



MAT 330: Application Assignment Guidelines and Grading Guide

Overview

The purpose of this assignment is to guide you through the process of developing a differential equation model, solving the resulting initial value problem, and interpreting the solution in the context of a real-world application. Completing the assignment will enable you to make a connection between what you are learning about differential equations and the world in which we live. Economists, engineers, linguists, biologists, and many other professionals use models based on differential equations, and this activity will give you a glimpse of how differential equations apply to everyday life.

The assignment submission process is organized into **two milestones and a final submission**. At each milestone, you will submit a portion of the overall assignment to scaffold learning and to ensure quality final submissions. These milestone submissions will be made at the conclusion of **Module Two and Module Five**. The final submission will be due in **Module Seven**.

Assignment Requirements

Submit a report in which you describe and analyze a real-world scenario for which ordinary differential equations apply. Research applications for ordinary differential equations and submit the following reports at each milestone. Your final submission should include the following **critical elements**:

1. **Select a topic** that can be modeled by a first-order ordinary differential equation. Note that your topic should generate a differential equation that can be solved by the techniques in this course. Chapter 3 of our text introduces the modeling process and examples of applications that can be found throughout the text. Additionally, it is not hard to find interesting applications by searching the internet.

Example topics:

- Crime scene investigation using Newton's law of cooling
- Population growth models, with either unconstrained or constrained growth
- Simple dynamic models of mathematical economics, such as the change in the price of a product related to stock levels of that product
- Interest rate models involving loans or investments, such as determining the largest loan affordable that can be paid off in a given time period when considering a fixed-rate mortgage with monthly payments
- Modeling the velocity of a sprinter
- Carbon dating

- Drug concentration in the human body
2. Model the topic using a differential equation.
 - a) **Draw any visuals (diagrams)** that exemplify the model and facilitate understanding of the modeling process. Your visuals should represent the topic and help develop the differential equation.
 - b) **Write the differential equation** that models your topic of choice. Define all the variables used in the model, and be sure to include initial conditions.
 - c) **Classify the differential equation**, including the order and if it is linear or nonlinear.
 3. Solve the differential equation using the techniques from this course.
 - a) **Provide a valid solution** to the differential equation. Be sure to apply the initial conditions that you developed.
 - b) **Discuss the method used to solve** the differential equation. Explain all steps in arriving at the solution, writing in paragraph form and in complete sentences.
 4. **Discuss the solution in context of the initial topic.** Write the solution of the differential equation in terms of the initial topic you chose in Part 1. Describe how this could be useful for someone in the field from which the model was obtained. Include solution values or graphics to illustrate the utility and applicability of the solution in the context of the topic you chose.
 5. **Discuss what you learned from the modeling process.** Write one to two paragraphs pertaining to what you can take away from the modeling process in general.

Deliverable Milestones

Milestone	Deliverables	Module Due	Grading
1	Determine the topic of your choice. Submit the topic only to your instructor (Part 1). Your instructor must approve before you can move forward.	Two	Ungraded but required. Your topic must be approved by the instructor before you can move forward.
2	Develop the model and solve the differential equation. You should include only the differential equation, variables and initial conditions, and solution (Part 2b and Part 3a only). You can choose to include the classification of the differential equation, any visuals, and method used to solve, but that is not required in this milestone.	Five	Graded at 50 points for submission.
	Parts 1–5: Final Submission	Seven	Graded separately at 200 points; Final Product Rubric

Final Product Rubric

Requirements of submission: Written components of project must follow these formatting guidelines when applicable: double spacing, 12-point Times New Roman font, 1-inch margins, and discipline-appropriate citations. **An equation tool must be used for all mathematical formulas and equations.**

Critical Elements	Exemplary (100%)	Proficient (85%)	Needs Improvement (55%)	Not Evident (0%)	Value
Topic Selection	Submission meets “Proficient” criteria and effectively describes the interest in the topic of choice	Submission contains a real- world topic that can be modeled by a first-order differential equation	Submission contains a topic that can be modeled by differential equation, but does not have a real-world application or it cannot be modeled by a differential equation in the scope of this course	Submission does not include a real-world topic modeled by a first-order differentialequation	5
Model Visuals	Submission meets “Proficient” criteria and describes each component of the visual and its connection to the topic of choice	Submission contains a visual representation of the model in order to facilitate the modeling process	Submission contains some visual representation of the model, but it does not fully represent the reality of the topic	Submission does not contain any visual representation to describe the model	15
Differential Equation	Submission meets “Proficient” criteria and includes explicit variable definitions and initial conditions	Differential equation accurately describes the model	Differential equation does not accurately describe the model	Submission does not contain a differential equation to solve	20
Classification of Differential Equation	Submission meets “Proficient” criteria and describes why it is classified as such	Submission includes the classification of the differential equation	Submission includes partial or incorrect classification of differential equation	Do attempt to classify the differential equation	10
Solution to Differential Equation	Submission meets “Proficient” criteria and solution is written using clear displayed math	Solution is correct and initial conditions are applied	Solution is incorrect or submission does not include the correct application of the initial conditions	No attempt to solve the differential equation	15

Method to Solve	Submission meets “Proficient” criteria and further extends the explanation to why that method was chosen	Submission describes in words the method used to solve the differential equation	Submission describes the method from the course used to solve the differential equation, but the description is incomplete or not in paragraph form	Submission does not include the method used to solve the differential equation	10
Solution in Context to Initial Topic	Submission meets “Proficient” criteria and further illustrates the applicability in the context of the topic	Submission includes the solution in terms of the topic and includes how it could be useful in the field	Submission does not include how the model and solution are used in the field	No solution in terms of the topic of choice is provided	15
Lessons Learned		Submission includes a summary of what was learned from the differential equation modeling process	Summary of the modeling process is lacking in personal tone or is not appropriate to the topic	Submission does not include lessons learned from the modeling process	10
Total					100%