# Math 5131: Project Guidelines

## Project Overview:

You will pick a novel problem which we have not discussed in class and model it using differential equations (other modeling may be used, but you need to check). The project will be 80% paper, 20% presentation.

### Paper Guidelines

The paper should at least do the following:

1. **Problem Description (10%):** Clearly state the problem you are trying to model, gather relevant information about the problem, and state what kinds of outcomes modeling result in. Examples:
   1. Setting fishing quotas.
   2. Determining dosage times.
   3. Evaluating pest control strategies for financial effectiveness.
   4. Quantifying ethical concerns.
   5. Discovering population thresholds.
2. **Modeling (10 %):** Write down a differential equation based on local assumptions. Justify all formulas and assumptions. Give a clear interpretation of each constant and term. Remember: constants need to have some hope of being calculated/empirically estimated.
3. **Analytic Work (20 %):** Perform an analytic analysis of your model, deriving explicit formula for equilibrium solutions, classifying solutions by stability criteria, and displaying any qualitative phase space information. If explicit solutions are derivable, do so.
4. **Simulations (20 %):** Perform simulations, either of possible futures if your constants are fixed, or of different aspects of parameter space. If explicit solutions are not derivable, simulate examples.
5. **Draw conclusions/Use Conditions (10 %):** Depending on the problem, this can look like a forecast, or formula for computing relevant quantities from the constants of the model. Examples:
   1. Increasing parameter A 10% yields better outcomes than increasing parameter B 10%.
   2. Given parameters K\_1 and K\_2 and max does M, a new dose should be administered every F(K\_1,K\_2,M) hours
   3. We have proposed two solutions and modeled both. Model 1 leads to a more efficctive strategy.
   4. Given our model, ambulance routing is most effected by red light density D and road size R\_i, and congestion C\_i with the mean time to emergency given by F(R\_i, D, C\_i) given this we propose…
6. **Present the above cleanly and clearly (10%).**

### Presentation Guidelines

The presentation should at least do the following:

1. **Content (10%)** Clearly state the problem. Clearly state the model, listing all assumptions. Present results, including analytic and computational. (Note: This is just double counting, if you can summarize your results from the paper you get these points)
2. **Presentation Skills (10%)** Do you stay within time. To what degree do you include the necessary information. Do you clearly communicate your methods and results.

## Project Instructions

You may work in groups, up to 3 per group.

1. Your paper should be roughly 4 pages long.
2. You do NOT have to model a real-world situation, but you should strive for realism. You may use hypothetical scenarios and data.
3. You must include some simulation analysis.
4. Your paper should have a significant mathematical component, and a significant writing component. The text and the analysis should enhance each other.
5. Your paper should resemble the case studies in the text, or papers linked from the labs, but you need not constrain yourself by that format.
6. The presentation will be 10-15 minutes long. You must explain your problem, the equations you used to model it, the analysis and computational aspects of your model and its accuracy.
7. If you would like to model something that doesn’t seem to fit into the grading breakdown above you may with permission. For example, you have real world data, a more advanced model that you’re already working on, or are interested in a specific type of modeling.

The final grade will be 80% paper, 20% presentation.