Southern New Hampshire University

MAT 223 Final Project Guidelines and Rubric

Overview

At its essence, calculus is the study of how things change. In the field of information technology, the practical applications of calculus span a wide variety of industries and other areas, from data analysis and predictive analytics to image, video, and audio processing; from physics engines for video games to modeling software for biological, meteorological, and climatological models; and from machine learning and artificial intelligence to measuring the rate of change in interest-accruing accounts or tumors. What all these applications have in common is understanding how objects change with respect to time. The derivative function represents a rate of change. We can take the derivative of a function by using either the limit definition of a derivative or the different differentiation rules. What do we do when we don't have a given function, but only a set of data points?

There are two possible scenarios for the final project in this course. You must choose only **one** of the following options, which are outlined in the Final Project Scenarios document:

1. Motion Problem
2. Decay Problem

You will create a report that illustrates your final answer, process, explanations, and detailed solutions. You will defend the validity of your solutions and demonstrate your ability to effectively communicate using calculus notations, conventions, and terminology. The project includes **one milestone**, which is an important opportunity to submit a draft of Part II and ensure the accuracy of your calculations. This milestone will be submitted in **Module Five.** The final product will be submitted in **Module Seven**.

In this assignment, you will demonstrate your mastery of the following course outcomes:

- Interpret real-world problems by selecting mathematical theorems that appropriately address the problem
- Utilize appropriate calculus techniques for solving real-world problems
- Determine the behavior of functions by analyzing a real-world model through appropriate calculus techniques
- Defend mathematical processes and solutions using appropriate calculus terminology

Prompt

Specifically, the following **critical elements** must be addressed:

I. **Introduction**: In this section, you will briefly describe the mathematical theorem you selected, what you are trying to answer with your report, the approach for how you arrived at this selection, and the data points related to the rate of change of the object and how you will use them to arrive at your final results.

A. Briefly describe the **mathematical theorems** you selected and what you are trying to answer with your report. [MAT-223-01]
B. Describe the **approach** for determining how you arrived at this selection. [MAT-223-01]
C. **Explain** mathematically how the provided **data** will be used to arrive at your final results. [MAT-223-01]

II. **Analysis of Data: Applying Derivatives**
A. Using the given data, calculate the **average acceleration** of the changing object over given time intervals. [MAT-223-02]
B. Using the given data, calculate the **instantaneous acceleration** at specific time values. [MAT-223-02]

III. **Analysis of Data: Applying Integrals**
A. Using the data provided, estimate the **total change** in the object. [MAT-223-02]
1. Use a right-endpoint estimate.
2. Use a left-endpoint estimate to approximate the total change of the object.
3. Calculate the best estimate for the total change of the object.
B. **Graph the model** using the behavior of the functions represented by the data. [MAT-223-03]

Note: To complete your graph, you can print graph paper at the Incompetech website, or you can complete a graph in Excel. The Microsoft Office website offers help with creating graphs in Excel.

C. After completing your graph, **discuss the** relevance of the solution and how this **graph** represents it, using the calculus terminology of curve sketching. (Is the graph decreasing or increasing? How is this related to the data presented?) [MAT-223-04]

IV. **Analysis of the Model:** Calculate Parts I and II.
A. Given the model for each set of data, calculate the acceleration of the object using **rules for differentiation**. [MAT-223-03]
B. Given the model for each set of data, calculate the total change of the object using **rules for integration**. [MAT-223-03]

V. **Final Results and Recommendations**: In this section, you will conclude your report with your recommendations for a solution based on your findings.
A. **Compare** the **results** obtained in Section II and Section III (Applying Derivatives and Applying Integrals) **with** the results in Section IV (**Analysis of the Model**). Discuss the accuracy of each method and explain the application of each method in a real-world context. [MAT-223-04]
B. **Defend** your **process of solving the problem** by explaining a rationale for each process step. What does each step contribute to the ability to solve the problem and make recommendations? [MAT-223-04]
C. Use calculus terminology to clearly **explain your results and recommendations**. Be sure to explain your answers using real-world terminology relevant to your topic in a way that is clear and understood. [MAT-223-04]

Southern New Hampshire University

Milestones

Milestone One: *Draft of Part II*

In **Module Five**, you will submit part II of your project. This is an important opportunity to ensure your report is accurate and gain feedback prior to submitting your final project. **This milestone will be graded with the Milestone One Rubric.**

Final Submission: *Final Report*

In **Module Seven**, you will submit your final project. It should be a complete, polished artifact containing **all** of the critical elements of the final project prompt. It should reflect the incorporation of feedback gained throughout the course. **This submission will be graded with the Final Project Rubric.**

Final Project Rubric

Guidelines for Submission: Your final problem walkthroughs should be a 3- to 4-page Microsoft Word document with double spacing, 12-point Times New Roman font, and one-inch margins.

Critical Elements	Exemplary	Proficient	Needs Improvement	Not Evident	Value
Introduction: Mathematical Theorems [MAT-223-01]	Meets "Proficient" criteria, and the description illustrates an in-depth grasp of the mathematical theorems selected (100%)	Describes the mathematical theorems that were selected and the question being answered in the report (85%)	Describes the mathematical theorems, but does not describe the question being answered with the report, or the description is incomplete or contains inaccuracies (55%)	Does not describe the mathematical theorems that were selected (0%)	7
Introduction: Approach [MAT-223-01]	Meets "Proficient" criteria, and the description demonstrates a keen insight into the process of selecting appropriate theorems (100%)	Describes the approach for determining mathematical theorems selected (85%)	Describes the approach for determining mathematical theorems selected, but the description is illogical or incomplete or contains inaccuracies (55%)	Does not describe the approach for determining mathematical theorems selected (0%)	7
Introduction: Explain Data [MAT-223-01]	Meets "Proficient" criteria, and the explanation illustrates a comprehensive application of the mathematics used (100%)	Explains mathematically how the provided data was used to arrive at the final results (85%)	Explains mathematically how the provided data was used to arrive at the final results, but the explanation is illogical or incomplete or contains inaccuracies (55%)	Does not explain mathematically how the provided data was used to arrive at the final results (0%)	7

Analysis of Data: Applying Derivatives: Average Acceleration [MAT-223-02]		Correctly calculates the average acceleration of the changing object over all given time intervals (100%)	Incorrectly calculates the average acceleration of the changing object over some of given time intervals (55%)	Does not calculate the average acceleration of the changing object over all given time intervals (0%)	8
Analysis of Data: Applying Derivatives: Instantaneous Acceleration [MAT-223-02]	Correctly calculates the instantaneous acceleration at all specific time values (100%)	Applies correct calculus techniques in calculating instantaneous acceleration at all specific time values with minor errors in calculations (85%)	Applies correct calculus techniques in calculating instantaneous acceleration at all specific time values with critical errors in calculations (55%)	Does not apply correct calculus techniques in calculating instantaneous acceleration (0%)	8
Analysis of Data: Applying Integrals: Total Change [MAT-223-02]	Correctly estimates the total change using a right-endpoint, left-endpoint, and best estimate (100%)	Estimates the total change using a right-endpoint, left-endpoint, and best estimate, with minor errors in calculation (85%)	Estimates the total change using a right-endpoint, left-endpoint, and best estimate, with critical errors in calculation (55%)	Does not estimate the total change using a right-endpoint, left-endpoint, and best estimate (0%)	8
Analysis of Data: Applying Integrals: Graph the Model [MAT-223-03]		Graphs the model using the behavior of the functions represented by the data (100%)	Graphs the model, but the graph contains errors in construction, or the behavior of the function does not accurately represent the data (55%)	Does not graph the model using the behavior of the functions represented by the data (0%)	7
Analysis of Data: Applying Integrals: Discuss the Graph [MAT-223-04]	Meets “Proficient” criteria, and the description illustrates an in-depth grasp of the relevance of the relationship between the graph and the behavior of the function (100%)	Discusses the relevance of the solution this graph represents using the calculus terminology of curve sketching (85%)	Discusses the relevance of the solution, but discussion is incomplete, contains inaccuracies, or does not properly use the calculus terminology of curve sketching (55%)	Does not discuss the relevance of the solution this graph represents using the calculus terminology of curve sketching (0%)	8
Analysis of the Model: Rules for Differentiation [MAT-223-03]		Calculates the acceleration of the object using the model for each set of data correctly and applies rules for differentiation (100%)	Calculates the acceleration of the object using the model for each set of data incorrectly, or does not properly apply the rules for differentiation (55%)	Does not calculate the acceleration of the object using the model for each set of data or apply rules for differentiation (0%)	8

Analysis of the Model: Rules for Integration [MAT-223-03]		Calculates the acceleration of the object using the model for each set of data correctly and applies rules for integration (100%)	Calculates the acceleration of the object using the model for each set of data incorrectly, or does not properly apply the rules for integration (55%)	Does not calculate the acceleration of the object using the model for each set of data (0%)	8
Final Results and Recommendations: Compare Results with Analysis of the Model [MAT-223-04]	Meets "Proficient" criteria, and the description demonstrates a keen insight into the accuracy and application of the calculation techniques (100%)	Compares the results obtained in section II and section III with the results found in section IV, and includes a description of the accuracy of each method and explains the application of each method in a real-world context (85%)	Compares the results obtained in section II and section III with the results found in section IV, but does not include a description of the accuracy of each method or does not explain the application of each method in a real-world context, or the comparison contains inaccuracies (55%)	Does not compare the results obtained in section II and section III with the results found in section IV (0%)	8
Final Results and Recommendations: Defend Process of Solving the Problem [MAT-223-04]	Meets "Proficient" criteria, and illustrates an in-depth grasp of the mathematical processes and their significance to solving the problem (100%)	Defends the problem-solving process by explaining a rationale for each process step, including a description of what each step contributes to solving the problem and making recommendations (85%)	Defends the problem-solving process, but the defense does not explain a rationale for each process step or does not include a description of what each step contributes to solving the problem and making recommendations (55%)	Does not defend the problem-solving process by explaining a rationale for each process step (0%)	8
Final Results and Recommendations: Explain Your Results and Recommendations [MAT-223-04]	Meets "Proficient" criteria, and demonstrates an extensive grasp of the application of calculus techniques for making recommendations in real-world problems (100%)	Clearly explains the results and recommendations using proper calculus and real-world terminology relevant to your topic in a way that is clear and understood (85%)	Explains the results and recommendations, but the explanation lack clarity, contains inaccuracies, or does not use proper calculus and real-world terminology in a way that is clear and understood (55%)	Does not explain the results and recommendations using proper calculus (0%)	8
				Total	**100%**