Solving Real Life Problems with Mathematical Modelling
IE303 Operations Research I
Course Project
Spring, 2025

You will work on **one of the following real-world optimization problems** using mathematical programming techniques such as Linear Programming (LP), Integer Programming (IP), or Mixed Integer Programming (MIP). Your task is to formulate the problem mathematically, collect relevant data, and propose a solution using an appropriate solver (e.g., Excel Solver, Python with PuLP, or any optimization software you prefer).
Each problem consists of a realistic scenario with defined objectives, constraints, and suggested data sources. You are encouraged to validate your model using real or estimated data, and compare your solution with existing practices.
It is a group project with up to 4 people in a group.

Date	**Deliverable**
May 13	Form groups (up to 4 people) and select project topic – submit via Teams
May 23	Submit **Progress Report I** (template will be shared): • How you'll collect/estimate data • Draft model: decision variables, objective, constraints (can be verbal at this point) • *(Optional)*: Toy model results with sample data
June 5	Submit **Progress Report II** (template will be shared) Validate your model: • Implemented model in a solver • Model output and interpretation • Sensitivity (what if analysis/ scenarios)
June 13	Present your final model, results, interpretation, and recommendations

PICK ONE OF THE FOLLOWING IDEAS (*or come with your own but get approval from me*):

1. **Scheduling Problem: Classroom Assignment for Scheduled Courses**

Problem Statement

Use the existing semester course schedule at IUS to create an optimized classroom assignment plan. Evaluate whether more efficient classroom usage is possible.

Objective

Minimize the total unused seat-hours, i.e., the difference between room capacity and course enrollment across all assignments:

Constraints

- No overlapping courses in the same room
- Room capacity must be sufficient for the enrolled students
- Each course must be assigned during its scheduled time
- Each course is assigned exactly one classroom
- What else?

Data to Collect (*you may need more, these are the data comes to my mind*)

- Course timetable (course, times, enrollment numbers)
- Room availability and seating capacity
  (*Data can be found in the IUS course schedules or requested from the program coordinator*)

Compare your optimized plan with the current classroom assignments and provide recommendations for improvement.

2. Facility Location Problem: Placement of Recycling Bins on Campus

Problem Statement
Determine the optimal placement of recycling bins within IUS buildings so that students and staff can easily access them with minimal walking distance.
Objective
Minimize the total weighted walking distance from all demand points (classrooms, offices, lounges) to their assigned recycling bin, where each point is weighted by the estimated number of users.
Constraints

- Bins can only be placed at predefined candidate locations (e.g., hallways, building entrances)
- Each classroom or office should be assigned to the nearest bin
- Limited number of bins (due to budget or space constraints -you can try different numbers here: 2/3/4/5 bins at each floor)

Data to Collect (*you may need more, these are the data comes to my mind*)

- Floor plans of IUS buildings (classroom and candidate bin locations -bin locations you will need to decide: make sure you have at least 10 candidate locations at each floor)
- Estimated walking distances between each classroom and candidate bin locations (*Measurements can be estimated using building maps or measured directly*)
- Estimated number of people in each area. You can use IUS course schedule to count how many sessions are held in each classroom or make reasonable assumptions and write them clearly.

Report your location plan and corresponding weighted walking distance per day. Optionally: you can interview cleaning personnel and estimate their bin collection and use this data somehow?

What do you mean by weighted?
Let's say:

- *Classroom A has 80 seats*
- *Classroom B has 20 seats*
- *Both are 10 meters from a candidate bin*

Without weights: their distance contribution is equal
With weights: Room A contributes 4x more to the total cost, because it has more users

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