

## 1. Course Description

Operations Research (OR) is a mathematical method which can be applied to various fields. OR is originated for military purposes. Nowadays, OR is put to practical use as one of the analysis tools for increasing the efficiency of daily essential processes such as production, materials and physical distributions in factories, and no large-scale projects are carried out without OR today. However there are many various techniques and fundamental techniques in OR that will be studied intensively in this class. Simple OR exercise problems using Microsoft Excel will be worked out in this class. This subject corresponds to the diploma policies DP4.

## 2. Course Objectives

In this class, we aim to understand fundamental techniques such as linear programming (LP) and queuing theory in OR. And we also aim to acquire the skill of calculating simple OR problems and the skill of making actual use of OR methods by using Microsoft Excel's spreadsheet program.

## 3. Grading Policy

Passing of the two reports is just the qualifications of the final examination. The overall grade of this course will be decided based on the final exam. If the result of the final exam is 60 points or more, you will pass.

If you have ability to pass the two reports and to answer questions in a written exam similar to the two reports, you can pass this course easily.

Feedback is given after the submitted reports are corrected.

## 4. Textbook and Reference

Textbook

Materials for the textbooks are shown on LMS.

Reference

References are introduced in the textbook materials, therefore, please refer to them appropriately.

To solve the exercises in the textbook materials and the questions in the two reports, please use the Microsoft Excel's spreadsheet program 2007/2010/2013, etc.

## 5. Requirements(Assignments)

For preparations of each class, students must read and organize the contents, and must go through the example questions in the relevant part in the textbook (about 1.0 hour).

For reviews of each class, students must do the corresponding exercises using reports (about 2.0 hour).

It is desirable to have grounded ability of mathematics such as probability and statistics, and elementary skills to operate Excel in advance. Therefore, you should learn them in advance or simultaneously with this course.

Furthermore, there is meaning in applying knowledge of OR in actual problems. You should try some exercises in the textbook or the references and the two reports.

## 6. Note

The two reports include questions using the spreadsheet program Microsoft Excel. However, the final examination does not require using the spreadsheet program. The final examination requires calculating the problems on paper at the lecture room without computers.

LMS will be used in this course.

## 7. Schedule

- [1] Outline of OR and what is LP?: The history, various methods, applications of OR, and the outline of LP will be explained. How to solve a two-variable LP problem by graphical solution will also be explained.
- [2] Solution of LP using Excel: Reviewing the outline of linear-programming, the procedure to solve a LP problem automatically by using the solver attached to Excel will be explained.
- [3] Simplex method (1) basics: Simplex method, with which you can solve a LP problem by calculating on paper will be explained.
- [4] Simplex method (2) procedures: The detail of procedures of simplex method according to the property of various LP problems will be explained.
- [5] Two-step simplex method: a counterplan for a LP problem that ordinary simplex method at the first step can not be applied for will be explained.
- [6] Dual problem of LP: the concept of dual problems to exchange maximum problem and minimum problem of LP mutually will be explained.
- [7] Network problems (1) shortest route problems: How to solve the shortest route problem between routes expressed with a network will be explained.
- [8] Network problems (2) maximum flow problems: How to solve the maximum flow problem between routes expressed with a network will be explained.
- [9] Network problems (3) minimum cost flow problems: How to solve the complicated problem between routes expressed with a network will be explained.
- [10] Queuing theory (1) what is queuing theory, Poisson distribution, and exponential distribution: The details of probability models indispensable to understand queuing theory will be explained.

- [11] Queuing theory (2) probability model for queuing theory and  $M/M/1(1)$  model: the basic concept of equilibrium equations to solve queuing theory will be explained.
- [12] Queuing theory (3)  $M/M/1(\infty)$  model: a queuing theory model for one window approximating the actual events will be explained with equilibrium equations.
- [13] Queuing theory (4)  $M/M/n(\infty)$  model, etc.: a queuing theory model for two or more windows approximating the actual events will be explained with equilibrium equations.
- [14] Queuing theory (5) other models: Little's formula, Pollaczek-Khintchine formula, etc. will be explained.
- [15] Dynamic programming (DP): DP, by which overall optimum solution can be solved with partial optimum solutions, will be explained.