. Afterwards, I will give a short lecture and students will break into groups to work on the daily exercises, which are not turned in for credit. At the end of class, solutions to the exercises are discussed.

**Course Description:** Business Calculus is a critical component in the education of any business, financial, or economics professional who uses quantitative analysis. This course introduces and develops the mathematical skills required for analyzing change, and the underlying mathematical behaviors that model real-life economics and financial applications. The primary goal of our business calculus courses is to develop the students’ knowledge of calculus techniques, and to use a calculus framework to develop critical thinking and problem solving skills.

**Masking:** Penn State University requires everyone to wear a face mask in all university buildings, including classrooms, regardless of vaccination status. ALL STUDENTS MUST wear a mask appropriately (i.e., covering both your mouth and nose) while you are indoors on campus. This is to protect your health and safety as well as the health and safety of your classmates, instructor, and the university community. Anyone attending class without a mask will be asked to put one on or leave. Instructors may end class if anyone present refuses to appropriately wear a mask for the duration of class. Students who refuse to wear masks appropriately may face disciplinary action for Code of Conduct violations. If you feel you cannot wear a mask during class, please speak with your adviser immediately about your options for altering your schedule.

**Learning Outcomes:** Upon successful completion of the course, students will be able to

- Identify polynomial, rational, power, exponential, and logarithmic functions.
- Calculate the domains of polynomial, rational, power, exponential, and logarithmic functions.
- Calculate the sums, differences, products, quotients, and compositions of functions.

- Model cost, revenue, profit, supply, and demand business functions.
- Calculate equilibrium points within supply/demand markets and interpret the results.
- Calculate or estimate finite/infinite limits of functions given by formulas, graphs, or tables.
- Calculate one-sided limits of functions.
- Determine whether a function given by a graph or formula is continuous at a given point or on a given interval.
- Determine whether a function given by a graph or formula is differentiable at a given point or on a given interval.
- Distinguish between average and instantaneous rate of change and interpret the definition of the derivative graphically.
- Determine derivatives of some functions using the definition of derivative of a function.
- Calculate derivatives of polynomial, rational, power, exponential, and logarithmic functions, and combinations of these functions.
- Calculate derivatives of implicitly defined functions.
- Apply the ideas and techniques of derivatives to related rate problems to include basic algebraic/geometric models and cost/average cost, revenue/average revenue, profit/average profit, supply, and demand models.
- Apply the ideas and techniques of derivatives to perform marginal analysis of basic economics models.
- Apply the ideas and techniques of derivatives to calculate elasticity of basic economics models.
- Apply the ideas and techniques of derivatives to determine intervals where a model/graph is:
  - (a) increasing/decreasing,
  - (b) concave up/down.
- Apply the ideas and techniques of derivatives to determine points in a model/graph that are:
  - (a) relative extrema,
  - (b) absolute extrema,
  - (c) inflection.
- Identify vertical and horizontal asymptotes.
- Apply the ideas and techniques of derivatives to graphing or recognizing the graphs of functions.
- Apply the ideas and techniques of derivatives to optimization problems to include basic algebraic/geometric models and cost, revenue, profit, supply, and demand models.
- Apply the ideas and techniques of derivatives to solve:
  - (a) compound interest,
  - (b) continuous interest,
  - (c) effective interest rate,

- (d) present value business models.
- Determine the point-of-diminishing returns for a model/function.
  - Calculate the derivatives of functions using logarithmic differentiation.
  - Calculate the Riemann sum for a given function, partition and collection of evaluation points.
  - Describe a definite integral as the limit of a Riemann sum.
  - Determine anti-derivatives of basic algebraic functions.
  - Calculate values of definite integrals using anti-derivatives and areas.
  - Apply concepts of integration to solving basic business model applications.
  - Apply substitution and integration by parts techniques to integrate basic functions.
  - Apply the ideas of definite integrals to solve problems of areas.
  - Calculate the average value of business models using the definite integral.
  - Apply the ideas and techniques of the definite integral to evaluate:
    - (a) consumer/producer surplus,
    - (b) future/present value of income streams,
    - (c) future/present value of annuities business models.
  - Evaluate improper integrals and apply the ideas and techniques to evaluate perpetuities.

**Grading Policy:**

Your final grade is broken up as follows.

Category	Percentage
Daily Quizzes	10%
Lab Assignments	15%
Homework Assignments	20%
Exams (10% each)	40%
Final	15%

Your final letter grade is based on the following scale.

Grade	Percentage Interval	Grade	Percentage Interval
A	[93, 100]	C+	[77, 80]
A-	[90, 93)	C	[70, 77)
B+	[87, 90)	D	[60, 70)
B	[83, 87)	F	[0, 60)
B-	[80, 83)		

**Daily Quizzes:** Daily quizzes are assigned during the first 5 minutes of each class period. These short quizzes cover pertinent definitions and concepts that students should know in order to effectively work on the class exercises. In addition, these quizzes serve as an attendance marker. To help alleviate students' concern with missing quizzes due to illness, the three lowest quiz scores will be dropped. Under extreme situations, students may be eligible for re-do assignments.

**Lab Assignments:** On lab day, students will interact with Desmos Activities, which provide an interactive learning environment where students can gain intuition for the course concepts. These labs are administered online but should be done in class, which allows students to interact with each other and myself to enhance their learning experience. If the student has an excused absence, they will be given additional time to complete the assignment. Regarding this matter, the student must communicate with the instructor prior to the assignment deadline.

**Homework Assignments:** To help develop a mastery of the material, students will be given several homework assignments which cover the material in greater depth. Not only are these problems more challenging, but the students are held to a higher expectation with regards to the clarity and precision of their solution. If the student has an excused absence, they will be given additional time to complete the assignment. Regarding this matter, the student must communicate with the instructor prior to the assignment deadline.

**Exams:** We will have 3 exams throughout the semester. These exams are intended to test your general understanding of the concepts covered up to that point, with a heavy emphasis on the main definitions, concepts, and problem solving techniques covered. These exams will be administered in class and are designed to be finished within 30 minutes, leaving enough time for everyone to complete. See the section on disabilities and learning differences if you require additional time. If the student has an excused absence, they will be given additional time to complete the assignment. Regarding this matter, the student must communicate with the instructor prior to the assignment deadline.

**Final:** We will have a final exam during finals week. The final is comprehensive and will include questions on limits, derivatives, first and second derivative tests, optimization and business applications, the fundamental theorem of calculus, area between two curves, integration by parts, calculus with exponential and logarithmic functions, and improper integrals.

**Academic Integrity:** Academic integrity is a basic guiding principle for all academic activity at the University, and all members of the community are expected to adhere to this principle. Specifically, academic integrity is the pursuit of scholarly activity in an open, honest, and responsible manner. It includes a commitment not to engage in or tolerate acts of falsification, misrepresentation, or deception. Such acts violate the fundamental ethical principles of the University community and undermine the efforts of others.

Violations of academic integrity are not tolerated at Penn State Behrend. Violators will receive academic sanctions and may receive disciplinary sanctions, including the awarding of an XF grade. In cases such as these, an XF grade is recorded on the transcript and states that failure of the course was due to an act of academic dishonesty. All acts of academic dishonesty are recorded so those repeat offenders can be sanctioned accordingly. For more information:

<http://behrend.psu.edu/for-faculty-staff/faculty-resources/academic-integrity>

**Extra Help:** Do not hesitate to come to my office during office hours or by appointment to discuss a homework problem or any aspect of the course. You also may want to consider the Math Lab (located on the second floor of Roche Hall) or the Learning Resource Center (located in the library). Hours can be found here:

<http://psbehrend.psu.edu/Academics/academic-services/lrc>.

See a schedule for all options on TutorTrac at <https://tutorapp.bd.psu.edu>

**Disabilities and Learning Differences:** Penn State is strongly committed to providing full access to its programs and services for all individuals. The University encourages academically qualified students with disabilities to take advantage of the educational programs and accommodations offered at Penn State Behrend. For more information:

<http://behrend.psu.edu/student-life/educational-equity-and-diversity/student-resources/students-with-disabilities-and-learning-differences>

**Educational Equity Concerns:** Penn State takes great pride to foster a diverse and inclusive environment for students, faculty, and staff. Acts of intolerance, discrimination, harassment, and/or incivility due to age, ancestry, color, disability, gender, national origin, race, religious belief, sexual orientation, or veteran status are not tolerated and can be reported through Educational Equity at the Report Bias site: <https://equity.psu.edu/reportbias>

**Counseling and Psychological Services:** Students with academic concerns related to this course should contact the instructor in person or via email. Students also may occasionally have personal issues that arise in the course of pursuing higher education that may interfere with their academic performance. If you find yourself facing problems affecting your coursework, you are encouraged to talk with an instructor and to seek confidential assistance at the Penn State Behrend Personal Counseling Services at (814) 898-6504. For more information: <http://psbehrend.psu.edu/student-life/student-services/personal-counseling>

**Copyright of Class Materials:** You may not share any information from this course (including notes and assignments) with others who are not currently registered for the course, nor post such information electronically without the permission of the instructor—this includes online note-taking/note-sharing services (See Penn State Administrative Policy AD-40). Also prohibited in the policy is the posting of audio, video, or photographs posted to social media sites or other publicly accessible resources. Unless you have my permission, you risk disciplinary sanctions.

**Title IX:** Penn State is committed to fostering an environment free from sexual or gender-based harassment or misconduct. The Office of Sexual Misconduct Prevention and Response ensures compliance with Title IX, a federal law that prohibits discrimination based on the sex or gender of employees and students. Behaviors including sexual harassment, sexual misconduct, dating violence, domestic violence, and stalking, as well as retaliation for reporting any of these acts violate Title IX and are not tolerated. The University is also committed to providing support to those who may have been impacted by incidents of sexual or gender-based harassment or misconduct and may provide various resources and support services to individuals who have experienced one of these incidents. For more information: <http://titleix.psu.edu/> or

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<http://titleix.psu.edu/resources-penn-state-erie-the-behrend-college/>

**Important Dates:**

Classes Begin .....	August 23
Regular Drop Deadline .....	11:59 pm August 28
Regular Add Deadline .....	11:59 pm August 29
Labor Day (No Class) .....	September 6
Exam 1 .....	September 14
Final Exam Conflict Filing Period .....	September 27 – October 17
Exam 2 .....	October 5
Exam 3 .....	November 2
Late Drop Deadline .....	November 12
Exam 4 .....	November 19
Thanksgiving .....	November 21 – 28
Classes End .....	December 10
Final Exams .....	December 13 – 17

**Disclaimer:** I reserve the right to diverge from this syllabus in the best interest of my students learning and achievement. Any changes made will be announced in advance.