Homework: *Make a Dynamical Model Diagram + a Statistical Framework*
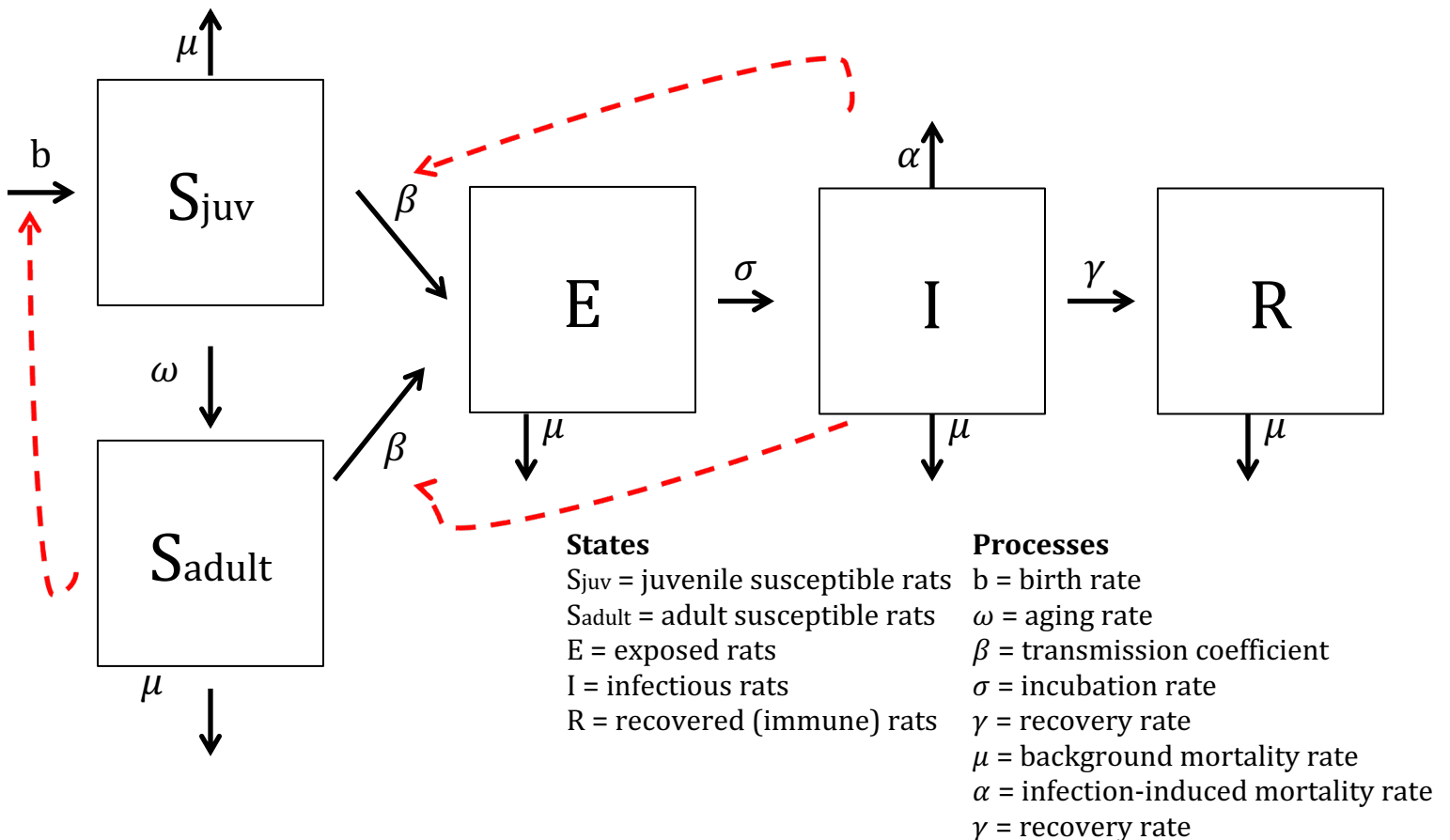
Due on Friday, March 15 at 8:00am

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: trap_season, district_elevation, average_district_rainfall, trapping_grid

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.