

## **IE 407 Fundamentals of Operational Research**

### **Term Project**

#### **1. SELECTING CORPORATE TRAINING PROGRAMS**

As training has become a major cost of doing business, developing strategies to implement cross-training has been of an increasing interest to operational researchers. Increased training costs have occurred for many reasons. It has been claimed that high schools and universities are not producing the skills needed by industry, so industry must train and reeducate recent graduates. For high school graduates, this may include training in technology-based skills; for college graduates, this may include developing nontechnical skills such as leadership, communications, interpersonal relations, and ethics. In addition, management consultants advocate aggressive education and professional development to remain competitive in the global and local markets. Employees now expect job and skill growth to be a major component of their duties. They view training in the form of formal degrees and documented technical skills as important for job security.

##### **1.1. Problem Environment**

For a corporation, the primary purpose of training is to ensure that employees have the key skills needed to effectively manage and operate the business. For example, to train staff members in computer skills, there are many options for providing training which are (1) hiring an outside consultant to develop and present an on-site training course, (2) using corporate personnel to develop and present an on-site training course, (3) purchasing a training course and having employees use it for self-study, (4) contracting with a local college or university to provide training, or (5) sending employees to an off-site training seminar. These possibilities are for a single skill. The purpose of many training programs, however, is to give employees a broad set of skills. Often the skill sets of two or more programs partially overlap. When this happens, the corporation must choose the set of programs that give employees the required skills for their jobs and the appropriate employees for each training program. In any case, training decisions made in an ad-hoc “pay-as-you-go” manner will be inefficient and generally result in additional expense.

## 1.2. Potential Corporate Setting

Your job is to develop models to aid businesses and corporations in determining the appropriate training programs to use. The type of model and issues often depend on the size of the corporation and the potential uses of the models. For large corporations, there are many employees in each class, so it is not necessary to model and schedule down to the individual employee. Instead, the focus is on the assignment of classifications to programs and the assignment of specific individuals to programs is ignored. Also, sufficient resources exist to develop internal training programs, hence you should consider program development costs in the objective. A large corporation can use the model to plan the development of courses. This will help determine (1) program-development costs so that in-house programs are cost-effective and (2) appropriate programs for each employee classification so that, on average, there is sufficient time to complete the assigned programs within the available time. For small businesses, the focus is often different. Typically, these companies do not develop in house programs because they do not train enough employees to justify development costs. Because the number of employees is small, it is important to model down to the employee level and schedule employees so that both training and job tasks can be completed.

Your OR consulting firm has been hired to design the training program for a small company for next year. There are no in-house classes, and vendors provide all training. The company has determined 41 skills, listed in Table 1, that are required to be improved for its employees. It has 13 employees (a senior manager, 2 project managers, 3 professionals, 2 sales persons, 3 technicians and 2 administrative assistants). Required skills are given in Table 2 for each position. There are 15 programs available for use; Table 3 contains the cost per person and the skills covered for each program. Enrollment costs and duration of the programs are given in Table 4. Some of the programs conflict in time with other programs. Program 1 conflicts with program 3, program 9 conflicts with program 15 and program 11 conflicts with program 12. It is company policy that each employee is limited to 15 days for training per year. In addition, at least 1 professional and 1 technician must be present at the company to continue the operations during the trainings.

*\*Table 1, 2, 3 and 4 are available in "Tables.xlsx" file on ODTÜClass.*

You are required to develop a recommendation for the company for addressing its training needs. In particular, you should address the following key questions. Note that you may need the results of part (a) to address the questions in parts (b), (c) and (d).

- a. Which training programs should be used? What is the assignment of employees to those programs? What is the total cost of assignment of employees to those programs to the company?
- b. Identify programs with heavy use (in terms of the number of employees assigned) that may justify the development of an in-house course. What is the maximum amount that the company would be willing to pay for that development for the next year?
- c. The company has the opportunity to negotiate prices for programs. Which programs would you suggest are candidates for negotiation?
- d. What skills are especially expensive to cover? If the company was to develop its own programs, what skills should be covered?

## 2. CONDUCT

Any kind of non-ethical behavior (i.e. cheating) will be penalized. You can discuss the problem only within your teams.

## 3. SUBMISSION

The submission deadline is **December 20<sup>th</sup> (17:00)**. Upload a zip folder including your written report and Excel file(s) to ODTÜClass. You are also required submit a hard copy of your written report to one of the teaching assistants before the deadline. In addition, you need to upload your written report to Turnitin assignment on ODTÜClass. Let only one of the members of each team upload the file on ODCTÜClass and Turnitin. Please follow the instructions for you written report and Excel sheets in Section 3.

### 3.1. FORMAT

Report and solution sheet format instructions are given in the following two sections.

#### 3.1.1. Report

The main section headings should be numbered and written in capital letters. The subtitles should be written in lower case letters and underlined. All pages should be given page numbers.

Figures, drawings, tables, pictures, etc. should be numbered and named appropriately. (Note that table numbers and names appear above the tables, whereas those for figures lie below them.) In the cover page, the title of the project, date and names of your team members should be written. Please write in Times New Roman, font 12 and with 1.5 spaces and do not exceed 6 pages excluding the appendices. No part of the report should be handwritten.

### 3.1.2. Solution Sheet

Your solution sheet should be **well organized** and easy to understand at first look. You should name the columns and rows in your tables. In addition, you should explicitly show the cells corresponding to your objective function and right hand sides of the constraints. Please note that if your formulation in solver is efficient in terms of number of expressions (each constraint you define in solver) then you will receive extra points (bonus!).

## 3.2. CONTENT

Note that your written report should include the followings:

- Table of contents (with corresponding page numbers)
- Introduction (Briefly summarize the problem situation and what the reader should expect to find in the report. Please use your own words instead of using the question to explain the problem situation.)
- Main body of the report
  - The detailed explanation of the work carried out
    - State all the assumptions used in your study (whether they are already given or they are your own).
    - Provide a formal mathematical model formulation in closed form. Explain the decision variables (together with indices and their meanings), constraints and objective function clearly. Define any additional notation that you use.
  - Discussions about your findings
    - Summarize the solver outputs by using tables, figures or graphs in the body of main text.

- Clearly discuss your findings for each key question. Analyze the problem to see reasons that led to the current findings.
- Conclusions and recommendations
  - Very shortly, re-mention what the problem was about and what you have done. Re-highlight your most important results and discussions.
- References (list all the material referred to in the report text, if any)
- Appendix
  - Include all data, tables, diagrams, drawings, etc. which are not immediately relevant to the main text in the appendix.
  - Refer all the material you provide in appendices in the body of the text.