IE 202 - INTRODUCTION TO MODELING AND OPTIMIZATION
PROJECT STAGE 1

SPRING 2023

March 19, 2023

Contents

Problem Definition

Optimization is simply defined as the methodology of doing something as good as possible with respect to some criteria. In mathematical optimization, the goal is finding the maximum or minimum of a function with given limitations. This process consists of mathematically modeling the problem while keeping the given limitations as "constraints" and the given function as an "objective function", and solving the model using an optimization software. Such applications can be found in many different industries such as fast-moving consumer goods, the car industry, or logistics. Consulting is another industry in which optimization is heavily utilized.

A&N is a consulting firm that operates in more than 30 countries. In this consulting firm, there are 6 different types of positions: associate, senior associate, manager, senior manager, director, and partner. In the Ankara office, there are K employees in total with different position levels. In addition, the A&N consulting firm gives services in M different departments in this office. We assume that all employee has enough knowledge of all departments.

Currently, there are N available projects. Complexity of the projects differ in three levels. Projects in each level require a predetermined amount of workload (in terms of hours spent on the project) based on their difficulty levels. More complex projects are considered as more profitable.

A project can be assigned to a department if it is suitable for the department's qualifications. While every department needs to conduct at least one project, a project can be assigned to a single department or left unassigned. There is a penalty cost for each project that is not assigned and done. Each employee must be assigned to at least one project but at most five. Also for each project, there is an upper and lower limit on the number of employees assigned from each position.

Workload requirement of project must be met by the employees. Every employee usually works 8 hours per day. Employees' usual salaries per project depends on their position.

In addition to the normal working hours, employees may overwork only if they are assigned to a project with difficulty level 3. They get 50 dollars per each extra hour they work. Furthermore, regardless of their position, each employee can work up to H hours in a month, including overtime. (assume that there are 30 working days in a month).

Also, there are some specific requirements: Since the Department 1 and Department 2 have fierce competition, number of project assigned to these departments should be similar. If Department 1 will conduct Project 1 and 2, then Project 3 cannot be conducted by the Department 3.
Projects are prioritized based on their complexity. Due to this, if a project with difficulty level 3 is left unassigned then no project with difficulty level 2 can be completed.

Part A

Write the mathematical model which makes the proper assignments between the elements of the company while maximizing monthly profit.

Part B

Revise your model such that the objective of the firm is to maximize the number of completed projects. How would the monthly profit change in this case?