Mathematical Association of America
Minicourse Proposal Form

1. *Information for the Primary Contact Presenter*:

   (a) *Name*: **(omitted from Sample)**
   (b) *Affiliation*: Muhlenberg College
   (c) *Address*: **(omitted from Sample)**
   (d) *E-mail Address*: **(omitted from Sample)**
   (e) *Telephone*: **(omitted from Sample)**
   (f) *Fax*: **(omitted from Sample)**
   (g) *Date:* **(omitted from Sample)**

2. *Names and Affiliations for any Additional Presenters*: **(omitted from Sample)**

3. *Choose the upcoming meeting for which you are applying*: JMM 20xx

4. *Does the proposed minicourse require the participants to use a computer*?
   ☐ No ☒ X Yes

5. *Is this a request to repeat a minicourse that has already been offered or approved*?
   ☐ No ☒ X Yes

6. *Course Title*: Teaching Differential Equations With Modeling

7. *Course Abstract: (Note: This is the only information prospective participants will see. Thus, it should clearly articulate the content and goals for the minicourse, the format of the course, and any necessary prerequisite knowledge. Given space limitations, the abstract should not be more than 100 words in length.)*

Participants will learn about incorporating modeling into their differential equations courses and will do some modeling themselves using technology. The workshop will have three segments: (1) a short overview of curricular goals, what is modeling and why it is important, how modeling benefits student learning in differential equations; (2) activities and discussions in small groups on specific projects, to include modeling the dynamics of flight, stochastic population growth models, modeling malaria outbreaks, deflection in steel beams, and others; and (3) a wrap-up with references, sharing of best practices, and resources that are available to instructors and students.

8. *Detailed Description:* (*Please include a list of topics to be covered and the approximate time spent on each topic. Also, indicate how the participants will be involved. Note: Minicourses are scheduled for two, 2-hour sessions, on two different days; e.g., Monday and Wednesday, 9:00 – 11:00.)*

We expect the first day to be devoted to segment (1) – about half an hour – and the beginning of segment (2) – about 90 minutes. The second day will be devoted to

finalizing segment (2) and segment (3) – about 90 minutes for presentations.

Our vision is that participants will actually be doing some of the modeling exercises themselves and then the group will discuss how they could see their students benefitting from that experience and how they can incorporate it into their classrooms. We also want to share with participants important results from the education literature that relate to the teaching and learning of differential equations.

We have compiled a large set of modeling projects for the minicourse. These include:

- Modifying an infectious disease problem. Instead of incorporating the popular SIR model (susceptible-infected-recovered) for a disease, we will look at modeling malaria in Central America. Malaria is a disease in which a person may become susceptible again and again, so we will discuss a variation of the SIRS model. We will also look at the pharmacokinetics of drug treatments and the effects of repellents, such as DEET. The project requirements can be solved using numerical techniques, Laplace transforms, logistics growth equations, and systems of linear and nonlinear equations.
- Utilizing a stochastic population growth model with a variety of applications. The population models are affected by stochastic processes which must be modeled and solved using various techniques.
- Modeling the deflection of steel beams in construction projects. Your university is building a new student union building. This project investigates the deflection when the beam is fixed, under various loads, etc. Numerical and analytic methods are used to solve first-, second-, and fourth-order differential equations.
- Investigating the dynamics of flight strategies, when altitude, speed, and load are varied. The differential equations governing aircraft flight tie in well with civil and mechanical engineering department courses. Participants are presented lift and thrust equations which can be solved analytically and numerically. Another similar project centers on sport parachuting from a helicopter or airplane. Participants can study the effects of drag, wind, and weather elements on a parachutist in freefall or with the chute deployed.
- Testing Newton's Law of Cooling to exercise. How long must a thermometer be kept in contact with a body to gain an accurate temperature reading? What happens to the body's temperature after exercise, chewing gum, drinking a cold beverage, etc.? This project has applications in first-order ODEs with hands-on activities for students to gather and analyze data.
- How far can a baseball travel? When a baseball undergoing spin moves through the air, in addition to the force of gravity acting on it, there are two other important forces, the drag force and the Magnus force, which accounts for lift. This project uses data from Major League Baseball to study how far a batted ball would travel under different conditions. The differential equations are solved numerically. We would start with Mickey Mantle's famous blast in 1963, when his ball clipped the upper façade at Yankee Stadium.
- Applying differential equations to classic mythology. Several of the Twelve Labors of Hercules can be modeled using differential equations. For example, Hercules wrestled with the giant Antaeus. Each time Hercules lifted Antaeus off

the ground, the giant's strength decayed exponentially, but then it recovered when Hercules threw him to the ground. This creates a step forcing function which can be modeled with Heaviside equations. In another labor, Hercules had to clean the stables of Augeus in a single day. Using Torricelli's Law, we can model the situation and determine if the stables could be cleaned in one day. Seven of the twelve labors can be modeled with ordinary differential equations.

Our vision is to offer some of our projects up for discussion and then part of the minicourse can be set aside for participants to tailor them for their courses. If participants attend with a specific project in mind, part of segment (2) can be used for this purpose. We would then proceed in the minicourse by getting participants to understand how to motivate applications using differential equations. The presenters would break the participants into groups who have chosen different sample projects. All of the projects will be made available to participants.

9. *Special Logistical or Equipment Requests: (A computer projector and overhead projector will be provided; presenters are expected to bring their own laptops. Generally, rooms for minicourses are set up with tables and chairs facing the front. List any special needs for the course, in terms of equipment or furniture set-up.)*

We see great opportunities in collaborating among participants. One of the organizers will capture the discussions of participants for dissemination. It will be very helpful for participants to have laptops and to be able to get to internet resources.

10. *Biographical Sketches: (For each presenter, provide a brief bio, including information concerning the presenter's experience related to the proposed minicourse.)*

(omitted from Sample – should be a paragraph for each presenter)

11. *Policy on Commercial Promotion*:
Whereas some minicourses will relate to commercially-available products, such as books or software, the promotion of such products in a minicourse is not appropriate. Participants in a successful minicourse naturally will want to know more about the materials used in the course, but the minicourse may not be used to promote any particular product.

☐ X The presenters understand and accept this policy.

12. *Policy on Recording or Broadcasting*:
The recording or broadcasting of any MAA sponsored event, including but not limited to proceedings at sectional and national meetings, workshops, minicourses, short-courses, and colloquia, is strictly forbidden without the explicit permission of the Mathematical Association of America.

☐ X The presenters understand and accept this policy.

This application should be submitted electronically to:

Martha Abell, Chair
MAA Committee on Minicourses
martha@georgiasouthern.edu