

# Operations Research, Spring 2022 (110-2)

## Final Project

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In the final project, you are invited to conduct an OR study on a real problem. You are expected to find your own problem, formulate a model that describes the problem, collect relevant data, solve the model, and make interpretations and suggestions from your solutions. What we really want to see are (1) how you apply OR to solve real problems, (2) how you select a suitable topic and appropriate methods, and (3) how you present your ideas and results. Good luck and enjoy!

## 1 Teams

Please form a team of *eight to ten* enrolled students for this project. One student cannot participate in two teams.

## 2 The study

In this project, each team needs to apply OR techniques to solve a real problem until helpful suggestions are made or insightful implications are found. The topic will be chosen by team members. While there is no restriction on the topic, it will be nice that the topic is (1) relevant to our daily life and (2) can be understood easily by everyone in class.

When you choose your own topic, you are welcome to discuss with the instructor to ensure that the topic is fine. Below are some example topics that were studied by former students:

1. (Personnel scheduling for IM Week) Facing time-variant demands for the coming IM Week, how to schedule your classmates to complete all the tasks? Do not forget that your classmates still have classes and cannot work for too long. Moreover, how would you model service level as a function of demand volume and personnel supply?

2. (Beer ordering and shipping for German beer festivals) Given the demand forecasts for three beer festivals and supply and transportation information in Germany, one needs to decide the order quantity and shipping routes. Should we minimize the expected total costs, minimize the risk of running out of beer, or do something else?
3. (The installment of ice cream machines in Family Mart) Given a chance to install ice cream machines to Family Mart stores, how to choose a few stores to maximize the total profit? Is it profit-maximizing not to install ice cream machines in all stores? Note that estimating demands is a big challenge!

As this is a project, most details should be left for you to decide. However, you are more than welcome to discuss your ideas with me. Please do not work on the above topics (or convince the instructor why you need to work on the same topic); find your own!

### 3 Tasks

Each team needs to sign up, write a proposal, make a presentation, and write a report. For any submission, exactly one team member of a team should make the submission. The teams who fail to do so may get some penalties. For each due time, submissions that are late for no more than twelve hour will get at most ten points deducted as a penalty. Submissions afterwards are not accepted.

1. Sign up: Students should sign up by providing the names of team members to a given online form by **23:59, May 7**. Please also indicate whether you want to do your oral presentation *in English or Chinese*.<sup>1</sup>
2. Proposal: A proposal describes the problem you want to study and the tentative methods you want to apply. An electronic copy should be uploaded to NTU COOL by **23:59, May 14**. Please indicate each team member's name and student ID on your proposal. Limit your proposal to **two A4 pages** (including everything).
3. Oral presentation: Each team needs to do an oral presentation with slides for around **20 minutes** on **June 6**. Upload an electronic file of your slides to NTU COOL by **23:59, June 5**. You may decide the number of speakers by yourself (at least

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<sup>1</sup>Speakers are encouraged to present in English, though Chinese is still welcome with no penalty. However, please do not try to present in English if you are not confident of doing that.

one, of course). After putting presentations in the same languages together, the presentation order will be randomly determined in class.

4. **Written report:** You may write your report in English or Chinese as long as it is readable. The report is limited to ***twelve pages***, including everything. Upload an electronic file of your report to NTU COOL by ***23:59, June 10***. Indicate your team ID (which will be assigned to you after the submission of proposals) on the first page. Please also indicate the student IDs and names of all team members. Failing to do so may get some penalties.

## 4 Report writing and oral presentation

As always, you are required to ***type*** your work with L<sup>A</sup>T<sub>E</sub>X (strongly suggested) or a text processor with a formula editor. Hand-written works are not accepted. You are responsible to make your work professional in mathematical writing.

More importantly, you are responsible to make it *a well-organized article* rather than a collection of unrelated information. If you have no prior experience of documenting an OR study, you are suggested to include the follow sections in order in your report:

1. **Introduction.** You should always start by describing the background and motivation of your problem. Then the problem should be defined.<sup>2</sup> If possible, you should explain why the problem is interesting, i.e., challenging and important. Real-world observations are good for motivating your study. The problem should have a decision maker dealing with a complicated environment with various types of operations. You should highlight the trade-offs faced by the decision maker when choosing among alternatives.
2. **Problem description.** Use words to describe your conceptual model and use formula to describe your mathematical model. Make your problem description precise.
3. **Data collection.** Describe the background of your case and the process of collecting information to generate the parameter values in your instance(s).
4. **Method.** Tell us how you solve your problem, say, using Python to invoke Gurobi Optimizer, implementing your own (heuristic) algorithm(s), etc.

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<sup>2</sup>The problem needs not to be the same as that in the proposal.

5. **Results.** Write down the results of solving your instance(s). If you have an executable plan, write it down. Some visualization is typically a plus. It will be better if you have some performance evaluation (say, your proposed solution may save how much time/money compared with the current solution).
6. **Conclusions.** Say something to summarize the whole study and possible ways to improve it.

Obviously, the above order is also natural for your presentation.

## 5 Grading policy

Below we describe how your works will be graded:

1. Proposal: A team gets full credits once a proposal is submitted. The proposal is for the instructor to know how students form teams and, more importantly, give comments and feedback to some teams when it is helpful.

**Note.** The key is to find your teammates and submit in time!

2. Presentation: According to the quality of your presentation, a letter grade will given to you by the instructor AND students. Grades from all students will be averaged (A for 4, B for 3, etc.) and counts for 60% of the grade; the grade from the instructor counts for 40%.

**Note.** The key is to choose a good topic, give a clear and interesting talk, and generate useful conclusions.

3. Report: According to the quality of your written report, the instructor will give you a letter grade (with + and -).

**Note.** The key is to apply appropriate methods correctly and write a formal report.

4. Peer review: Each student will give a letter grade based on the contribution of each other teammate. Excluding the highest and lowest grades, the remaining grades will be averaged.

**Note.** The key is to work hard and be responsible!

The four average grades for presentation, report, peer review, and proposal are then averaged with weights 35%, 35%, 20%, and 10%.