Project Description

IE1086/IE2086, Fall 2021

University of Pittsburgh

Imagine that you work in the analytics department of your company, non-profit, or government. The course project requires you to identify a relevant sequential decision-making under uncertainty problem. In other words, you may choose any problem of your interest where the decision maker operates in the following way:

$$\text{choose } a_t \rightsquigarrow \text{observe } W_{t+1} \rightsquigarrow \text{choose } a_{t+1} \rightsquigarrow \text{observe } W_{t+2} \rightsquigarrow \cdots,$$

where a_t are decisions or "actions" and W_t are random variables. We'll see many examples in class, but be creative! There are several goals of the project:

- Develop an accurate mathematical model and use it to build a simulator. The problem should contain at least $T = 10$ stages and at least 3 state variables. (30%)
- Design at least 3 heuristic policies (i.e., functions that map *state* to *action*) and test them in the simulator. Examples may include (1) reducing the multistage problem to a two stage LP, (2) fixing random variables and solving a deterministic program, or even (3) a simple strategy such as "buy low sell high." However, at least one of the policies should involve an optimization of some sort. The other two can be simple ones. (50%)
- Present your work to the class. (20%)
- I'll ask for a breakdown of work and contributions of each member of the team to be submitted with the writeup, so please discuss and divide responsibilities early with your teammate(s).

Each part will be graded on creativity, technical strength, and execution. The first two parts will comprise your technical write-up. Some guidelines and thoughts:

- Your project should be a based on a real world problem. It is encouraged to find some real data related to your project, but you do not necessarily need to do so if it is not available. You may make up realistic data (assume some distributions).
- The technical write-up is a good opportunity to learn LaTeX, but MS Word and equation editor is fine too. There are many LaTeX tutorials on-line. It should be approximately 3 pages single spaced.
- This project will count toward 20% of your final grade.
- If done properly, I think this project could very valuable for you; it can be a great talking point in a job interview or on a graduate school application. I don't believe there are many undergraduate or master's level courses that cover these topics, so if you do a good job, you could very well be ahead of your competition when searching for jobs or graduate programs.

Here are some important dates.

- **November 3** – Project description due. In one page, please provide:
    1. a narrative about the project setting,
    2. describe the decisions and random variables, and give a preliminary sequential decision model in the style of Lectures 12 and 13),
    3. describe what you are optimizing (costs, profits, happiness, lives saved, medical supplies deliveried, etc.),
    4. the responsibilities of each teammate.
- **December 1** – Oral presentations in class and write-ups due.

You'll have about a month to do the work. Please start early. Given that you have to write some code, there will be lots of issues (guaranteed) so doing it last minute is not feasible. Good luck!