Ph.D. in Applied Management & Decision Sciences  
Operations Research Specialization

Specialized Knowledge Area Module V  
Deterministic Operations Research Techniques

Overall Learning Objectives

Students who have been admitted into the operations research specialization should already have a background in classical techniques. The purpose of this KAM is to ensure that you understand the theoretical basis of classical, deterministic optimization algorithms and heuristics. You are expected to be familiar with the Karush-Kuhn-Tucker conditions and be able to apply them. Furthermore, you should be familiar with the rich variety of models that are available and be able to apply them. Pulling a model out of a software “black box” is not sufficient. Software may be an aid in computation, but you must be able to defend a particular technique, demonstrate an understanding of the assumptions behind the technique and their implications, and interpret the results. So-called “quick and dirty” techniques may be a starting point for the KAM but not a completion.

Breadth Component  
Theory of Deterministic Methods

To begin study for the Breadth component, work through a basic textbook in operations research. A good text will discuss the general topic areas of classical (deterministic) operations research such as mathematical programming and its variants: linear, integer, and dynamic programming; network flows; duality; and transportation and assignment problems. In addition, study newer methods such as interior point algorithms. You should decide on three or four topics of interest and work with your faculty assessor to determine the scope.

The demonstration of learning must include a complete application example of the Karush-Kuhn-Tucker conditions; all details must be explained. The demonstration of learning may be an essay of about 30 pages or an explication of problems with detailed solutions and any annotations clarifying the solution. Another way to demonstrate your learning could be to construct a set of detailed course notes for teaching a graduate-level course or leading a graduate-level seminar.
**Depth Component**

**Current Research in Deterministic Methods**

You are expected to thoroughly research one of the general topic areas considered in the Breadth section in order to become an expert in that topic. Current research abounds in these topic areas. One requirement of the KAM is to produce an annotated bibliography based on at least 15 journal articles. The usual maximum age of the articles (5 years) is specifically relaxed in this KAM, since some of the fundamental articles are more than 5 years old. You must be familiar with these standard articles in the topic area you have chosen. However, not more than 25% of the articles reviewed in the annotated bibliography may be more than 5 years old.

The demonstration of learning could be a publishable paper or an essay of about 30 pages. Given the subject matter, however, such an essay is likely to be heavily peppered with mathematics. You might, instead, choose to demonstrate a thorough understanding of the topic by using a software package to formulate a set of problems with solutions. In such a case, you should not use a black box, but offer discussion the algorithms the software uses with an explanation of assumptions underlying the algorithms. For example, the use of a linear programming software package (or a spreadsheet optimizer such as that in Excel®) without understanding the foundation on which the program rests is not acceptable. You are not required write code.

**Application Component**

**Professional Practice: Application of Deterministic Methods**

Generally, students have an application in mind when beginning the KAM. The anticipated application determines which topic you study in the Depth section. The application should be a real-world problem that you have solved or will solve using a technique studied in the Depth section. Implementation is desired and results reported; however, sometimes implementation is not feasible.

The demonstration of learning should include a brief discussion of the problem you addressed with an explanation of why the particular technique you chose was appropriate. This means that you are expected to discuss the assumptions and limitations of the technique as they apply to the problem at hand. If the technique was adapted in some way to better fit the situation, you should discuss the validity of that adaptation. Finally, the implementation strategy, analysis, and results should be described in detail. You are encouraged to write a publishable article for submission to a journal such as *Interfaces*. You are also expected, as a part of the demonstration of learning, to defend the application’s utility.