SA463 • Operations Research in Action Fall 2024 • Uhan

**Writing about Operations Research – Model and Results - Optimization**

**Overview**

* Recall that:
	+ The purpose of the model section is to describe the operations research or statistical model you used to analyze your problem.
	+ The purpose of the results section is to present and interpret your results in a reader-friendly way.
* We discussed how you would do this for a regression model.
* Here, we will focus on optimization models.

**The model section**

* State all components of your model mathematically.
	+ Sets
	+ Parameters
	+ Decision variables
	+ Constraints
	+ Objective function
* Describe each of the components in words.
* Discuss any simplifying assumptions you made.

**Writing an optimization model mathematically in Word**

* Align the objective function, constraints, for statements, and equation numbers (if applicable) with a matrix.
* Begin by inserting an equation into your document.
* In the “Design” tab, click on matrix.
 
* Select an empty 3 x 3 matrix.

$$\begin{matrix}&&\\&&\\&&\end{matrix}$$

* The matrix will help us keep the model properly aligned.
* To add rows or columns to the matrix, right click on any cell and select “Insert”. This will give you the option to add rows or columns. In the example below, we will use a 4x 4 matrix.
* General format:
	+ Use the first column for the objective function sense and the “subject to” for constraints. Make sure they are formatted as “Text” within the equation.
	+ Use the second column to completely write out the objective function and constraints.
	+ Use the third column to write out the “for …” statements. (You may use $∀$ if you prefer.)
	+ Use the fourth column for the equation numbers.
	+ Note, if you right click on an individual cell you can set the column alignment to left so that the equations in each cell are left, center, or right justified.

$$\begin{matrix}minimize&\sum\_{j\in J}^{}c\_{j}y\_{j}+\sum\_{i\in I}^{}\sum\_{j\in J}^{}d\_{ij}x\_{ij}&&\\subject to &\sum\_{j\in J}^{}x\_{ij}=1&for j\in J&\\&x\_{ij}\leq y\_{j}&for i\in I, j\in J&(2)\\&x\_{ij}\in \left\{0,1\right\}&for i\in I , j\in J &\end{matrix}$$

* Use equation numbers to refer to equations when you write about them. For example:

Constraints (2) capture the fact that if there is no facility at location $j$ ($y\_{j}=0$), then client $i$ cannot be served there, and we must have $x\_{ij}=0$.

* Only include equation numbers for equations you actually refer to in your main text.
* After writing out the full model, you should have one or two paragraphs below that describe the objective function and each constraint in words.

**The results section**

* Report the running times for each instance:
	+ how long it took to solve the model, if you solved it to optimality, or
	+ how long you let the solver run, if you did not solve the model to optimality.
* Report any performance metrics of interest for each instance. Often, this is the objective function value.
* Display the solution you found in a user-friendly format for each instance.
	+ e.g., a timetable for a schedule, a table of stops for a route, a map for a facility location solution.
* Interpret the solutions you found. Do they make sense? Why or why not? Do they have any interesting or surprising features?