Assessment Guide for SIMIODE Remote Teaching Module:

Introduction to Modeling

Learning Goals: Students will understand that…

1. A differential equation model is the embodiment of a dynamic pattern which allows us to predict the future. Knowing multiple ways to interpret a differential equation can help us solve/analyze it effectively and skillfully apply it as a model.
2. Knowing multiple ways to interpret a differential equation can help you solve/analyze it effectively and skillfully apply it as a model.
3. Key characteristics of a differential equation determine the validity of solution methods and analytical techniques
4. Crucial understanding of a differential equation model can be found more readily in visualization of the shape and behavior than the algebraic form of the solution

Questions for students to keep considering throughout this module:

1. *What is the purpose for solving this (diff. eq.)?*
2. *How is this method built upon mathematical theory?*
3. *What characteristics of this (diff. eq.) are important?*
4. *What does it mean for this (diff. eq.) model to fit?*

Additional Assessment Questions (quiz/exam)

Note: the modeling project is a significant assessment of these learning goals

1. [Show a graph of student collected data or from the template] For the dataset graphed below, circle the best fitting initial value problem for the susceptible population. Justify. [fill in your own values for N,a,b>0]
   (1) S'(t) = aS(N-S) ,S(0) =N-1
   (2) S'(t) = -aS(N-S) ,S(0) =N-1 [Correct]
   (3) S'(t) =at(t-b) ,S(0) =1
   (4) S'(t) = aS(S-N),S(0) =1
2. List two things this model ignores which are relevant to an actual cold spreading in a dorm. Justify their relevance.
   [Many valid answers, including: Spread of the infection from/to other locations outside the residence hall. Immunity from the virus. Recovery from the virus (possibly leading to immunity).]

Module Project

The assignment for this module is a project where students model data that is generated via group simulation over Zoom, analyze that data, and present their results. The simulation represents the spread of the common cold throughout a floor of a residence hall under various social/hygienic scenarios. This project is meant to introduce the idea of a differential equation model and investigate the impact of heightened hygiene and decreased interactions on the spread of an infectious disease. The focus of this simulation is on the common cold, a recurring, but mild, disease. The analysis and conclusions, however, can be extended to other more serious infectious diseases like the COVID-19 pandemic.

The simulation could be done outside of class using personal Zoom accounts or implemented in a socially-distanced class within Zoom breakout sessions. Either way, all the students become familiar with the full modeling experience from data collection to completion. What students learn from this experience is then solidified by organizing and communicating their results through a presentation (again recorded from their screens, using software such as Zoom or Screencastify).

The time the simulation portion takes depends heavily upon how many scenarios are assigned for students to complete. Personally, I would assign 4 runs (Normal and scenarios A, B, and C) for each pair and spend about 50 minutes during one class session for the simulation phase. Then, I would assign the analysis and discussion phases to be done outside class time.

Rubric for Modeling Project:

Students should complete the project with a presentation from a wiki in your LMS, from slides, or equivalent. This presentation is preferably a screen & webcam recording using software such as the Chrome extension Screencastify. The following rubric scores the project out of 50 points, meant to be equivalent in value to about two week's work of homework or half of an exam.

The Project Rubric is an analytic version which is optimal for efficient grading and implementation in a Learning Management System (LMS). The Project Scoring Guide is a more traditional version of the rubric with room for personal comments.

Project Rubric			
Simulation			**Pts earned**
0 No data was collected	1 Insufficient data collected	2 Required amount of data is collected	
0 Spreadsheet is not filled out	2 Spreadsheet is filled out, with errors	3 Spreadsheet is filled out correctly	
0 Individual did not participate	3 *Individual* participated	5 *Individual* succeeded in their role and assisted their group mates	
Model Development			
0 No mention of selection process	3 Selection process of model is clearly stated	5 Selection of model is clearly justified using visualizations	
0 Model is not correctly solved	2 Model solution is correctly used	5 Solution of model is correctly demonstrated and implemented	
Analysis			
0 No initial estimates of parameters	2 Initial estimates of parameters are given	4 Initial parameter estimates are logically justified	
0 Regression of model slope function is not implemented correctly	2 Regression of model slope function is implemented correctly	4 Regression of model slope function is implemented and interpreted correctly	
0 No parameters were optimized	1 Optimization of key parameter(s) is accurate to 3 sig. fig. for one data run	3 Optimization of key parameter(s) is accurate to 3 sig. fig. for each data run and clearly explained	
Discussion			
0 No summary of results	2 Results are clearly summarized	3 Results are clearly summarized and their significance correctly interpreted (e.g. R^2/RMSE)	
0 No discussion questions are answered	1 Discussion questions are all answered	3 Discussion questions are all thoughtfully answered and include specifics	
0 Discussion does not demonstrate any understanding of the simulation or subject matter	2 Discussion demonstrates some understanding of the simulation and subject matter	4 Discussion demonstrates complete understanding of the simulation and subject matter	
Presentation			
0 No clear organization	2 Has clear organization	3 Organization is functional and professional	
0 Not within time limit	1 Is within time limit	3 Is focused, well-rehearsed, and within time limit	
0 Individual did not contribute to the presentation	2 *Individual* participated significantly	4 *Individual* spoke clearly and contributed well to presentation	
Total	**50**		

Project Scoring Guide			
Component	Pts Possible	Comments	Pts Earned
Simulation			
Required amount of data is collected	2		
Spreadsheet is filled out correctly	3		
Individual contributed well in simulation/recording role	5		
Model Development			
Selection of model is clearly justified using visualizations	5		
Solution of model is correctly demonstrated and implemented	5		
Analysis			
Initial parameter estimates are logically justified	4		
Correct regression with model slope function	3		
Correct local/global optimization of key parameter(s)	3		
Discussion			
Clearly summarized results and correctly interpreted their significance (R^2/SSE/RMSE)	3		
Completely answered discussion questions, including specifics	3		
Demonstrated a good understanding of the simulation and subject matter	4		
Presentation			
Organized slides / wiki well	3		
Presented in a focused/practiced way within the time limit	3		
Individual spoke clearly and contributed well to presentation	4		
Total	**50**		