

Project

Introduction to Math Programming

OPER 510

Assigned: October 3, 2018

Due: November 30, 2018

Project Requirements. The purpose of the project is for you to select which modeling approaches and OR methods to utilize to provide key insights into decisions that will be made for a potential company.

The major product of your project will be a report summarizing your models, methods, and results. Therefore, you should describe any mathematical models of the problem that were developed, listing the decision variables and constraints. Further, please discuss the procedures (for example, the type of sensitivity analysis applied) to generate your findings or support your conclusions. There is a natural ‘organization’ to the structure of your report which coincides with the topics of interest to the company; however, keep in mind that you must adequately organize your project report so that it is understandable and provides enough details for me to understand your solutions.

For this report imagine I am the CEO (i.e G.O. equivalent) you work for. Communicate clearly and translate technical talk into operational language.

Policies.

1. You must work in assigned groups, do not collaborate outside of your group. You are only allowed to discuss the project with members of your group and myself. You will turn in a single hard copy of your project report (including appendices providing electronic files) and also e-mail me (at Bruce.Cox@afit.edu) the electronic files used to generate the results.
2. You will also present a 15 minute out-brief on 30 November. This brief should summarize the problem, outline your methodology (including any assumptions) and detail your results. While I am the primary audience, your group will be briefing results in front of the class.
3. Each group may request one thirty minute block of my time to meet with me one on one to discuss your project. This can be used anytime during the quarter (pending my availability), I will critique any draft products during this meeting if available. Note that I will take ‘smaller’ questions on the project during office hours but I need to make sure I rotate to all students attending the office hours. Therefore, this private meeting with me provides you a mechanism for my undivided attention.

Project Description.

MCS Corporation produces an amazing toy called the DinoBall. This toy is so popular that MCS Corporation can run 8 retail stores dedicated to selling just this product. MCS Corporation is dedicated to meeting all demand for Dinoball. The toy is produced at 3 production facilities owned by MCS Corporation, each of which has multiple production lines dedicated to producing the DinoBall toy. The characteristics of each of these production lines are a function of their age: newer production lines produce the DinoBall toy quicker and use less power.

MCS Corporation plans monthly for production levels across its facilities based on the demand for DinoBall. Currently, DinoBall operates under the policy that each facility will, monthly, produce the same number of toys. In other words, the facilities are ‘balanced’ in that each of them produces $\frac{1}{3}$ of DinoBall’s monthly demand. MCS Corporation likes the idea of equal ‘wear and tear’ on each

production line at a particular facility: MCS Corporation currently implements the requirement that every production line at a facility runs for the same length of time during a month. For purposes of this analysis, you can assume that a 'month' consists of four 40 hour weeks (for a total of 160 hours). MCS Corporation contracts with LM Trucking to transport DinoBall from their facilities to their retail stores. LM Trucking has an OR team that solves a transportation problem to determine the shipment levels and associated costs. The policy of LM Trucking is then to charge a premium of 20% to MCS corporation in billing them for the logistics services.

MCS Corporation has hired your project group to address several areas of interest that they believe can be addressed through OR modeling and methods. They have provided you with past data (e.g., demand levels, distances between facilities and retail stores, characteristics of production lines) about their company to help address these areas of interest, which is available in the associated Excel file. The MCS Corporation is interested in addressing several 'what-if' questions independent of each other.

1. MCS Corporation is considering removing the policy that each facility is responsible for the same number of toys. They believe that this would drive down their total operating costs but are concerned about the idea of restructuring their company (i.e., they may need to relocate workers amongst their facilities). MCS Corporation is interested in determining the amount of savings that would result from removing this policy. Note that the even wear and tear policy on the production lines at each facility will remain in place.
2. MCS Corporation has an opportunity to update some production lines with the new technology 'FastProd'. This production line will decrease production costs of DinoBall since FastProd produces them at a faster rate with less energy. They believe that the life cycle of each new production line will be 3 years. The company that sells FastProd has a very specific contract: each production facility of the MCS corporation will receive exactly 2 FastProd production lines. The MCS Corporation has room for exactly 3 production lines at each facility, so it will need to determine which 2 production lines would be replaced with 2 FastProd lines. Each existing production line has a 'selling price' for the MCS corporation to help offset some of its replacement costs. MCS Corporation would like to determine a 'reserve price', which is the maximum amount they are willing to pay for this type of contract, in preparing to negotiate with the company that produces FastProd.
3. MCS Corporation is now concerned with the environmental impact of their operations. Each DinoBall produced results in a set amount of emissions specific to each location. Given their current operations dictating equal wear and tear and the policy that each facility is responsible for the same number of toys are the two objectives (i) minimizing cost and (ii) minimizing emissions conflicting? If they are conflicting provide a subset of the pareto frontier providing the solution for when emissions is the only concern, cost is the only concern, and some weighted combinations of these two objectives.

Grading Rubric

Report - 80 points

1. *Overall organization and clarity - 5 points*

The report should flow logically, and require minimal flipping between sections. The report should be written in the active voice instead of the passive voice. Each section should have an introduction, well defended analysis, and a conclusion. The report should be self-contained and not require referencing external materials.

2. *Explanation and rationalization of model assumptions - 10 points*

In numerous places throughout the project you are given insufficient information. Some of this is intentional, some is simply natural ambiguity. You should either clarify uncertainties with me a-priori and reference that clarification in your report, or explicitly explain and rationalize the assumptions you make.

3. *Correctness and explanation of base case - 20 points*

This project requires you to create a mathematical model(s) based off of the given data. This model can be programmed and solved in LINGO or in excel using solver as appropriate/desired. Regardless of software tools used you should explain (and defend as necessary) your choice of decision variables, parameters, objective function and constraints. You should explain and defend any assumptions you need to make (see 2). You should explain your solution methodology and results, both mathematically and from the perspective of a business consultant. This model is the basis for all future "what-if" questions and is thus weighted more heavily than the "what-if" questions.

4. *Correctness and explanation of first "what if" question - 15 points*

Each of the three "what-if" questions poses a specific wrinkle to the original model. You should explain the problem statement, outline and defend your assumptions (see 2), explain your methodology, and summarize your results both mathematically and from the perspective of a business consultant.

5. *Correctness and explanation of second "what if" question - 15 points*

See 4

6. *Correctness and explanation of third "what if" question - 15 points*

See 4

Presentation - 20 points

1. *Overall organization and clarity - 5 points*

Your briefing should flow logically. Your visual aids should be clear and tie in organically with your presentation. Unless you seek and receive approval from me before hand all members of group should brief a relevant section.

2. *Base case - 6 points*

You should outline the problem statement, and the model you developed. Explain the methodology you used to solve the model, and organically introduce and defend assumptions made. Explain results primarily from a business case perspective.

3. *First what if - 3 points*

You should outline the problem statement, focusing on what changed between the base case and this "what-if" question. Explain your the model you developed. Explain the methodology you used to solve the model, and organically introduce and defend assumptions made. Explain results primarily from a business case perspective.

4. *Second what if - 3 points*

You should outline the problem statement, focusing on what changed between the base case and this "what-if" question. Explain your the model you developed. Explain the methodology you used to solve the model, and organically introduce and defend assumptions made. Explain results primarily from a business case perspective.

5. *Third what if - 3 points*

You should outline the problem statement, focusing on what changed between the base case and this "what-if" question. Explain your the model you developed. Explain the methodology you used to solve the model, and organically introduce and defend assumptions made. Explain results primarily from a business case perspective.