

Individual Assignment 2: Modeling Business Logic

If you have any questions regarding this assignment, please feel free to contact Andy Hu (a.hu@queensu.ca), the teaching assistant for this course. Feel free to cc me in your email.

For the problems below, submit (1) a consulting report (approximately ½ a page for each problem) accompanied by a technical appendix **as a single document** (pdf or word) and (2) the Excel file(s) containing your spreadsheet model(s) to the portal dropbox. The report should highlight your findings (e.g. business implications), *be as non-technical as possible*, and be written in language that could be easily understood by an audience with little knowledge of quantitative models. Feel free to include any figures you deem appropriate. The technical appendix should include the verbal and mathematical formulation of the model, as laid out in class (decisions, objective, constraints), key assumptions, and the screenshots of both the numerical values, as well as the formulae (accessed by pressing Ctrl + ~) for your model in Excel. You can submit multiple Excel files (e.g., one for each question).

Please note that this assignment is due by 8:30 am, March 18th, 2023.

Problem 1: TelecomOptics Revisited

Refer to the TelecomOptics Case that we have discussed in class. The following parts of the question should be answered independently of each other.

Suppose that the management at TelecomOptics has decided that each market is to be supplied from a single manufacturing location. Formulate your problem as a linear integer program and determine the manufacturing location for each market. Discuss the advantages and/or disadvantages of having a single supplier policy.

Problem T2: Avengers in Action¹

The Avengers are trying to protect the world from an alien invasion led by the villainous Thanos. The team consists of Captain America, Iron Man, Thor, Black Widow, Hawkeye, and Hulk. The Avengers need to deploy themselves to three different battlefields, each with a different threat level, as specified in the following table.

	Battlefield 1	Battlefield 2	Battlefield 3
Threat Level	7	5	9

At the same time, the Avengers need to protect their base, the Avengers Tower. The protection provided by each Avenger depends on the location. The following table shows the maximum protection values each Avenger can provide on each battlefield and the Avengers Tower.

¹ Please review the Copyright policy in the course outline carefully. The assignment questions are the intellectual property of Dr. Guang Li and shall not be distributed or disseminated to anyone other than students registered in this course without Dr Li’s express consent.

Protection Value	Battlefield 1	Battlefield 2	Battlefield 3	Avengers Tower
Captain America	5	3	4	5
Iron Man	6	2	3	7
Thor	7	4	8	5
Black Widow	3	2	5	4
Hawkeye	2	1	3	3
Hulk	6	5	9	7

To fully protect each battlefield, the total protection value across all Avenger members in that battlefield must be at least the same as the threat level of the battlefield. In addition, when deploying the Avengers, the following logical constraints must be satisfied:

- (1) Each Avenger either needs to stay at the Avengers Tower or to be deployed to one battlefield.
- (2) At least one and no more than 3 Avengers can be deployed to each battlefield.
- (3) The total number of Avengers deployed must not be more than 5.
- (4) At least one of Iron Man and Captain America needs to stay at the Avengers Tower (i.e., not deployed to any battlefield).
- (5) If Black Widow is present at a battlefield, then Captain America must also be present at that battlefield.
- (6) If Black Widow and Hawkeye are both present at a battlefield, then they will argue and not provide any protection to the world. This means that at most one of Black Widow and Hawkeye can be present at any battlefield.
- (7) If Hawkeye is present at a battlefield, then at least one of Iron Man and Thor must also be present at that battlefield, to prevent Hawkeye from getting bored and leaving.

Formulate a linear integer program to help the Avengers determine the optimal deployment plan that maximizes the protection of the Avengers Tower while fully protecting all the battlefields.