Operations Research Fall 2022

Community-Engaged Learning Case Study Project - Group Components

Overview The process of operations research typically involves the steps listed below. In this project, you will work in a group to complete steps 1-5 (implementation is optional) on a real world problem optimization problem. While you will hopefully use some techniques learned in this course, if all problems were ‘textbook-simple’, many would not be interesting or useful. Thus, you are expected to incorporate knowledge from prior courses and life experience, and engage creatively with the problem.

1. Defining the problem

2. Formulating the model

3. Solving the model

4. Post-optimality analysis

5. Model validation

6. Implementing the model

Working with Community Partners Students are expected to comply with their partner or ganization’s policies, standards, and regulations, and serve in a professional manner with respect for others, especially with regard to confidentiality.

Each group should decide on one person to be the primary point of contact with the community partner. Early in the semester you will be provided with contact information for your community partner. You are expected to think carefully about your first email, and be mindful of your requests on the community partner’s time. You are expected to contact them within a week of receiving their contact information to introduce yourself, and, depending upon the partner, may need to visit (virtually) with the partner to start gathering data about the problem. Often it is better to have too much information (that you will then have to sort through to consider which is important and relevant) than not enough. At the same time, be mindful of the time that it may take your partner to gather information.

Representing Southwestern In this project, you are representing Southwestern University. You are expected to conduct yourself in a professional manner at all times. Failure to do so may result in a zero for the entire project grade (for an individual student or for an entire group, depending upon the circumstances). If in doubt about appropriate behavior, consult with Dr. Anthony. Students are responsible for bringing any concerns about their classmates behavior to Dr. Anthony. Similarly, if there are any concerns about the behavior or expectations of the Community Partners, also bring them to Dr. Anthony.

Groups Because OR is often interdisciplinary, the groups/teams have certain requirements. Some people love working in groups; others do not. The reality is that the ability to work in a group and with diverse people is an important skill. I have seen the vast majority of students engage in this successfully when I have taught this course in the past. There will be opportunities for you to provide feedback about each group member’s contributions and the group dynamic. I hope everyone can focus on the project goals and work together as productively as possible. That said, you can always contact me if there is anything you want to discuss about your own performance or how the group is working together. For many students, this type of project has been quite valuable in future interviews and obtaining internships, jobs, and access to other opportunities. You will indicate some of your preferences for projects and group characteristics.

Tentative Dates Unless otherwise specified, deadlines are 11:59pm. Late submissions are penal ized 10 (ten) percentage points per day late (24 hour period or portion thereof). Wed. 8/24: Confidentiality agreements signed in class

Thurs., 9/1: Submit group and project preferences (likely via form linked from Moodle) Ongoing, after groups assigned: Shared Google Drive

Thurs., 10/6: Written proposal due (one per group)

Thurs., 10/27: Peer Discussion/review must be completed

Weeks of 11/14, 11/21, and 11/28: In-class presentations (specific dates TBA) Weds., 11/30: Final report and project portfolio due (one per group)

Thurs., 12/1: Final reflection due (one per student, details provided mid-semester) (Optional) Spring 2023: You are encouraged to present at Research and Creative Works.

Project Proposal Your 2-4 page single-spaced proposal (plus any appropriate appendices) should both define the problem, and present a preliminary model or plan. The target audience for the proposal is me, someone who is skilled in modeling and optimization techniques, but may have limited knowledge about the scenario on which you are working. Though I am the target audience, the proposal will also be provided to your Community Partner, and should make them feel confident about the project trajectory.

Questions to consider: What is the significance of or motivation for the problem? Who are the relevant stakeholders? Typically, the original problem you consider will not be fully-defined; how have you molded the problem into something tangible? What simplifying assumptions will you need to make? How do you intend to model this problem? What optimization techniques do you anticipate using? (You are welcome to rely on techniques that go beyond the scope of the course.) What computational considerations or issues might arise? (Be sure to select a problem that is likely to be computationally tractable.) What data have you already collected? What data remains to be collected, and how will you go about collecting it?

Drive Documentation and Feedback Each group must maintain a shared Google Drive Folder (shared with all group members and Dr. Anthony) with project information. Groups should regu larly (at least weekly, if not more often) update the contents (while retaining older documents) to log their progress and contributions. This folder should contain notes from partner meetings, cur rent project statuses, and other information helpful to group members. All group members should regularly contribute (as evidenced by the revision history). Group members may also maintain in dividual documents (shared with Dr. Anthony, but not their group mates) noting their individual responses/progress/reflections, but are not required to do so.

There will be occasional documents relating to reflection and group statuses that you will be expected to complete. These will be provided as appropriate throughout the semester. Completion of these will factor into overall participation in the course, and into this component of the project.

When possible, feedback from the community partners will be gathered by Dr. Anthony..

Peer Discussion/Review During October, after the project proposal has been submitted, each student must meet with a student working on a different project to explain their project and progress. [A student may provide feedback to multiple people, but no more than once per project.]The listener (i.e. the student who is hearing about their classmate’s project) must submit a (one-page single-spaced, typed) report about their understanding of the project. It should include a brief explanation of the project motivation and preliminary model. The progress on the project should be noted, hopefully indicating that the preliminary model is in place, data have been collected, and the proposed methodology seems reasonable for the time remaining in the project. The listener

must also provide some constructive feedback to the presenter. The listener is expected to report truthfully on the state of the project, in accordance with the Honor Code. The student explaining the project must read the report, and either assert that all statements are true, or attach a brief addendum notating any discrepancies.

Each report will be evaluated based on the provided rubric, and the scores will be averaged for all group members to provide the group score on peer evaluation. Failure on the part of a group member to explain their project to an appropriate classmate, or to ensure that the classmate submits a report, will result in a score of 0 being included in the average.

Presentation(s) Each group will present their work in class during the last few weeks of the semester. Specific dates for the in-class presentation for each group will be announced in the second half of the semester. Any individual who knows of a conflict preventing them from presenting on a given date must notify Dr. Anthony as soon as possible for consideration in scheduling. The slides are expected to be substantial, appropriate, and professional. Groups may be requested to give an additional presentation to their community partners; these will be coordinated with the partners.

Final Report Your 10-12 page single-spaced report plus any necessary appendices, due the last day our course meets, should include the following:

1. Abstract: A short (one paragraph) description of your project and key findings 2. Executive Summary: A nontechnical overview of the entire project, emphasizing the main con clusions, typically 1-2 pages. The target audience of the Executive Summary is the ‘client’ or primary stakeholder of your project.

3. Technical report. The report must describe all five (or six) phases of this project and provide the reader with a clear picture of your process, as well as of the model results. The target audience of the Technical Report section is the imaginary person who will be replacing you on the project now that you have chosen to retire (living off your consulting riches...): a technically proficient person who is not necessarily familiar with the details of the problem but who has taken an introductory operations research course. She will need to understand the model sufficiently well, on the basis of this report alone, to be able to use it and build upon it after your departure.

a. Introduction: Presents the motivation of the problem, a brief summary of the methodology and results and a ‘roadmap’ for the remainder of the report.

b. Literature Review (if applicable)

c. Model Formulation

d. Results

e. Conclusions and Recommendations

4. Appendices as needed

5. Bibliography as needed

Reflection Paper Each student will individually complete a reflection paper about the group project. Details will be provided in a separate document, available by mid-semester.

Honor Code The signed Honor Pledge must be included on all project submissions. The problem formulation and solution must be completed by the students in the group, with everyone contributing meaningfully and significantly. The writing must be the original work of the students in the group. In short, the project must be your own. Furthermore, all students in the group must understand, agree with, and be prepared to explain all submissions by the group.

Evaluation The rubrics for evaluating the group components of the project are attached. The points represent the points towards the final grade. Since operations research is not only

about solving problems, but about being able to communicate problems and solutions clearly and effectively, for each portion of the project, your grade will be based on both technical content and the quality of the communication. Additionally, each group member will complete evaluations of their group members’ contributions, which will be incorporated into the participation grade for the course. In extreme situations, group members may earn different grades *on any component of the project* if one or more individuals do not contribute or are harmful to the group. Hopefully such situations will not arise, but if they do, students are expected to bring them to Dr. Anthony’s attention as soon as possible.

Acknowledgment: This project was originally conceived by Dr. Susan Martonosi, Harvey Mudd College. Many of the specifications, requirements, and questions originated with her project and have been adapted over time.

Grading Rubric for OR Case Study

Project Proposal (4 points)

Project Title:

Group Member Names:

Format and Writing

1

2*pt* Cleanly written (few typos; few distracting grammatical hiccups; clear structure and composition; appendices, tables and figures are well-labeled and easy to read) and within page limits. Writing is coherent and fluid and has a clear structure.

1

2*pt* Appropriately written for target audience (me). (Project motivation and context is pro vided and proposed methodology is clearly explained and justified.) Content

1

2*pt* Context and motivation of the problem are provided.

1

2*pt* Relevant stakeholders are identified, and their respective objectives and trade-offs are addressed and weighed.

1

2*pt* Reasonable simplifying assumptions are proposed to make the problem tractable within the project’s time limitations.

3

2*pts* Reasonable methodology for solving the problem is proposed. Decision variables and pa rameters are defined. Appropriate data collection procedure is proposed for parameter estimation. 0 = Proposed solution techniques are not provided.

1

2 = Solutions techniques are provided, but they are not appropriate or adequate for the problem. Computational issues and data collection are not discussed.

1 = Solution methodology is described in the proposal and is a reasonable course of action for solving the problem. Potential computational issues are addressed. Data has already been col lected, but may have been collected using inappropriate methodology; or plan for collecting data has methodological flaws that need to be addressed.

3

2 = Solution methodology is described in the proposal and is a reasonable course of action for solving the problem. Potential computational issues are addressed. Data has already been collected, or a reasonable plan for obtaining data has been outlined.

Late Penalty: (10% deducted per day late)

Total:

Poorly written proposals will not receive a passing grade. Proposals that appear not to have been proofread will be returned unread.

Grading Rubric for OR Case Study

Drive and Feedback (as a group) (5 points)

Project Title:

Group Member Names:

*3 pts* Shared Google Drive updated and maintained throughout the semester, with timely and appropriate contributions from all members. Group is managing itself reasonably well, following expectations set out in Team Contract.

*1 pt* Feedback from group members on short reflection activities as announced in class/posted on Moodle. *Note: While this considers the completion and content of those activities, failing to be an active participant throughout the semester on the project can result in a student earning a 0 on multiple components of the project, even if other teammates earn higher grades.*

*1 pt* Based on feedback from Community Partners, where available. When such feedback is not available, Dr. Anthony will base it on her assessment as if she were the community partner, and consider all evidence she has of partner communications.

Note: You are encouraged to copy Dr. Anthony on emails to community partners. You should keep records of all communications conversations (electronic, phone, text, in-person) with commu nity partners in notes in Google Drive.

Late Penalty: Contributions throughout the semester to Google Drive are ex pected, and a spate of contributions at the end, while better than nothing, will earn little credit.

Total:

Grading Rubric for OR Case Study

Peer Discussion (3 pts, averaged together)

Project Title:

Presenting Group Member:

Listening Classmate submitting the report:

*1 pt* Cleanly written submission, following the overall guidelines.

1

2*pt* Reporting student understands the project motivation and preliminary model. 1

2*pt* Reporting student is able to verify that the team has made good progress (the preliminary model is in place, data have been collected, and the methodology seems reasonable for the time remaining in the project).

1

2*pt* Reporting student offered constructive feedback to the group in the report. 1

2*pt* Presenting student has either affirmed the correctness of the report, or attached an adden dum satisfactorily clearing up any discrepancies. Late Penalty: (10% deducted per day late)

As detailed above, the peer discussions for all students in the group are averaged to determine the group’s grade.

Total:

Grading Rubric for OR Case Study

Presentations (5 pts)

Project Title:

Group Member Names:

*2 pts* The in-class presentation slides are substantial, well-designed and well-written. Ideas are supported by ample evidence, and the audience understands the problem, the solution approach taken, and the conclusions.

*1 pt* All group members are present and participate satisfactorily in the in-class participation; factors considered include awareness of audience, content, organization, and delivery.

*2 pts* The in-class presentation provides an appropriate model formulation and background information, discusses the solution’s applicability for the community partner, indicates how sensitive it is to assumptions in the data, and reflects meaningfully on the community-engaged learning aspect of the project.

0 = Zero of these four criteria have been met.

1

2 = One of these four criteria has been met.

1 = Two of these four criteria have been met.

3

2 = Three of these four criteria have been met.

2 = Four of these four criteria have been met.

Late Penalty: Failure to present as scheduled may result in earning no points for this activity.

Total:

Grading Rubric for OR Case Study

Final Portfolio (14 points)

Project Title:

Group Member Names:

Format and Writing

*1 pts* Cleanly written (few typos; few distracting grammatical hiccups; clear structure and composition; appendices, tables and figures are well-labeled and easy to read) and within page limits. All required components included.

*1 pts* Writing is coherent and fluid and has a clear structure.

*1 pts* Executive Summary appropriately written for target audience.

*1 pts* Technical Report appropriately written for target audience.

Content

*1 pts* Problem is clearly defined and motivated. Relevant stakeholders are identified, and their respective objectives and trade-offs are addressed and weighed.

*4 pts* Model has been clearly formulated, with decision variables and parameters defined. Model formulation is correct and applicable to the problem. Assumptions made in the model are clearly stated and assessed. Data used in the model have been collected and used correctly. 0 = Zero of these four criteria have been met.

1 = One of these four criteria has been met.

2 = Two of these four criteria have been met.

3 = Three of these four criteria have been met.

4 = All four of these criteria have been met.

*4 pts* Report proposes a solution to the problem that makes sense. Report assesses how well the solution meets the criteria of the stakeholders. Post-optimality analysis assesses how sensitive the solution is to the assumptions and data. It is clear how such a solution could be implemented, often through a provided Excel spreadsheet.

0 = Zero of these four criteria have been met.

1 = One of these four criteria has been met.

2 = Two of these four criteria have been met.

3 = Three of these four criteria have been met.

4 = All four of these criteria have been met.

*1 pt* Students engaged creatively with the assignment. (This intentionally vague criterion is to remind you that you will not earn all possible points unless you make the assignment your own and move beyond the recipe provided by this rubric.)

Late Penalty: (10% deducted per day late)

Total:

Observe that only a limited portion of the points are awarded based on technical content! Poorly written reports will not receive a passing grade. Reports that appear not to have been proofread may be returned unread.