SMM641 REVENUE MANAGEMENT AND PRICING

Individual Problem Set 2

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 expositional 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 responses to **500 words in total.**
- Where applicable, please also submit any codes separately (e.g., as an .R file), which should be clear to follow and be ready to run.

Question 1:

London is considering an extension to its Congestion Charge programme, a daily charge for driving a vehicle within the charging zone between the hours of 07:00 and 18:00, Monday to Friday. The extension explores the revenue and environmental impact of introducing a two-tier congestion pricing policy for *peak* and *non-peak* traffic periods.

The City conducted a survey to learn more about the willingness to pay of drivers that may enter the charging zone during the peak and non-peak hours. In total, 345 such drivers have responded to the survey and their maximum willingness to pay for peak and non-peak periods is reported in the **accompanying supplementary data file**. Assume that the respondents represent a total of 192,000 drivers the City estimates that may potentially enter the charging zone.

Perhaps the most important motivations for implementing a Congestion Charge are to reduce emissions and to generate funds to reinvest in improving public transportation services. A main factor that determines emissions per car is the average travel speed, which in turn is influenced by the number of drivers entering the charging zone. Suppose that the relationship between the number of drivers and average speed is given by the following:

$$\text{Average Speed (in km/h)} = 30 - 0.0625 * (\text{\# of cars in thousands, '000}) \qquad (1)$$

Further, the emissions per car, which is generally measured in grams of CO_2 per kilometre, can be approximated by a piecewise linear function as follows:

$$\text{Emissions per car (g/km)} = \begin{cases} 617.5 - 16.7 * (\text{Average Speed}) & \text{if Average Speed} < 25 \text{ km/h} \\ 235.0 - 1.4 * (\text{Average Speed}) & \text{if Average Speed} \geq 25 \text{ km/h} \end{cases}$$

$$(2)$$

(a) If the programme's objective were solely to maximise revenue and a <u>single</u> congestion charge were to be applied across both peak and non-peak hours, which price would maximize the total revenue? With this price in effect, what is the total level of emissions?

(b) If the programme's objective were solely to maximise revenue and a <u>peak period</u> pricing strategy is to be implemented, with the price for the non-peak period set at £7, what price would you recommend for the peak period? Please note the resulting revenue and emissions and compare the findings with those from part (a).

(c) Suppose now that the programme's objective is to minimize emissions rather than maximizing revenue. However, the City would like to ensure that the programme can self-sustain its operation and that a sufficient portion of the revenue is allocated to reinvest in the public transportation infrastructure. Overall, the City requires that the revenue should not fall below £1.1 million per day. Assuming a non-peak period price of £7, what price would you recommend for the peak period? Please compare the resulting revenue and emissions level with that of part (b).

Question 2:

Similar to Question 3 of Problem Set 1, please identify a practical setting in which any of the concepts and methodologies we have learned so far regarding **price optimization** can be implemented to potentially improve the service provider's profits/revenues. If you'd like, you can either build on your setting you have described for Problem Set 1 or pick a different setting.

For this problem, you are not expected to carry out any computations but please clearly describe your setting and your proposed methodology.

As before, 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 somewhat challenging and require you to think creatively on how to solve the problem.

Finally, if you'd like, and if the setting is relevant and enables a sufficient depth of analysis, you may expand on your work for Problem Set 1 and/or 2 as the basis of your projects as well.