Operations Research

Syllabus Number 3F322
Special Subjects
Elective 2 credit
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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 policy DP3.

2. Course Objectives

According to the diploma policy DP3, students will be able to apply natural science, especially, the fundamental knowledge of mathematics, such as OR, to solve actual problems. 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

Those who attend 10 or more lectures out of all 15 lectures will be given the qualifications of the regular examinations. The overall grade of this course will be decided based on the sum of total 100 points of the midterm exam (40 points), the final exam (40 points), and the score of exercises (20 points), and those whose grade is 60 or more will pass.
The score of exercises will be proportional to the number of the passed exercises submitted before each due date, and the maximum score of exercises is 20.
Doing the exercises includes using the Microsoft Excel's spreadsheet program. However, the midterm and final examinations do not require using the spreadsheet program. The two examinations require calculating the problems on paper at the lecture room without computers.
Feedback will be given right after the submission and the exercise will be corrected and returned in the offered session. Each final due date of the exercise is the date of the class a week later. No delay of submitting the exercises are allowed.
In principle, this course has no reexaminations.

4. Textbook and Reference

Textbook
No need of textbooks, however, the lecture slides and the related materials will be shown on LMS.
Reference
References are introduced during class.
Heung-wing Joseph LEE, Man-kin Adam LEUNG, et al. Operations Research: an Active Learning Approach
(This course has no ISBN code because of an e-learning course.) This course is written by the Hong Kong Polytechnic University and is registered as the following link in edX.
https://www.edx.org/course/operations-research-an-active-approach

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 of the related materials (about 1.0 hour).
For reviews of each class, students must do the exercises shown on LMS (about 2.0 hour).
You can not understand the methods of OR without handling them. It means that you can not obtain OR if you just listen to the lectures. Therefore, you will do training during class. Furthermore, you should try to do exercises by yourself using PCs or scientific calculators with referring the related materials on LMS. If you do, you will surely obtain OR.
You can use "Operations Research: an Active Learning Approach" in 4. References, that is an open resource for university education for self-learning materials, for the class 1 to class 10 in this course.

6. Note

The lectures and practices of this course will be conducted in a CL room.
LMS will be used for this course.
Students must prepare a scientific calculator without a communication function for doing the exercises and the regular examinations.
It is very important that you have a fundamental operation skill to use Excel for the most part of this course.
We will focus on the lectures and practices of the fundamental OR techniques in this course, therefore, you should be able to follow this course if you do not have a sense of difficulty to mathematics or calculating process. However, it is good having knowledge of probabilities studied in mathematical statistics to study queuing theory in the latter part of this course.
By the way, the fundamental techniques such as LP and queuing theory will be also questioned in IT Engineer Examinations.

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. An exercise to solve a two-variable LP problem by graphical solution will also be done.

[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. An exercise to solve a LP problem by using the solver will also be done.

[3] Simplex method (1) basics: Simplex method, with which you can solve a LP problem by calculating on paper will be explained. A simple exercise of simplex methods will also be done.

[4] Simplex method (2) procedures: The detail of procedures of simplex method according to the property of various LP problems will be explained. A simple exercise of simplex methods will also be done.

[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. A simple exercise of simplex methods will also be done.

[6] Dual problem of LP: the concept of dual problems to exchange maximum problem and minimum problem of LP mutually will be explained. A simple exercise of LP will also be done.

[7] LP problems for application: Transportation plans and assignment problems applied with LP will be explained. A simple exercise of LP will also be done.

[8] Network problems (1) shortest route problems: How to solve the shortest route problem between routes expressed with a network will be explained. A simple exercise of the shortest route problem will also be done.

[9] Network problems (2) maximum flow problems: How to solve the maximum flow problem between routes expressed with a network will be explained. A simple exercise of the maximum flow problem will also be done.

[10] Conclusions of the former half and midterm exam: The degree of understanding from the 1st class to the 9th class will be examined.

[11] Network problems (3) minimum cost flow problems and dynamic programming (DP): How to solve the complicated problem between routes expressed with a network will be explained. And DP, by which overall optimum solution can be solved with partial optimum solutions, will be also explained. Simple exercises of network problems and DP will also be done.

[12] 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. Simple exercises of probability models will also be done.

[13] 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. A simple exercise of queuing theory will also be done.

[14] Queuing theory (3) M/M/1(∞) model: a queuing theory model for one window approximating the actual events will be explained with equilibrium equations. A simple exercise of queuing theory will also be done.

[15] Queuing theory (4) M/M/n(∞) model, etc.: a queuing theory model for two or more windows approximating the actual events will be explained with equilibrium equations. A simple exercise of queuing theory will also be done.