

## SMM641 REVENUE MANAGEMENT AND PRICING

### Individual Problem Set 1 (due 21 February 2022)

#### General Guidelines:

- This assessment is individual work. You are allowed to discuss questions with your classmates, but all work and descriptions in your submission must be completely your own.
- The assessment will be based on both the quality of your analysis and the expository clarity of your descriptions. Please clearly describe the steps you take and allow a reader to follow your methodology and calculations with ease.
- Please feel free to make assumptions that might aid your analysis. Make sure that you provide a justification for all your assumptions.
- Please submit a single pdf document (not a Word document) to Moodle.
- Please limit your total response to 500 words.
- Where applicable, please also submit any codes separately (e.g., as an .R, or an .Rmd file), which should be clear to follow and be ready to run.

#### Question 1: (30 points)

A café receives 50 croissants daily. During the morning hours, the croissants can be sold individually for £1.00. The croissants can also be used to make sandwiches for lunch time. Regardless of the other ingredients in a sandwich, each croissant brings £1.50 if used for a sandwich. Suppose that the demand in the morning for individual croissants is Poisson with mean 50 and the demand for croissant sandwiches during lunch is Poisson with mean 20.

- (a) Suppose that the café does not reserve any croissants for lunch time and serves customers based on a first-come first-served (FCFS) basis. Compute the café's expected daily revenue.
- (b) How many croissants should the café reserve to be used for lunch time sandwiches in order to maximise their expected daily revenue?
- (c) What is the expected daily revenue from this protection (reserve) policy? What is the percent improvement compared to the expected daily revenue from the FCFS allocation that you computed in part (a).
- (d) Explore how the allocation decision changes with changes in the expected demand for sandwiches, the revenues that each croissant brings as an individual breakfast item or as a sandwich, and the number of croissants the café receives daily. For example, is it better to protect more croissants for lunch time if the demand for lunch time is higher?

#### Question 2: (40 points) (Please limit your response to 200 words.)

Consider the Airline Network Example we discussed in class, in which an airline is operating two flights, one from Dublin to London, and the other from London to Edinburgh.

- (a) Please explain in words what the optimal revenue obtained by dynamic programming, i.e., the value function for the state (100,120,300), represents.

- (b) Consider the structure of the optimal acceptance decision for product 2 at  $t=100$  periods to go (available in the slides). Please explain in words the main insights you gain from this figure.
- (c) Consider the structure of the optimal acceptance decision for product 3 at  $t=100$  periods to go (available in the slides). Please explain in words the main insights you gain from this figure.
- (d) Suppose the company is considering adding a new product, which will be a flight from Dublin to London at a premium fare for £200, for which it estimates that the per-period arrival probability will be  $1/20$ . Please explain briefly how would you modify the dynamic program we have discussed in class to accommodate this new product?
- (e) Explain in words why the first-come-first-serve allocation brings a lower revenue than the optimal allocation found through dynamic programming.

Question 3: (30 points) (Please limit your response to 200 words.)

Identify a relatable setting either based on a service/operation on campus, locally, or elsewhere, in which any of the concepts and methodologies we have learned so far can potentially improve the service provider's objective (e.g., maximizing revenue)

Please describe the setting clearly and how you would model/analyse the setting. You do not need to work on the analysis itself or provide any results.

Please make sure to try to pick a setting that allows a sufficiently rich variation and extension to the examples we have covered in class, that is, your analysis should not be a very simple variation of the examples we have discussed in class but be challenging and require you to think creatively.

If you'd like, and if the setting is relevant and enables a sufficient depth of analysis, you will have the option to expand on your idea for your projects as well.