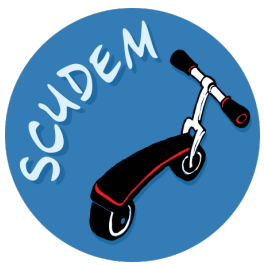
SIMIODE Challenge Using Differential Equations Modeling (SCUDEM): Overview and Advice



Dr. Stepien

tstepien@ufl.edu

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SIMIODE Challenge Using Differential Equations Modeling

What is SCUDEM?

It's an international contest for college undergraduates to engage in a differential equations modeling experience using real world modeling problems.

https://www.simiode.org/scudem/

When is it this year (2024)?

Begins: Saturday, October 19 (12:01am ET)
Three problems are posted.

Ends: Tuesday, November 12 (11:59pm ET)
Your team submits a 10-minute video solution.

SIMIODE Challenge Using Differential Equations Modeling

Eligibility

- Undergraduate student (any major)

What's in it for you?

- Camaraderie of the 3-person team
- Attractive experience for graduate schools or community/academic involvement discussion with employers
- Gather insight to different applications of differential equations
- Develops work outside the classroom similar to what higher level research is like or how to work in industry

Types of Problems and Award Designations

What types of problems are to be solved?

Each team (consisting of up to **3** students) chooses **1** problem out of:

- Physical Sciences/Engineering
- Life Sciences/Chemistry
- Social Sciences/Humanities

What are the possible award designations?

1. Outstanding
2. Meritorious
3. Successful

Examples of Past Problems

Physical Sciences/Engineering Problem (2019)

Movement Of An Object In Microgravity Environments: In February 2019, a Japanese probe made contact with a small asteroid, Ryugu. The team had to land a probe gently enough so that it does not bounce and move too far away from a designated landing position. The next problem is moving the probe to a new position using a minimal amount of energy and also minimizing how far the probe bounces on the surface of the asteroid.

You have been asked to provide guidance in helping find a new asteroid on which to land a probe. The goal is to determine the range of dimensions for the smallest possible asteroids which can be used to land a probe. (Keep in mind that asteroids can have high aspect ratios and are generally not round.)

Examples of Past Problems

Life Sciences/Chemistry Problem (2019)

Chemical Espionage: It can be difficult for some insects to find mates. One common way for a female to attract a male is to use chemical signals. One problem with this approach is that this signaling can attract many males, and in response the males often use chemical signals, called anti-aphrodisiacs, that are used to either mask or dissuade other males. The chemical signals can also be exploited by parasites.

These interactions introduce two competing pressures on the butterfly population. Determine the trade-offs and balance between the two competing interests.

Examples of Past Problems

Social Sciences/Humanities Problem (2019)

Group Affinity and Fashion Sense: People tend to congregate into groups in different ways. People can create strong links in small cliques or identify loosely as part of a larger trend. One example of the latter phenomena is hipsters.

This raises a number of questions about how people choose which groups to associate with as well as how they decide to adjust to the expectations of the other people within their group. Examine the propensity for a person to alter their appearance and conform to particular expectations. You should develop a model that describes how different people within an established group interact and decide to change some particular part of their appearance.

Get Prepared

- Read through SIMIODE's official directions at: https://qubeshub.org/community/groups/scudem/wiki/rules
- Read through advice documents at: https://modeling-contests.math.ufl.edu/scudem/
- Read through past problems and determine features of successful solutions
- Get to know your teammates

First Weekend (Oct. 19–20)

Research and Choose Problem

- Use Google (Search, Scholar, and Books) to find as many sources as possible for all 3 problems
  - You want to find models that already exist – then you do not need to come up with one completely on your own!
  - Scholarly papers, databases, and books should be your primary source of information
  - Finding related software packages/applets are also really helpful depending on the problem
- Then decide which problem to solve
  - Brainstorm: review ideas, what is most promising?
- By the end of the weekend: choose problem, LOTS of resources, beginnings of modeling

Week 1 (Oct. 21–27)

Model and Research

- The focus should be on making sure the model developed previously works and adding complexity to the model, or finish modeling the entire system
- While developing the model, develop computer code to run simulations
- By the end of the week: most of the modeling and computations done

Week 2 (Oct. 28–Nov. 3)

Model and Improve

- Don't forget to check out the resources the libraries might have (e.g. eBooks)
- Explore model refinements, parameter sensitivity, etc.
- By the end of the week: all of the modeling and computations done

Week 3 (Nov. 4–8)

Prepare the Presentation

- Make sure you have NO mistakes in your model
- Prepare slides for your video presentation
  - Hook the judges in the introduction
  - Provide some context and overview of problem
  - Describe what you did in general terms
  - Summarize main results
- Write up a script to go along with the presentation
- By the end of the week: slides completely done and proofread at least once

Last Weekend (Nov. 9–12)

Record Presentation

- Create the video presentation
- Completely finish and upload video presentation to YouTube by 11:59 on Tuesday, November 12

Other Tips

- Excellent presentation is key – clearly explain what you did and be engaging, like you're telling a story
  - Don't put too many words on slides! Use illustrations whenever possible
  - Only make the model as elaborate as you can fully understand and explain
  - Discuss strengths and weaknesses of your model and connect results with your model

- If you focus too much on your model, you will not have enough time to prepare the presentation and be able to thoroughly explain it
  - Partial solutions are accepted though! So even if you feel like you didn't "complete" your solution, submit it!

Other Tips

- Make sure to validate your model with real sources
  - This can expose flaws that SIMIODE had in writing their problems, and you want to make sure that you can back up your claims
  - Don't forget to cite all of your sources, including software packages
    - A slick way to do this is to put shortened citations on the slide where you reference the source
    - You can also put a list of references at the end of the presentation
- Have a copy of all old computer code you have ever written so it can be pulled out and used immediately

Logistics

- The contest is a significant time commitment – one comment past participants have said is that that they wished they had budgeted more time to do the best possible job!
- The group should meet once before the contest begins to determine what days and times you will regularly meet during the contest
- Do not register on the SIMIODE web site until teams are finalized! Also, do not pay any fees, as they will be covered if you are a part of a UF team

After the Contest

Participate in the COMAP Mathematical/Interdisciplinary Contest in Modeling (MCM/ICM) on January 23–27, 2025!

Get recognized at the Department of Mathematics Spring Celebration on Thursday, April 24!

Present your solution at the Undergraduate Mathematics Research Symposium (UMRS) on Friday, April 25!

Training Sessions #2–4

Training Session #2

Crash Course in Modeling

Tuesday, October 1
Period 6 (12:50-1:40pm)
423 Little Hall

Training Session #2

Simulation and Analysis Methods

Tuesday, October 8
Period 6 (12:50-1:40pm)
423 Little Hall

Training Session #3

Date/Time TBD

Your team will meet one-on-one with a graduate student mentor to practice creating a mathematical model.