Course Assignments

Continuous Mathematical Modeling with Biological Applications

MATH 315 – TR 11:00 - 12:15 AM, Barret 035

Class Meetings

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Thursday, 25 August

In Class Today:

- Go over syllabus, structure of the course, student/instructor expectations
- Lecture: *The Yellow Fever Epidemics of Memphis*
- Video: Memphis Yellow Fever Epidemic of 1878

Homework:

Online Tutorial 01 — Due Date: Tuesday, 30 August

Watch screencasts:

- LaTeX: Getting Started
- LaTeX: Mathematical Text

Individual Writing Assignment 01 & Coding Exercise 01 — Due Date: Tuesday, 30 August

All articles for this reading assignment are posted on Moodle.

Read *Infectous Disease Terminology* and *Simple Epidemic Models*. These two articles will help provide a background for understanding the remainder of the reading assignment. If there are other terms you feel it would be helpful to add to the *Infectious Disease Terminology* document, please let me know.

Read *Schwartz2007* (Introduction, Methods, and Appendix sections) and *Esteva2005* (Introduction and The Model sections). Note, you do not need to read the entirety of each paper, just the sections listed. Then, answer the following questions:

- For each paper, what type of information is contained in the Introduction?
- For each paper, what questions are the authors trying to address by constructing their model?
- For each paper, how is the model presented in the paper? Comment on the use of textual description and graphical depiction. Comment on the use of lists and tables for parameters and assumptions. How are any tables references within the text of the article?
- For each paper, what are the states of the models? What variables are used to describe each state?
- For each paper, what are the model parameters? How are they presented in the paper?
- For each paper, where are the model assumptions stated in relation to the presentation of the model equations? Are there underlying assumptions that have been made and not explicitly stated?
- In light of your answers to the above questions, describe who you think the intended audience is for each paper.
- For each paper, is there any content that is unclear? Be specific.

Write up your answers in a LaTeX document. The document should use as a title "Individual Writing Assignment 01" and use `\maketitle` to include the title, author's name, and date. Submit the `*.tex` and `*.pdf` files of your document to Box with the naming scheme `IW01_YourLastName.tex` and `IW01_YourLastName.pdf`, respectively.

Individual Writing Assignment 02 — Due Date: Tuesday, 30 August

Fill out the *Group Formation Questionnaire*. Bring the completed form to class on Tuesday, 30 August. Please be realistic about the times during which you will be able to regularly meet. Check all aspects of your schedule. It will be extremely important that your group be able to meet at least one hour a week outside of class each week.

Tuesday, 30 August

Due Today:

- Individual Writing Assignment 01
- Coding Exercise 01
- Individual Writing Assignment 02 (Submit at the beginning of class)

In Class Today:

- Class discussion: Elements of a Model Description. Within this discussion we will generate rubrics (written description, parameter tables, flow diagrams) to use in future writing assignments.
- Lecture: The SEIR Model

Homework:

Online Tutorial 02 — Due Date: Thursday, 1 September

Watch screencasts:

- LaTeX: Tables
- LaTeX: Including Figures

Individual Writing Assignment 03 & Coding Exercise 02 — Due Date: Thursday, 1 September

Write a description of the SEIR model developed/discussed in class using the rubric developed in class. Include a parameter table with an appropriate caption *above* the table. Make sure to reference the table within the textual description of the model.

Your description should be written as a LaTeX document, should use the title "Individual Writing Assignment 03", and should use `\maketitle` to include the title, author's name, and date. Submit the `*.tex` and `*.pdf` files of your document to Box with the naming scheme `IW03_YourLastName.tex` and `IW03_YourLastName.pdf`, respectively.

Read through the *Feeback & Reflection* article (posted on Moodle) in preparation for giving and receiving peer feedback on this assignment. This assignment will be peer-reviewed on Thursday, 1 September.

Thursday, 1 September

Due Today:

- Individual Writing Assignment 03
- Coding Exercise 02

In Class Today:

- Peer-review of Individual Writing Assignment 03 according to the class rubrics developed on Tuesday, 30 August.
- Lecture: Yellow Fever Dynamics
- Group formation. Establishment of group meeting times and group working practices. Read through the *Creating Your Team*, *Effective Communication*, and *Group Project Management* documents on Moodle.
- Group Work: Group Writing Assignment 01 and Group Writing Assignment 02

Homework:

Group Writing Assignment 01 Due Date: Tuesday, 6 September

Prepare a LaTeX document title "Group Working Practices (Group Writing Assignment 01)" which lays out the ground rules for how your group will function. The document should address the following questions.

- When, where, and for how long will the group meet? You should have at least one face-to-face weekly group meeting, but you may want to take advantage of technology like Google Hangouts. How long will these meeting run?
- How will the group stay in contact outside of class time and group meetings?
- What should someone do if they cannot attend a meeting or complete work on time? What are the consequences if someone fails to attending a group meeting or fails to turn in their portion of work on time? (Remember that each group member has some influence over the grades of their fellow group members.)
- Will there be a team leader and/or other roles?
- How will decisions effecting the group be made?
- What is your plan for conflict resolution when disagreements arise? (Please recognize that disagreements will arise, and make an appropriate plan for how to deal with those disagreements.)
- For each individual in the group: What is the best way for you to hear/receive criticism?
- For each individual in the group: If you start to struggle (with content, load, etc.), what is *your* plan?

Your working practices should be written as a LaTeX document and should use `\maketitle` to include the title, authors' names, and date. Submit the `*.tex` and `*.pdf` files of your document to Box with the naming scheme `GW01_YourLastNames.tex` and `GW01_YourLastNames.pdf`, respectively.

Bring **3 copies** of your Group Working Practices document to class on Tuesday, 6 September. Each group will be given a chance to review the working practices of other groups and make modifications if they see ideas from other groups which they would like to incorporate into their own.

Group Writing Assignment 02 Due Date: Tuesday, 6 September

Your group should investigate various (modern) methods of controlling outbreaks of yellow fever. Write a brief description (1-2 sentences will suffice) of at least two of these methods. List the control methods in the order of interest to your group (listing the most interesting control method first). Later in the semester your group will be asked to modify your mathematical model to include at least one control method.

This item should be typed in LaTeX. Submit the `*.pdf` file to Box with the naming scheme `GW02_YourLastNames.pdf`. This item will be graded solely on completion and turning the assignment in on time.

Individual Writing Assignment 04 & Coding Exercise 03 Due Date: Tuesday, 6 September

Make appropriate edits to your model description from Individual Writing Assignment 03 according to the peer-reviews you received today. This edited version will only be graded by the instructor, but will be graded according to the rubrics developed by the class.

Your description should be written as a LaTeX document, should use the title "Individual Writing Assignment 04", and should use `\maketitle` to include the title, author's name, and date. Submit the `*.tex` and `*.pdf` files of your document to Box with the naming scheme `IW04_YourLastName.tex` and `IW04_YourLastName.pdf`, respectively.

Tuesday, 6 September

Due Today:

- Group Writing Assignment 01 (3 copies)
- Group Writing Assignment 02
- Individual Writing Assignment 04
- Coding Exercise 03

In Class Today:

- Discussion of Group Writing Assignment 01
- Discussion of yellow fever control measures based on Group Writing Assignment 02
- Lecture: *Solving systems of ODEs in Mathematica*

Homework:

Coding Exercise 04 — Due Date: Thursday, 8 September

In Mathematica, write code which solves the SEIR model

$$\begin{aligned} \frac{dS}{dt} &= -\frac{\beta SI}{S+E+I+R} & \frac{dE}{dt} &= \frac{\beta SI}{S+E+I+R} - kE \\ \frac{dI}{dt} &= kE - \gamma I & \frac{dR}{dt} &= \gamma I \end{aligned}$$

where $\beta = 0.33$, $1/k = 5.30$, and $1/\gamma = 5.61$. Choose some appropriate initial conditions and generate a graph of the solution over a reasonable period of time (i.e., you can cut the graph off after nothing interesting is happening when it reaches equilibrium).

Submit the `*.nb` file to Box with the naming scheme `CE04_YourLastName.nb`.

Online Tutorial 03 — Due Date: Thursday, 8 September

Watch screencasts:

- LaTeX: Environments
- LaTeX: Referencing Internal Content
- LaTeX: Including Figures

Individual Writing Assignment 05 & Coding Exercise 05 — Due Date: Thursday, 8 September

Create a LaTeX document which contains a description of the SEIR system given above, and the figure(s) generated in Coding Exercise 04 with appropriate captions *below* each figure. The caption should reference the model and state the parameter values and initial conditions used to generate the graph in the figure. This document does NOT need to include an introduction or parameter table.

Your LaTeX document should use the title "Individual Writing Assignment 05", and should use `\maketitle` to include the title, author's name, and date. Submit the `*.tex`, `*.pdf`, and `*.png` files to Box with the naming scheme `IW05_YourLastName.*`.

Thursday, 8 September

Due Today:

- Coding Exercise 04
- Individual Writing Assignment 05
- Coding Exercise 05

In Class Today:

- Lecture: Formulate a model of yellow fever with no control.
- Discussion of of possible parameter values for model parameters.

Group Research:

- Discuss which control method your team will include in the model. How will you change the model developed in lecture to include this method of control? Formulate the equations for your model.
- Find at least one peer-reviewed journal article which examines this method of control for a different disease (e.g., dengue fever or chikungunya).

Homework:

Online Tutorial 04 — Due Date: Tuesday, 13 September

Watch screencasts:

- LaTeX: Using BibTeX & JabRef
- LaTeX: Sections

Group Writing Assignment 03 & Coding Exercise 06 — Due Date: Tuesday, 13 September

Create a LaTeX document which contains a short description of the relevant biology and history of yellow fever and the control measure of yellow fever your group will be modeling, a description of your group's proposed model, a parameter table which describes each parameter and gives a referenced value (with units). The document should additionally contain a bibliography containing any and all references. The document you submit should use as a title "Group Writing Assignment 03" and use `\maketitle` to include the title, authors' names, and date, and should contain the sections *Background*, *Mathematical Model*, and *References*. The model section should contain a flow diagram of your group's proposed model. Submit the `*.tex` and `*.pdf` files of your document to Box with the naming scheme `GW03_TeamName.tex` and `GW03_TeamName.pdf`, respectively. Additionally, submit the BibTeXfile using the naming scheme `TeamName.bib`. If you have not done so already, come up with a clever team name.

Your submission will be peer-reviewed on Tuesday, 13 September.

Tuesday, 13 September

Due Today:

- Group Writing Assignment 03 (six copies)
- Coding Exercise 06

In Class Today:

- Peer-review of Group Writing Assignment 03 using class designed model description rubrics developed on Tuesday, 30 August.
- Group Coding Time: Coding Exercise 07

Homework:

Coding Exercise 07 Due Date: Thursday, 15 September

Write the necessary code in Mathematica to solve the system of ODEs describing your team model. Generate results for three different sets of initial conditions (each group member can choose one set of initial conditions). The Mathematica file should be saved using the naming convention `CE07_TeamName.nb`, and should contain three graphs each corresponding to a different set of initial conditions. Submit your Mathematica file to Box.

Group Writing Assignment 04 Due Date: Thursday, 15 September

Make edits to your model description and parameter table based on the reviews received today. Additionally, modify your group LaTeX document from Group Writing Assignment 04 to contain figures showing graphs of results for each set of initial conditions from Coding Exercise 07. The document you submit should use as a title "Group Writing Assignment 04" and use `\maketitle` to include the title, authors' names, and date, and should contain the sections *Background*, *Mathematical Model*, *Results*, and *References*. Note the figures should appear in the *Results* section. The text in the results section should describe the parameter values and initial conditions used to generate the results shown, and should reference the corresponding figures. Also, all figures should have appropriate descriptive captions. Submit only the `*.pdf` file to Box with the naming scheme `GW04_TeamName.*`.

This document will NOT be peer-reviewed, however one member of your group should be prepare to make a short 1–2 minute presentation to the class on Thursday, 15 September of each of the graphs included and what each graph is showing.

Thursday, 15 September

Due Today:

- Group Writing Assignment 04
- Coding Exercise 07

In Class Today:

- Each group will present there figures generated for Group Writing Assignment 04 to the class. We will have a class discussion about each group's set of figures.
- Class Discussion: Figures & Describing Results
  - Are the figures clear and legible?
  - Are the figures easily understood with the aid of the caption?
  - What are the main features of the figure? What make it interesting?
  - If there are multiple curves on one graph, does it make sense to have them all on one graph? Should they be separated? If there multiple curves across several graphs, could they be condensed onto one graph without loss of clarity?
  - If we were to write a description of the results displayed in this graph, what would we write? Are the graphs telling the story we want them to tell? Do we need additional graphs? Are some graphs irrelevant?
- Group Research Time: Group Writing Assignment 05

Homework:

Group Writing Assignment 05 — Due Date: Tuesday, 20 September

Your groups should modify the document from Group Writing Assignment 04 to include the constructive feedback from today. Your modifications may include producing new results via Mathematica. In the *Results* section, write a brief description of your results.

The document you submit should use as a title "Group Writing Assignment 05" and use `\maketitle` to include the title, authors' names, and date, and should contain the sections *Background*, *Mathematical Model*, *Results*, and *References*. Submit the only the `*.pdf` file to Box with the naming scheme `GW05_TeamDisease.*`.

This document will be peer-reviewed on Tuesday, 20 September.

Individual Writing Assignment 06 — Due Date: Tuesday, 20 September

Read *Calculating* R_0 and *Vector Born Threshold Condition*. Then, derived a threshold condition for the baseline yellow fever model. This can be written by hand, but should be written neatly, and in an easy to follow (linear) fashion.

Tuesday, 20 September

Due Today:

- Group Writing Assignment 05
- Individual Writing Assignment 06

In Class Today:

- Peer-review of Group Writing Assignment 05 (Providing feedback on the Results section)
- Coding Lecture: *Using Mathematica to Calculate ~~Ugly~~ Computationally Intensive Eigenvalues*

Homework:

Group Writing Assignment 06 — Due Date: Thursday, 22 September

Make edits to your LaTeX document based on the reviews received today. The document you submit should use as a title "Group Writing Assignment 06" and use `\maketitle` to include the title, authors' names, and date, and should contain the sections *Background*, *Mathematical Model*, *Results*, and *References*. Submit the `*.tex`, `*.pdf`, image, and BibTeX files for your document to Box with the naming scheme `GW06_TeamDisease.*`.

This document will NOT be peer-reviewed.

Coding Exercise 08 — Due Date: Thursday, 22 September

As a group, write code in Mathematica to determine a threshold condition for your group model. Submit your Mathematica to Box using the naming scheme `Threshold_TeamName.nb`.

Individual Writing Assignment 07 — Due Date: Thursday, 22 September

Read *Schwartz2007* (Methods section) and *Esteva2005* (Equilibrium Points and Stability of Equilibria sections). Answer the following questions:

- For each paper, what is the depth of the explanation of the mathematical method being described?
- For each paper, what do the authors assume the reader knows?
- For each paper, what references do the authors point the reader towards within the description of the method?
- For each paper, what additional information would you need (if any) to fully understand the description of the methods used to analyze the model?

Write up your answers in a LaTeX document. The document should use the title "Individual Writing Assignment 07" and use `\maketitle` to include the title, author's names, and date. Submit the `*.pdf` file of your document to Box with the naming scheme `IW07_YourLastName.pdf`.

We will discuss this reading assignment on Thursday, 22 September.

Thursday, 22 September

Due Today:

- Group Writing Assignment 06
- Coding Exercise 07
- Individual Writing Assignment 07

In Class Today:

- Class Discussion: What Should Be Included in a Methods Section? We will develop a rubric during this discussion.
- Class Discussion: How Does Parameter Uncertainty Effect Results?

Homework:

Group Writing Assignment 07 — Due Date: Tuesday, 27 September

Modify the document from Group Writing Assignment 06 to include a *Methods* section which describes the method by which you found the threshold conditions for your model. Use the rubric developed in class today as your guide of how much detail to include.

The document you submit should use as a title "Group Writing Assignment 07" and use `\maketitle` to include the title, authors' names, and date, and should contain the sections *Background*, *Mathematical Model*, *Methods Results*, and *References*. Submit the `*.pdf` file for your document to Box with the naming scheme `GW07_TeamName.*`.

This document will be peer-reviewed.

Individual Writing Assignment 08 — Due Date: Tuesday, 27 September

Read *Blower2005* (Introduction, The Current State of HIV Vaccines, Transmission Models and Health Policy, A Disease-Modifying HIV Vaccine Model for Multiple Subtypes, and Predictions for the HIV Epidemic in South Africa) and *Schwartz2007* (Results). Answer to the following questions:

- There are two models proposed in the Blower2005 paper. Describe the different between the models. Additionally, what are the states of each model? What are the parameters for each model?
- For the Blower2005 paper, describe how the authors present the models and the parameters. Comment on the use textual descriptions as well as graphics and tables. Are each of these used effectively? Why or why not? (Feel free to reference the class rubrics.)
- In each of the papers, how do the authors handle parameter uncertainty? How do the authors display how the parameter uncertainty effects the model's state variables?
- For each of the papers, describe how the results are presented? The Latin-hypercube sampling used in each paper generates many parameters sets (1000 unique parameter sets in each paper), and the uncertainty analysis evaluations the variability of the model's dynamics over those 1000 unique parameter sets. How do each of the paper visual display the variability in of the model's dynamics generated through the uncertainty analysis?

Write up your answers in a LaTeX document. The document should use the title "Individual Writing Assignment 08" and use `\maketitle` to include the title, author's names, and date. Submit the `*.pdf` file of your document to Box with the naming scheme `IW08_YourLastName.pdf`.

Tuesday, 27 September

Due Today:

- Group Writing Assignment 07
- Individual Writing Assignment 08

In Class Today:

- Peer-review of *Methods* section of Group Writing Assignment 07. Each individual will use Mathematica to perform an independent confirmation of correct calculations within the methods section.
- Class Discussion of Individual Writing Assignment 08

Homework:

Group Writing Assignment 08 — Due Date: Thursday, 29 September

Make edits to your LaTeX document based on the reviews received today. The document you submit should use as a title "Group Writing Assignment 08" and use `\maketitle` to include the title, authors' names, and date, and should contain the sections *Background*, *Mathematical Model*, *Methods*, *Results*, and *References*. Submit the `*.tex`, `*.pdf`, image, and BibTeX files for your document to Box with the naming scheme `GW08_TeamDisease.*`.

This document will NOT be peer-reviewed.

Individual Writing Assignment 09 — Due Date: Thursday, 29 September

Read the *Blower1994* paper. Answer the following questions:

- In your own words, describe Latin hypercube sampling (LHS).
- In your own words, describe what uncertainty analysis is. Note that Blower & Dowlatabadi use LHS to sample the parameter space; LHS, in an of itself, does not constitute uncertainty analysis.
- In your own words, describe what sensitivity analysis is. Note, Blower & Dowlatabadi use Partial Rank Correlation Coefficients (PRCCs) to describe model sensitivity to parameters; PRCCs do not, in an of themselves, constitute sensitivity analysis.
- What if anything is still unclear after reading through this paper?

Write up your answers in a LaTeX document. The document should use the title "Individual Writing Assignment 09" and use `\maketitle` to include the title, author's names, and date. Submit the `*.pdf` file of your document to Box using the naming scheme `IW09_YourLastName.pdf`.

You may want to bring a copy of this assignment to class on Thursday, 29 September to aid in your participation in the class discussion.

Thursday, 29 September

Due Today:

- Group Writing Assignment 08
- Individual Writing Assignment 09

In Class Today:

- Class Discussion: Individual Writing Assignment 09 and Uncertainty & Sensitivity Analysis
- Code Lecture: *Implementing Latin-hypercube sampling in Mathematica & Depicting Uncertainty Analysis Results Graphically*
- Coding Time: Getting Started on Coding Exercise 09

Homework:

Coding Exercise 09 Due Date: Thursday, 6 October

Group Assignment: Write code in Mathematica which samples at least two of the parameters in your model over a given interval using the Latin-hypercube sampling scheme. Solve your team model for each of the generated parameter sets. Generate at least two graphs for the results section of your team's paper which illustrate how your model varies with uncertain parameter inputs.

Submit a copy of the Mathematica file using the naming scheme `CE09_TeamName.nb` to Box. Additionally, save copies of the graphs. One member from your group (not the one who presented last time) will present your graphs to the class on Tuesday, 4 October.

Tuesday, 4 October

Due Today:

Nothing due today!

In Class Today:

- Each group will present their figures generated for Coding Exercise 09 to the class. We will have a class discussion about each group's set of figures.
- Group Research Time: Groups will revise figures generated for Coding Exercise 09. If necessary, groups will revise their models and generate new results.

Homework:

No new homework assigned today! Reminder: Coding Exercise 09 is due on Thursday, 6 October

Thursday, 6 October

Due Today:

- Coding Exercise 09

In Class Today:

- Class Discussion: Figures & Describing Results (Round 2)
  - Are the figures clear and legible?
  - Are the figures easily understood with the aid of the caption?
  - What are the main features of the figure? What make it interesting?
  - If there are multiple curves on one graph, does it make sense to have them all on one graph? Should they be separated? If there multiple curves across several graphs, could they be condensed onto one graph without loss of clarity?
  - If we were to write a description of the results displayed in this graph, what would we write? Are the graphs telling the story we want them to tell? Do we need additional graphs? Are some graphs irrelevant?
- Class Discussion: *Calculating Cumulative Infections and Deaths*
- Class Discussion: *Using Matrix Plots for Sensitivity Analysis*
- Class Discussion: **Midterm Paper** (Group Writing Assignment 10 & Group Writing Assignment 11)

Homework:

Group Writing Assignment 09 Due Date: Tuesday, 11 October

Write a description of the uncertainty analysis methods with appropriate references. Start with a description of uncertainty analysis in general, then give a description of Latin hypercube sampling (LHS) and how you are using it in performing uncertainty analysis. Add the description of the uncertainty analysis to the methods section of your group's current manuscript.

Write a description of the results of your uncertainty analysis referencing figures of graphical results generated in Coding Exercise 09. Add the description of the results of the uncertainty analysis to the results section of your group's current manuscript.

The document you submit should use as a title "Group Writing Assignment 09" and use `\maketitle` to include the title, authors' names, and date, and should contain the sections *Background*, *Mathematical Model*, *Methods*, *Results*, and *References*. Submit the `*.pdf` file for your document to Box with the naming scheme `GW09_TeamName.*`.

This document will be peer-reviewed on Tuesday, 11 October.

Tuesday, 11 October

Due Today:

- Group Writing Assignment 09

In Class Today:

- Peer-review of Group Writing Assignment 09 (uncertainty analysis methods paragraphs only)
- Group Research Time: Group Writing Assignment 10

Homework:

Group Writing Assignment 10 (Draft of First Research Paper) Due Date: Thursday, 13 October

For your midterm paper your group will submit a manuscript in which you present the the yellow fever model with a method of control that your group developed. Your paper should focus on the 1878 outbreak of yellow fever in Memphis. As such, you should present the results of at least one simulation of your model without any control to show that without the control measure, your model with appropriate parameter values approximates the 1878 yellow fever outbreak in Memphis. Additionally, your uncertainty analysis results should show how uncertainty in the parameters that affect the modeled control measure impact the dynamics of the epidemic. Specifically, you should consider how the cumulative number of infections or deaths are effected by parameter variation.

The document you submit should use as a title "Group Writing Assignment 10" and use `\maketitle` to include the title, authors' names, and date, and should contain the sections *Background*, *Mathematical Model*, *Methods*, *Results*, and *References*. Submit the `*.pdf` file of your manuscript to Box with the naming scheme `GW10_TeamName.*`. Sumbit all the files in a single folder titled `GW10 TeamName`.

This assignment will count as the first submission of your first research paper. **The first research paper is worth 12% of your final grade.** The files for this assignment must be in submitted by the beginning of class on Thursday, 13 October to be considered on time. Remember, 25% of the grade for this assignment is awarded for submitting the assignment on time. For each day the assignment is late 5% will be docked.

This document will be peer-reviewed.

Thursday, 13 October

Due Today:

- **Group Writing Assignment 10: Draft of First Research Paper**

In Class Today:

- Peer-Review: Group Writing Assignment 10
- Discussion about the Reflection Writing Assignment

Homework:

Individual Writing Assignment 10 — Due Date: Thursday, 20 October

Thinking back over all the work conducted by your group to create Group Writing Assignment 11, including all previous group writing and coding assignments that led up to what your group turned in for Group Writing Assignment 11, answer the following questions:

1. For each member of your group, what actions/skills contributed to the progress of this project?
2. For each member of your group, what actions/skills hindered progress on this project?
3. In light of your answer to the second question, what could you have done to help each group member overcome their weaknesses?
4. Which of your actions/skills contributed to the progress of this project?
5. Which of your actions/skills hindered progress of this project?
6. In light of you answer to the previous question, what could your group members have done to help you overcome your weaknesses? What could you have done to help yourself overcome your weaknesses?
7. What conflicts arose within your group? How did the group as a whole address these conflicts? How did you, individually address these conflicts? Are the conflicts currently resolved? If so, what action could be taken to resolve these continuing conflicts?

Please note that the answers to these questions will only be read by the instructor, and that this assignment will count as 10% of your first research paper grade.

Group Writing Assignment 11 (Final Submission of First Research Paper) — Due Date: Thursday, 20 October

Edit your group's current manuscript to include changes recommended by instructor (see your graded copies of previous iterations of your manuscript), and incorporate any helpful feedback from the peer-review of Group Writing Assignment 10. The document you submit should use as a title "Group Writing Assignment 11" and use `\maketitle` to include the title, authors' names, and date, and should contain the sections *Background*, *Mathematical Model*, *Methods*, *Results*, and *References*. Submit the `*.pdf` file of your manuscript to Box with the naming scheme `GW11_TeamName.*`.

This assignment will count as the final submission of first research paper. The first research paper is worth 12% of your final grade. *The files for this assignment must be submitted by the beginning of class on Thursday, 20 October to be considered on time.* Remember, 25% of the grade for this assignment is awarded for submitting the assignment on time. For each day the assignment is late 5% will be docked.

Tuesday, 18 October

Fall Break

No class! Woohoo!

Thursday, 20 October

Due Today:

- **Group Writing Assignment 11: Final Submission of First Research Paper**
- Individual Writing Assignment 10

In Class Today:

- Group Discussion: Your group will be discussing how to modify your current model to include one or more additional features. You are encouraged to consider the types of features other groups included in their first models.

Homework:

Group Writing Assignment 12 Due Date: Tuesday, 25 October

Your group must decide how it will modify your existing group model to include one or more additional features which require a modification to the model equations from Group Writing Assignment 11. Your group will submit a document which includes an introduction describing the form of yellow fever control you are modeling, a flow diagram and a set of equations which describe the dynamics of your group's modified model, a written model description, and an accompanying parameter table. Your description should portray how the model is different from your first model (reference your groups' Group Writing Assignment 11 within this new article), and why your group chose to include the proposed changes to the model. When referencing your Group Writing Assignment 11 submission, come up with a clever title, use the journal title *Journal of Rhodes Biomathematics*, volume 4, issue GW11.

The document you submit should use as a title "Group Writing Assignment 12" and use `\maketitle` to include the title, authors' names, and date. Additionally, the model description and parameter table should be placed in a section titled *Mathematical Model*. Submit the `*.pdf` file for your document to Box with the naming scheme `GW12_TeamName.*`.

Please note, on Tuesday, 25 October your group will make a short presentation of the modified model to the class. Be prepared to show the flow diagram and the model equations, and be prepared to describe why you chose to modify the model as you did.

This document will be peer-reviewed.

Tuesday, 25 October

Due Today:

- Group Writing Assignment 12

In Class Today:

- Presentation of modified models
- Peer-Review: Group Writing Assignment 12

Homework:

Group Writing Assignment 13 & Coding Exercise 10 Due Date: Thursday, 27 October

Make edits to your LaTeX document based on the reviews received today for Group Writing Assignment 12. Additionally, add into your paper a *Methods* section which describes one additional form of numerical analysis you will use to analyze your model. The document you submit should use as a title "Group Writing Assignment 14" and use `\maketitle` to include the title, authors' names, and date, and should contain the sections *Background*, *Mathematical Model*, *Methods*, and *References*. Submit the `*.tex`, `*.pdf`, and BibTeX files for your document to Box with the naming scheme `GW13_TeamName.*`.

This document will NOT be peer-reviewed.

Thursday, 27 October

Due Today:

- Group Writing Assignment 13 & Coding Exercise 10

In Class Today:

- Coding Lecture: *Graphing simulations where parameter values change at some time $t > 0$*
- Group Research Day
  - Work on Coding Exercise 11
  - Work on Group Writing Assignment 14

Homework:

Coding Exercise 11 Due Date: Thursday, 3 November

Group Assignment: Write the Mathematica code necessary to

1. Generate a solution for a single parameter set with no control of yellow fever over the entire simulation. Generate at least one graph which shows the results of this simulation.
2. Perform uncertainty and sensitivity analysis on your modified model to analyze uncertainty within the parameters affecting the control measure. Generate at least one graph showing the uncertainty of the model output and at least one graph showing the sensitivity of either cumulative infections or cumulative deaths in humans to changes in the parameters affecting the control measure.
3. Determine a threshold condition for the stability of the disease-free equilibrium (DFE) for the modified model. Your group should attempt to do this, however, this becomes an increasingly difficult task the more complex your model becomes and may not be a tractable problem in the alloted time for this assignment given the complexity of your new model.

Submit to Box a copy of the Mathematica file with parts 1 & 2 using the naming scheme `CE11_TeamName_Sims.nb` and a copy of the Mathematica file with part 3 using the naming scheme `CE11_TeamName_Threshold.nb`.

One member from your will present your graphs to the class on Thursday, 3 November. The presentation should focus on how the results differed from that of your team's first model.

Group Writing Assignment 14 Due Date: Tuesday, 8 November

Edit Group Writing Assignment 13 to include all methods used in Coding Exercise 11, and a *Results* section describing the results found in Coding Exercise 11.

The document you submit should use as a title "Group Writing Assignment 14" and use `\maketitle` to include the title, authors' names, and date, and should contain the sections *Background*, *Mathematical Model*, *Methods*, *Results*, and *References*. Submit the `*.pdf` file for your document to Box with the naming scheme `GW14_TeamName.*`.

This document will be peer-reviewed on Tuesday, 8 November.

Tuesday, 1 November

Due Today:

Nothing is due today!

In Class Today:

- Group Research Day
  - Work on Coding Exercise 11
  - Work on Group Writing Assignment 14

Homework:

No new assignments today!

Thursday, 3 November

Due Today:

- Coding Exercise 11

In Class Today:

- Each group will present three of their figures generated for Coding Exercise 11 to the class. We will have a class discussion about each group's set of figures.
- Class Discussion: Figures & Describing Results (Round 4)
  - Are the figures clear and legible?
  - Are the figures easily understood with the aid of the caption?
  - What are the main features of the figure? What make it interesting?
  - If there are multiple curves on one graph, does it make sense to have them all on one graph? Should they be separated? If there multiple curves across several graphs, could they be condensed onto one graph without loss of clarity?
  - If we were to write a description of the results displayed in this graph, what would we write? Are the graphs telling the story we want them to tell? Do we need additional graphs? Are some graphs irrelevant?
- The remainder of class time will be used for groups to work on Group Writing Assignment 14

Homework:

No new homework assignments!!

Tuesday, 8 November

Due Today:

- Group Writing Assignment 14

In Class Today:

- Peer-Review: Group Writing Assignment 14
  Include comments on the appropriateness of the methods used. Should other analyses be included? Are some unnecessary?

Homework:

Individual Writing Assignment 11 Due Date: Thursday, 10 November

Reread through the introduction/background and model description sections of *Blower2005*, *Esteva2005*, and *Schwartz2007*. Answer the following questions:

- For each paper, how many other papers are referenced within the introduction? What proportion of these references are made to support statements about the biology of the system in question? What proportion of these references refer to papers describing other mathematical models? You may have to read through the abstracts of some of the referenced papers to determine the nature of the referenced paper.
- For each paper, how many other papers are referenced within the model description sections? What proportion of these references are made to support statements about the biology of the system in question? What proportion of these references refer to papers describing other mathematical models? You may have to read through the abstracts of some of the referenced papers to determine the nature of the referenced paper.
- What are some common themes found in each of the introductions? Identify at least three common themes.

Thursday, 10 November

Due Today:

- Individual Writing Assignment 11

In Class Today:

- Class Discussion: Individual Writing Assignment 11
- The remainder of class time will be used to research additional appropriate references for the *Background* section of the group paper and to work on Group Writing Assignment 16

Homework:

Group Writing Assignment 15 — Due Date: Tuesday, 15 November

Modify Group Writing Assignment 14 to include the edits from the last round of peer-reviews on Tuesday, 8 November and any additions/alterations you would like to make to your background section.

The document you submit should use as a title "Group Writing Assignment 15" and use `\maketitle` to include the title, authors' names, and date, and should contain the sections *Background*, *Mathematical Model*, *Methods*, *Results*, and *References*. Submit the `*.pdf` of your document to Box with the naming scheme `GW15_TeamName.*`.

This assignment will NOT be peer-reviewed.

Individual Writing Assignment 12 — Due Date: Tuesday, 15 November

Read through the *Blower2005* paper again, and pay particular attention to how the two models and presented and their results compared. Then answer the following questions:

1. Which model is presented first? Does it make sense to present the models in this order? Why or why not?
2. Are the methods for the two models different? Does it make sense to describe different methods for analyzing the two different models? Why or why not?
3. How are the results of the two models (including uncertainty and sensitivity analysis compared)? What order are the results presented in? How are graphs displayed to aid in the comparison?
4. Identify one statement in the Results section which compares results for the two different models.

Tuesday, 15 November

Due Today:

- Group Writing Assignment 15
- Individual Writing Assignment 11

In Class Today:

- Class Discussion: Individual Writing Assignment 12
- Group Research Time: Group Writing Assignment 16

Homework:

Group Writing Assignment 16 — Due Date: Tuesday, 22 November

Write a LaTeX document which presents your original model and modified model (including relevant biological and background information), and an analysis and comparison of the two models (including uncertainty and sensitivity analysis). If appropriate, you can also compare and contrast any threshold conditions found for each model. Additionally, you document should contain a *Conclusions* or *Discussion* section which discusses the implications of your results, your policy suggestions based on your results, commentary on the role of your model in the context of other relevant models, and one or two possible extensions of your models.

The document you submit should use as a title "Group Writing Assignment 16" and use `\maketitle` to include the title, authors' names, and date, and should contain the sections *Background*, *Mathematical Model*, *Methods*, *Results*, *Discussion*, and *References*. Submit the `*.pdf` of your document to Box with the naming scheme `GW16_TeamName.*`.

This assignment will be peer-reviewed on Tuesday, 22 November.

Individual Writing Assignment 13 — Due Date: Thursday, 17 November

Reread through the conclusion/discussion sections of *Blower2005*, *Esteva2005*, and *Schwartz2007*. Answer the following questions:

- Considering all of the papers, what type of material is discussed in the conclusion/discussion section? How does it differ from what is in the results section? Make list of at least three types of items which are discussed in the conclusion/discussion section.
- For each paper, are there any citations in the conclusion/discussion sections? What purpose do these citations serve?
- For each paper, are there any references back to figures discussed in the results (or other) sections? In what context are the figures referenced?

Thursday, 17 November

Due Today:

- Individual Writing Assignment 13

In Class Today:

- Class Discussion: Individual Writing Assignment 13
- Group Research Time: Group Writing Assignment 16

Tuesday, 22 November

Due Today:

- Group Writing Assignment 16

In Class Today:

- Peer-Review: Group Writing Assignment 16

Homework:

Group Writing Assignment 17 Due Date: Thursday, 1 December

Modify Group Writing Assignment 16 to include edits from today's peer-review, and to include any further edits your group wishes to make.

The document you submit should use as a title "Group Writing Assignment 17" and use `\maketitle` to include the title, authors' names, and date, and should contain the sections *Background*, *Mathematical Model*, *Methods*, *Results*, *Conclusions* (or *Discussion*), and *References*. Submit the `*.pdf` of your document to Box with the naming scheme `GW17_TeamName.*`.

This assignment will be peer-reviewed on Thursday, 1 December.

This assignment will count as the first submission of the second research paper. The second research paper is worth 12% of your final grade. The files for this assignment must be submitted to Box by the beginning of class on Thursday, 1 December to be considered on time. Remember, 25% of the grade for this assignment is awarded for submitting the assignment on time. For each day the assignment is late 5% will be docked.

Thursday, 24 November

Thanksgiving

No class! Woohoo!

Tuesday, 29 November

Due Today:

Nothing due today!

In Class Today:

- Group Research Time: Group Writing Assignment 17

Thursday, 1 December

Due Today:

- Group Writing Assignment 17

In Class Today:

- Peer-Review: Group Writing Assignment 17 – Today we are reviewing the manuscripts in their entirety. Check everything. Be nit-picky, but constructive. Final grades are at stake!

Homework:

Group Writing Assignment 18 Due Date: Tuesday, 6 December

Final Research Paper! Modify Group Writing Assignment 17 based of the comments from today's peer-review and from edits given by your instructor.

The document you submit should use as a title "Group Writing Assignment 18" and use `\maketitle` to include the title, authors' names, and date, and should contain the sections *Background*, *Mathematical Model*, *Methods*, *Results*, *Conclusions* (or *Discussion*), and *References*. Submit the `*.tex`, `*.pdf`, image, and BibTeX files for your document to Box with the naming scheme `GW18_TeamName.*`.

This document will NOT be peer-reviewed

This assignment will count as the final submission of the second research paper. The second research paper is worth 12% of your final grade. The files for this assignment must be submitted to Box by the beginning of class on Tuesday, 6 December to be considered on time. Remember, 25% of the grade for this assignment is awarded for submitting the assignment on time. For each day the assignment is late 5% will be docked.

Tuesday, 6 December

Due Today:

- **Group Writing Assignment 18: Your Final Research Paper**

In Class Today:

- Class Discussion: Final Thoughts
- A pitch for participating in the Math Contest in Modeling next semester
- A pitch for continuing the research fun with Prof B
- Celebrate how much your scientific writing has improved and the fact that you have done some awesome research!!

Homework:

Individual Writing Assignment 14 Due Date: **1:00 PM on Monday, 12 December**

Thinking back over all the work conducted by your group to create Group Writing Assignment 18, including all previous group writing and coding assignments that led up to what your group turned in for Group Writing Assignment 18, answer the following questions:

1. For each member of your group, what actions/skills contributed to the progress of this project?
2. For each member of your group, what actions/skills hindered progress on this project?
3. In light of your answer to the second question, what could you have done to help each group member overcome their weaknesses?
4. Which of your actions/skills contributed to the progress of this project?
5. Which of your actions/skills hindered progress of this project?
6. In light of you answer to the previous question, what could your group members have done to help you overcome your weaknesses? What could you have done to help yourself overcome your weaknesses?
7. What conflicts arose within your group? How did the group as a whole address these conflicts? How did you, individually address these conflicts? Are the conflicts currently resolved? If so, what action could be taken to resolve these continuing conflicts?

Please note that the answers to these questions will only be read by the instructor, and that this assignment will count as 10% of your second research paper grade.