

## Volume II Number 1

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### WELCOME TO SIMIODE AND OUR NEWSLETTER

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SIMIODE - Systemic Initiative for Modeling Investigations and Opportunities with Differential Equations is about teaching differential equations using modeling and technology upfront and throughout the learning process. Learn more at our dynamic website, [www.simiode.org](http://www.simiode.org), where we offer a community in which colleagues can communicate, collaborate, publish, teach, explore, contribute, and engage.

The Newsletter will keep you informed about SIMIODE activities. Please give us a look and continue receiving news of SIMIODE in this manner. Contribute items of your own by sending them to [Director@simiode.org](mailto:Director@simiode.org). Thank you.

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### REGISTERING IN SIMIODE

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If you have not registered in SIMIODE please go to our [Home Page](#) and do so to benefit from the rich resources in the SIMIODE community.

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### SIMIODE MINICOURSE

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SIMIODE will be offering a minicourse at MathFest 2016 Columbus OH USA

**TITLE:** Teaching Modeling First Differential Equations - Building Community in SIMIODE.

**TIME and LOCATION:**

Part 1: Thursday, August 4, 3:30 PM – 5:30 PM, Taft D

Part 2: Saturday, August 6, 1:00 PM – 3:00 PM, Taft D

**DESCRIPTION:** This minicourse permits participants to experience SIMIODE - Systemic Initiative for Modeling Investigations and Opportunities with Differential Equations, an online ([www.simiode.org](http://www.simiode.org)) community of teachers and learners of differential equations who use modeling and technology throughout the learning process. Participants do modeling scenarios from the student perspective, discuss pedagogical and content issues that might arise in such teaching, and initiate the development of their own modeling scenario contributions to SIMIODE through partnering with other participants during and after the minicourse. The minicourse is appropriate for all interested in teaching differential equations in a modeling first approach.

**LEADERS:** Therese Shelton, Southwestern University and Brian Winkel, SIMIODE

Our leadership team will be joined by Rosemary Farley and Patrice Tiffany, Manhattan College.

Complete details and registration information will be in the spring copy of MAA's *FOCUS* magazine. Consider joining us and put the dates in your calendar.

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### FREE SIMIODE T-SHIRT

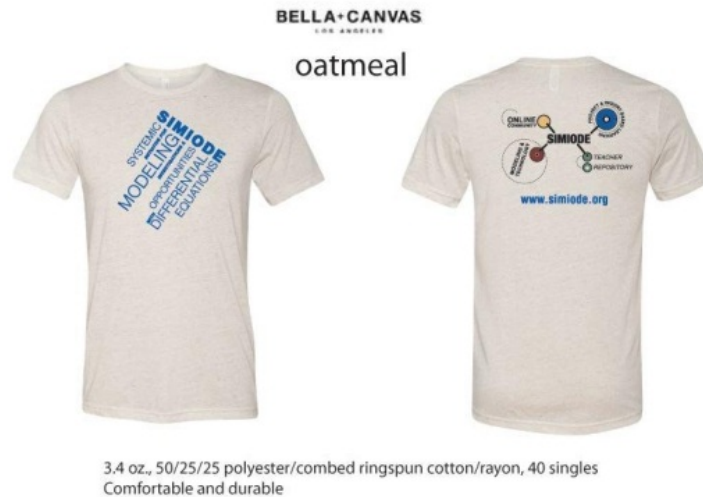
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Answer all 20 SIMIODE Trivia questions and send us your correct answers. If all your answers are right we will send you a way cool FREE SIMIODE T-shirt.

Cut and Paste the question section with your answers below the questions into some file. Then save as pdf and send it to us at [Director@simiode.org](mailto:Director@simiode.org). Be sure to tell us your mailing address and your size (see chart below) and we will send out a FREE SIMIODE T-shirt to the first 25 winners.

#### Size Chart – Men/Unisex Shirt

	S	M	L	XL	2XL
Chest (inches)	34-36	38-40	42-44	46-48	48-50
Waist (inches)	30-32	32-33	33-34	36-38	40-42



- (1) What is the newest modeling scenario uploaded at simiode.org? [Hint](#).
  - (2) What does the second I in SIMIODE stand for?
  - (3) What is the first video at SIMIODE YouTube channel about?
  - (4) What is the third story in the December 2015 latest SIMIODE NEWS Newsletter about?
  - (5) In what context is the word "Missouri" used at [www.simiode.org](http://www.simiode.org) ?
  - (6) Where does a SIMIODE member with name Henderson teach?[Hint](#).
  - (7) Name one Technique Narrative we need to add to SIMIODE.
  - (8) What is the most current post about at the SIMIODE blog, "What's happening in SIMIODE?"[Hint](#).
  - (9) What is the first name in SIMIODE Board of Contributing Advisors?[Hint](#).
  - (10) What number is assigned to an epidemic modeling scenario in SIMIODE?
  - (11) What group in SIMIODE begins with the letter "T"?
  - (12) Name one Modeling Scenario suggested on Day One of the Sample SIMIODE Course Syllabus.[Hint](#).
  - (13) What is the most recent of the "Latest Events" listed in the SIMIODE Calendar?
  - (14) How many views does the SIMIODE Introduction video have on SIMIODE's YouTube Channel?
  - (15) Kevin gave a Testimonial for SIMIODE. What is Kevin's last name?
  - (16) Name one connection to "Torricelli" found at [www.simiode.org](http://www.simiode.org) .
  - (17) Describe the picture in the About Us feature of SIMIODE?
  - (18) What two women whose first name begins with "H" posted a Question of SIMIODE?
  - (19) Where did SIMIODE hold an MAA-PREP Workshop in 2015?
  - (20) Someone on SIMIODE Team is Noble. What is his first name?
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### CUPM GUIDE - THE DIFFERENTIAL EQUATIONS MATERIAL

You can download the current (2015) MAA-CUPM Guide document for differential equations at a [MAA-CUPM Guide - Differential Equations](#). Two things are made clear in the report, "The first is that the ODE course has undergone a remarkable transformation over the past twenty years. The second is that there is now no set curriculum for this course." That indicates there is an opportunity for change, for excitement in your course, and for modeling in differential equations. Carpe diem!!!

The report goes on to say, "At many institutions, the ODE course is often the final mathematics course required by students in engineering and certain areas of science. At many large universities, over 90% of students enrolled in this course come from these client disciplines." Thus we have two good reasons to move our differential equations course in the direction of modeling: (1) if many students will find this to be their final undergraduate course do we want to leave them with our traditional "bag of tricks" course or with rich

examples of applications, of models in which differential equations play a crucial role in describing reality and solving real world problems and (2) do we want to reach out to the client disciplines and show them the rich applicability of differential equations and mathematical modeling in their discipline?

We quote from the report "Most modern courses now eliminate some or many of the specialized analytic methods for solving ODEs." and "There are major applications involving differential equations in all areas of science and engineering, and so many of these should be included in the ODE course to show students the relevance and importance of this topic. "

Consider use of technology. Here is what the report says, "The ODE course is easily the course in the introductory undergraduate mathematics curriculum in which the use of technology is most essential. Students should be encouraged to use these tools in homework, in projects, and in simply visualizing the various qualitative aspects of ODEs.

There is a great deal to think about concerning a new direction for differential equations and SIMIODE stands ready to assist in navigation and benchmarks.

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## **THINK BACK ON YOUR FIRST DIFFERENTIAL EQUATIONS COURSE**

What was your first experience like in your first differential equations course? Was it engaging and what were the engaging features? Were they tricks in solutions ala methods of integration, introductions to new solution strategies such as series solutions, Fourier series, separation of variables, etc.? Or did your professor spice up the course with motivating applications and interesting problems? Do you remember any of them? Can you update at least one for your course?

What can you now use from that experience? What do you think engages today's students? What would make you a better engager in your class? Well, if it is applications then you have come to the right place, SIMIODE. For remember it is a "SLA" (Seven Letter Acronym) for Systemic Initiative for Modeling Investigations and Opportunities with Differential Equations . SIMIODE offers you , the teacher, many ways to stimulate your students and to motivate them to learn differential equations because of all the applications, the original reason for differential equations.

Over the years you have found interesting ways to engage your students, nice modeling activities which you have developed and/or used in your coursework. SIMIODE is the place to share these approaches by writing up a modeling scenario and submitting it to SIMIODE for double-blind, peer-reviewed publication at SIMIODE. You can find out all you need to know in order to become a published author at SIMIODE by going to our web page [Present your Work through Peer-Reviewed Publication System](#). You can do it, others will value your ideas.

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## **SUMMER 2015 MAA-PREP COURSE ATTENDEES AND STAFF**

We had a very successful MAA-PREP Workshop in the summer of 2015 at Carroll College, Helena MT USA. Participants got hands on experiences in teaching differential equations in a modeling-first approach to peers. Our three student assistants also taught a unit. Below we have pictures of our participants and staff and of small group work in our classroom environment.



Participants and staff working - Summer 2015 MAA-PREP Workshop at Carroll College in Helena MT USA.



Participants and staff posing - Summer 2015 MAA-PREP Workshop at



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## **SIMIODE AT JOINT MATHEMATICS MEETINGS, SEATTLE WA USA, JANUARY 2016**

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### **SIMIODE Exhibit Hall Booth**

SIMIODE had a strong presence at the JMM. We had a booth in the Exhibit area and we were visited by hundreds of colleagues who wanted to know more about SIMIODE. Colleagues registered for SIMIODE and chance to win a cool SIMIODE T-shirt, sample literature, and take home examples of Modeling Scenarios for colleagues.



SIMIODE Booth at the Joint Mathematics Meetings, Seattle WA, January 2016.

Most importantly, we engaged colleagues and students in conversations about their interests in teaching differential equations in a modeling-first manner. All comments were positive, very positive. Some folks could not believe they had not heard of our efforts and signed up right away. Others had heard something about SIMIODE and were very pleased to learn the details. . . . they too signed up!

We gave away several hundred SIMIODE T-shirts in drawings at both the Exhibit Booth and the Open House. Look for them in a math event near you.

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### **SIMIODE Open House**

SIMIODE hosted an Open House Friday, 8 January 2016, in the Willow Room of the Sheraton Seattle Hotel with tasty refreshments for attendees of JMM. There were more opportunities to win a cool SIMIODE T-shirt. Rich Marchand of Slippery Rock University was MC and did a great job in fostering fun and awarding prizes. This was a chance to network and meet others who are interested in teaching differential equations using modeling.

We had a simulation table to experience a death and immigration model similar to an [m&m simulation model in SIMIODE](#) only we used plastic coins rather than m&m's.

There were several discussion/focus group tables in which participants joined the conversation to make SIMIODE a better offering. Here we present the themes of the three discussion groups along with a sampling of the responses from Open House attendees. What would you add? Send us your responses to [Director@simiode.org](mailto:Director@simiode.org).

#### **(1) Overcoming Issues/Obstacles to Modeling-First Differential Equations**

Do your colleagues resent you rocking the boat?

How do you fit it in? What do you drop?

I would like to try it, but I do not know what to do.

#### **(2) Examples and Uses of Modeling-First Differential Equation**

Use differential equation models to calculate optimal speed and dropping distance as well as when to apply brakes on the highway.

Model the power needed to ride a bicycle. Components could include road friction, friction of moving parts, wind resistance, and gravity.

Modified version of chain sliding off a table. This problem can be modified by adding a tilt to the table.

Jenny takes a drug (10 mg) every 8 hours. If she only took one, 5 mg would remain in her bloodstream after 6 hours. Model the amount of drug in her bloodstream.

Modeling the motion of a bobber or float when fishing using differential equations. Example of spring mass (buoyancy with period forcing function - the fish tugging).

I have a colleague who self-identifies as "one of those crazies that buys gold." I wonder if there is a nice differential equation that models the value of gold over the time period humans have valued it? (ED: Or is this but a fit to data? I.e., is there any mechanism which models the change in value?

Torricelli's Law on a falling column of water as water pours out an aperture near the bottom. What is the density of water hitting the table as a function of horizontal distance?

Highway modeling. One lane is closed. Bad behavior and judgment of switching, or narrowing to one lane late, leads to log jam. Model it.

Bungee jumping - one half free fall and one half spring mass system.

Employees of a company are representative of the local population with 4% having physical disabilities. The company has \_\_\_\_\_ employees. Each restroom has exactly 8 stalls, with only one of the 8 being wheel chair accessible and having handrails. How much time will employees spend waiting in line for the on accessible stall if there are \_\_\_\_\_ restrooms and \_\_\_\_\_ employees, equal numbers of men and women? If there are \_\_\_\_\_ restrooms and \_\_\_\_\_ employees and \_\_\_\_\_ % of employees are women?

Give students data from an underlying (but not known to the students) (say population) logistic model and have students approximate the rate of change (derivative) using finite differences and plot this rate of change against something, say the population data point for the data point used in the differencing. Determine the function that best fits and use it to obtain an appropriate differential equation  $x'(t) = f(x(t))$ , solve the differential equations, and compare the model to the data. Editor's Note: Such modeling scenarios like this already exist in SIMIODE, but we welcome more based on other phenomena. See for example, [1-18-T-LogisticPopGrowth](#), found in the Teachers Group material.

What is a differential equation model for the value of an investment of \$1.00 after  $n$  years? What sorts of parameters would be good to include?

### **(3) Realizing Opportunities in Using Modeling-First Differential Equations - What can happen for your students?**

Students expand their horizons.

Students could get experiential knowledge of differential equations.

Their brains could explode!

**Here is a general question which came up and we need to address it in SIMIODE:**

Question: Do some modeling scenarios have companions for Mathematica, MatLab, Excel, etc.? How do we know which scenarios do have those components. Are they denoted differently in the bank of scenarios?

Answer: Currently software issues are only found in the Teachers Version narrative and the accompanying files in the specific modeling scenario's directly. As to identification of which software might be used it is probably not a good idea to put this in the Student Version as it may put off some student inquiries if they thought that was the only way to work or if their teacher felt they could not learn from other codings.

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## **MODELING SCENARIOS OF THE FUTURE HAVE ARRIVED TO SIMIODE**

A good number of Modeling Scenarios have worked their way through the referee and editorial process and are now available (more on the way!) Here are some which might interest you.

**Feral Cat Control** From the abstract, "This activity is structured as a letter from a company seeking assistance with a mathematical problem. The students will act as professional mathematical consultants and write a report analyzing the client's problem. The client company is a fictional organization which advocates for the use of trap-neuter-return (TNR) as a control method for feral cat colonies. The students will utilize modified exponential growth models to analyze the efficacy of TNR compared to a euthanasia program."

**Fish Mixing** From the abstract, "This activity gives students a chance to build the underlying differential equation and/or difference equation for a mixing problem using tangible objects (fish) and a student-designed restocking and fishing plan in a lake. The mixture is of two species of fish, one being the current sole species in the lake and the other being introduced via restocking. The students generate data for the mixing problem via a brief game and then conjecture forms of the differential or difference equation model."

**Algae Population Self-Replenishment** From the abstract, "This modeling scenario investigates the massive algal blooms that struck Lake Chapala, Mexico, in 1994. After

reading a summary of news articles on the incident, students create an ODE system model from a verbal description of the factors, visualize this system using an executable Java applet (PPLANE) to predict overall behavior, and then analyze the nonlinear system using the Jacobian matrix, eigenvalues, phase plane, and feasibility conditions on parameters to fully describe the system behavior. Students are expected to be familiar with systems of differential equations, equilibria, Jacobian matrices, and eigenvalues. Students will learn modeling from qualitative descriptions, nondimensionalization, applying feasibility conditions to parameters, and how to use technology to interactively analyze a system of differential equations."

**WhalesAndKrill** From the abstract, "Students will use Excel to observe qualitative behavior in a simulation of a predator-prey model, with blue whales and krill as the predator and prey populations, respectively. Students are asked to explain terms in the system of differential equations, compute population values using iteration without a spreadsheet. Then they will implement the simulation in Excel and create charts to observe qualitative behavior."

**And now for somethings really different:**

**Probably Generating Function Approach to Modeling Death and Immigration model** From the abstract, "We develop a mathematical model of a death and immigration process using m&m's as a stochastic process with the help of probability generating functions."

**Barging Ahead on the Great Lakes** In which, "As captain of a barge, you need to determine how fast to transport your barge up river against the current in order to minimize the expended energy. Since expended energy is proportional to the force, and since the force is proportional to the speed, traveling too fast is inefficient. However, if traveling too slow, it will almost take an infinite amount of time to arrive, which is also inefficient. How fast then should you go? We find an answer to this question, and to the related question of minimizing cost of travel, where the cost is a linear combination of the energy and the time. "

That is quite an interesting list and there are more coming! The diversity of applications of differential equations and hence teaching modeling first differential equations is richly displayed in these titles. We are pleased at these developments.

Remember, your ideas from your own class projects or activities would make good Modeling Scenarios and we encourage you to submit your materials for publication in SIMIODE. You can find out how to do this at [Material Submission Process](#).

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## INDIVIDUAL MEMBER ACTIVITIES

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**Rosemary Farley**, Manhattan College, Riverdale NY USA is keeping a weekly blog about her activities using technology at [Progress Reports on Lab](#). Listen to her candid and open narrative of progress in her course. She is interested in using technology (Maple) to enhance her teaching and is sharing her ideas, activities, and view of results with us all. She shares some very practical advice based on NOW experience. Visit her blog. Thank you, Rosemary.

Rosemary also has formed a Project with Maple resources and activities - two actually - one version for Student material and one version for Teacher material. Write to her by sending her a message and identifying yourself. Do this from her blog page and ask to join the appropriate Project for you.

Here is some of what Rosemary offers in her Week 3 post:

*"Last week I hoped that my students would understand that the mathematics has to take center stage. I do believe that this has been achieved in Week #3. No longer are there questions like "What do you want me to do?" I want to reiterate here that no student is allowed to ask for help with the code for the creation of a DE until the student has something written down on paper. I have found, in week #3, that once they understand that they are responsible for speaking mathematically, fewer syntax questions are asked. The questions switch and become centered on the particular problem and the mathematics in that problem."*

**John Sieben (along with colleague Reza Abbasian)** from Texas Lutheran University, Seguin TX USA, have a paper just out in our favorite journal *PRIMUS-Problems, Resources, and Issues in Mathematics Undergraduate Studies*, Volume 26, Number 2, 2016, pp. 168-177, entitled, [Creating Math Videos: Comparing Platforms and Software](#). We offer the abstract here:

In this paper we present a short tutorial on creating mini-videos using two platforms—PCs and tablets such as iPads—and software packages that work with these devices. Specifically, we describe the step-by-step process of creating and editing videos using a Wacom Intuos pen-tablet plus Camtasia software on a PC platform and using the software Doceri with iPads to produce instructional math videos. We then focus on the merits and shortcomings of each platform. We conclude this paper by discussing the hardware and software requirements for presenting these videos in a classroom. This article is intended for mathematics and/or statistics educators with an interest in using instructional videos, online resources, and the flipped classroom approach to teaching, and is appropriate for the newcomer to the flipped classroom as well as more seasoned practitioner.

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## WORDS OF ENCOURAGEMENT FROM THE DIRECTOR

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SIMIODE is a community which is alive, vibrant, and rich in resources and individual talents to assist colleagues who wish to teach differential equations using modeling to motivate students.

There are a number of ways you can add to the community:

**Contribute materials** -- You can do this at [Resources: New](#). There you will find types of

materials and instructions on how to contribute and begin the process leading to publication in SIMIODE.

**Register to referee and review submitted materials.** -- Good scholarship merits attention and our double-blind, peer-referee system affords quality reviews of submitted materials. Please, visit our [Manuscript Management system](#) and register as a referee.

**Post slides from your presentations or talks.** -- When you give a talk locally or beyond you can post your slides, details of the talk or meeting, and comments at [Resources: Presentations](#). Now that you have spread the word beyond the SIMIODE community bring it back home for your fellow SIMIODE members to see.

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## SIMIODE IS ON TWITTER

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SIMIODE does have a Twitter account, but we are new to its use and we are welcome to ideas on how best to use it to communicate SIMIODE notions. [SIMIODE on Twitter](#).

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## INTERESTING RESOURCE LIST

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[Math Blogs](#) contains many blogs related to mathematics.

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## SIMIODE OUTREACH

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We are blogging from SIMIODE at [What's Happening in SIMIODE](#). Here you will find a broad SIMIODE Blog and also individual Blog entries from members. Check us out and Comment on our entries.

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## SIMIODE INREACH

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As always please let us hear from you with your concerns, your news, and your activities. Contact us at [director@simiode.org](mailto:director@simiode.org).

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