E^2M^2: Final Research Plan

Due on Friday, December 2, 2016 at 10am

Prepare **THREE** Powerpoint slides that you will share in a **three-minute oral presentation** to the class on Friday morning.

Please feel free to complete this assignment on any research topic of your choosing, either the topic that your have been developing all week, or a completely new system should you desire to change.

1. The first slide should contain the finalized version of your dynamical model diagram (including the question!) with all compartments and processes defined. This will be an edited extension of the first half of the assignment you brought to the "Model Telephone" activity on Wednesday.
2. The second slide should contain the statistical question, bulleted list of data sources, and plan for statistical analysis you began to develop in part two of your Wednesday assignment. This will include the R function, response and predictor variables, and corresponding distribution for the statistical model that you plan to use, as well as your hypothesized outcome. Please also include some sort of graphical representation of your plan for data collection or analysis.

   On your own time, please meet with one other E^2M^2 student between Wednesday and Friday to receive a critique of your original statistical framework before completing your statistical slide. Please acknowledge the partner who critiqued your original work somewhere on your slide.
3. The third slide should include a list of proposed "next steps" in your research agenda. Do you plan to pursue this research topic beyond E2M2? Will you primarily focus on dynamical or statistical modeling or both? How do you intend to further develop the skills you began to foster in this workshop?

Please come prepared to share your research plan—both dynamical and statistical—with the class during your presentation on Friday morning.

Directions for Wednesday's assignment are included on the attached two pages for your convenience.

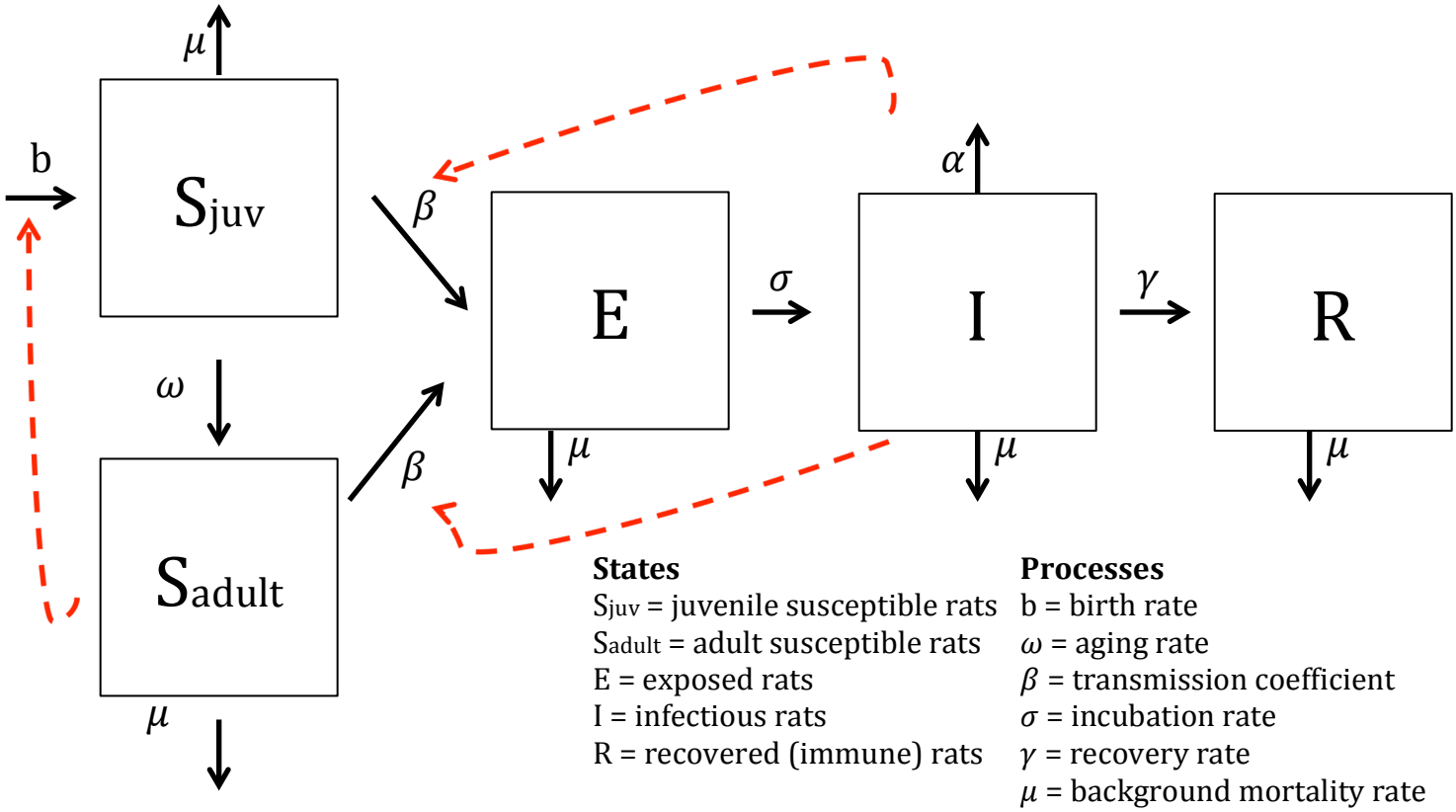
You have been assigned a meeting time and instructor pair from which you can solicit advice on any aspect of your final research plan on Thursday afternoon. Please see the Excel file included in this folder for the details of your assigned meeting.

Part One: Make a Dynamical Model Diagram

- Construct a diagram that represents all of the individual states and processes of interest in your system.
  - For your own purposes, you can use whatever graphical conventions work best for how you think about the system.
- Draw a clean, clearly labeled version of your model diagram and bring it with you to tomorrow afternoon's 'Model Telephone' session.
  - Use arrows to represent the *transitions* from one category or state to another. Label transition arrows with descriptions of what variables or other factors will influence the rate at which the transition occurs.
  - Include a key that clearly states what any symbol/letter/abbreviation you use means.
  - Include your research question at the top of the page,

Example:

Can the Malagasy black rat (*Rattus rattus)* population independently maintain transmission of the plague bacterium, *Yersinia pestis?*



States
S_{juv} = juvenile susceptible rats
S_{adult} = adult susceptible rats
E = exposed rats
I = infectious rats
R = recovered (immune) rats

Processes
b = birth rate
ω = aging rate
β = transmission coefficient
σ = incubation rate
γ = recovery rate
μ = background mortality rate
α = infection-induced mortality rate
γ = recovery rate

Part Two: Make a Statistical Framework

- Ask a statistical question related to your system.
- Describe your data
- Write your response variable.
- Write the appropriate family/distribution associated with your model.
- Write the link associated with that distribution.
- Write out the R code, including the function and potential predictors, that you propose to use to address your question in a statistical modeling framework.
- Write a hypothesis about your expected findings from this model.

Example: What factors explain the geographic distribution of plague infection in *Rattus rattus* in Madagascar?

Data: You set four grids of 100 traps simultaneously in five different districts distributed all across Madagascar. All districts were trapped within two weeks of one another at two different times of year: once in the wet season and once in the dry season. You lethally sampled all captured *Rattus rattus* and carried out Rapid Detection tests for plague on each rat to give you counts of plague positive rats for each grid andsite. You also have corresponding data on the average elevation of each district and the average rainfall in the district during the month preceding your trapping session.

Response Variable: count plague positive rats

Family: Poisson

Link: Natural log

Potential Predictors:

R code

```
glmer (count_plague_positive_rats ~ trap_season + district_elevation + average_district__rainfall +
        (1|trapping_grid), family= “poisson”)
```

Hypothesis

We predict that rat infection status will demonstrate significant positive correlation with increases in district elevation and rainfall. We anticipate no significant random effect of trapping_grid and trap_night and may drop these terms in later model selection.