**ORF 418 – Optimal learning**

**Spring, 2012**

**Course project**

For the course project, you need to identify a problem where you have to decide what information to collect in order to make a decision. Your setting can be on-line or off-line, but you have to design a problem that will allow you to test one of the methods we have (or will) cover for collecting information. Your project will be graded on the basis of creativity (20 percent), technical strength (35 percent) and execution (30 percent). There will be an oral presentation that counts for 15 percent of the grade.

Your project should be based around a real problem, but it is generally not going to be necessary to work with real data (although you should be working with realistic data, based on your application). Normally, you are going to use the problem setting to create priors about unknown parameters, but it is not necessary to collect real data to estimate these parameters (realistic guesstimates are fine). The process of evaluating the effectiveness of your information-collection algorithm is always going to be conducted using simulated data (the “simulated truth” that we have seen in class).

You are encouraged to work in teams of two.

**Project identification - Due Wednesday, April 4:**

A one-page write-up describing the problem. In English (you may you some mathematics if you like), describe the setting, what information is being collected, how you control information collection, the cost of information, how the information is being used to make a decision and how you would measure the benefits of the information.

I will provide feedback on this writeup, possibly meeting with teams to discuss the project. I will try to give you a sense of how ambitious your project may be. The goal is to find something that is reasonably ambitious without being unrealistic.

Most of the more interesting problems will involve correlated beliefs. More complex problems will require representations of your beliefs using something more complicated than the discrete models (one belief per alternative) we introduced in the first half of the course.

I have listed numerous applications in Chapter 1 of the book, and some of these are interesting and challenging. But I am also particularly interested in new and creative applications. However, if you use one of the applications in my list, there are opportunities for creativity, both in the modeling (especially in how you represent your beliefs), and the design of algorithms. For example, in class we often assume that a covariance matrix is known, while in practice this may not be the case.

Keep in mind that this is a course project, not a senior thesis (or Ph.D. dissertation). For the juniors, you may find that this forms the basis of a senior thesis. I will help you make sure that the project is achievable.

**Model, algorithm and experimental design – Due Wednesday, April 11.**

In this section I want to see a mathematical model (typewritten – please learn how to use the equation editor in MS Word) and a description of the algorithm you are going to use. Then, provide a description of how you will perform the experimental work (this is an initial proposal – of course, this may evolve by the time you complete the project).

You should describe what data you plan on collecting, the information collection policies that you want to test, and how you are going to conduct the comparison. In most (if not all) cases, I expect these comparisons to be conducted using simulated data (although the data should be based on realistic assumptions).

You are welcome to use the software you have already developed (in particular, the implementation of the knowledge gradient for correlated beliefs), but I will also be making available our “KG calculator” where some powerful algorithms have already been implemented in Java. Note that we have developed the software so that you can communicate with the library through files. The KG calculator, for example, uses an Excel spreadsheet as a front-end. You may use the spreadsheet, or you may access the Java library through Matlab.

**Oral presentations – April 23, 25 and 30.**

These will be short presentations (approximately 8-10 minutes) given in class. You will need to prepare a short powerpoint presentation that describes and motivates your problem, summarizes the core elements of the learning problem (what are your decisions to observe or measure, what is the nature of the observation, how is the information being used), and outlines challenges that you are (or anticipate) facing. At a minimum this should cover your belief model, how you created your prior, and the measurement policies you plan on testing.

You are not expected to present any numerical work.

**Final project – Due Tuesday, May 15 (Dean’s date)**

The final project should contain sections for problem description, mathematical model, algorithm and experimental results. The report should build on your prior submissions. For the final writeup, I am looking for a careful evaluation of your information collection policy. I anticipate that most of you will be using the knowledge gradient, but this is not required, and may not even be the best for some applications. However, I am looking for advanced methods – Boltzmann exploration or interval estimation is not going to score the highest.

I am looking for creativity, technical depth and a careful experimental comparison.