

Problem Statement

MG Motors is one of the largest automobile manufacturers in North America. Their marketing department conducted a recent survey and they found that since big players like Ford decided to exit the sedan market (and focus exclusively on trucks), there is a market for sedan. The Chief Product Officer approaches you to help to prepare a plan of action, to be presented before the Chief Executive Officer.

The MG Motors wants to move early to fill the gap in the market, and they do not have enough time to invest in the hybrid or electric option. Therefore, they decided that they can only develop a gasoline-based sedan model (given the short duration they have to launch a new model into the market). They code name the new product as 'Aura'.

You are asked to present an in-depth analysis of what should be the price of this new sedan, Aura. Assume that the price will remain the same throughout the selling horizon.

Timeline of the project:

- The R&D department estimates that they need approximately 6 months to develop the new car model that can be production ready after sufficient quality checks.
- The manufacturing plant needs 6 months for retooling its production and assembly lines to start producing the new car model.
- At the earliest, MG Motors can launch Aura at the beginning of 2025.
- It is anticipated that a new regulation is coming soon that will prevent the sales of gasoline-based cars after 2030.

Financial considerations:

- The R&D department would need to shift their few engineers from their current projects to this new project for 6 months, therefore delaying the projects they have been working on. They estimate the cost of delay as \$5 million.
- MG Motors has a manufacturing plant that is rarely in use currently. The fixed cost of retooling the manufacturing plant is approximately \$5 million. Depending on the final design of the car model, the cost price of producing one car would lie between \$15,000 to \$20,000.

You are aware that your competitor (GG Motors) is also trying to grab the market, and they are about to launch their new product, 'Asta' (which is very similar to what MG Motors is thinking) in the market. Although you are not sure about the price of their car, you anticipate its price to be:

$$\text{Market price of Asta} = \begin{cases} \$22,000 & \text{with probability } 0.3 \\ \$27,000 & \text{with probability } 0.7 \end{cases}$$

The aggregated demand for the sedan (Asta and Aura) in the market, of course, depends on the price. The marketing department suggests using the following expression of demand as a function of price:

$$\text{Annual Volume (in 1,000s)} = 10 - 3 * \text{Price (in \$10,000)} + \varepsilon,$$

where ε denotes the random error ($\text{mean} = 0, -1 \leq \varepsilon \leq 1$) in the demand forecast, and
Price is the average market price of Asta and Aura.

Since the two products are going to be very similar, the demand will get split. You can assume that the demand will split in inverse proportion to the prices of the cars. For example, if the demand in a certain year is 10,000, and Asta is priced in the market at \$22,000, and Aura is priced in the market at \$25,000, then $\frac{\$25,000}{(\$22,000 + \$25,000)} \times 10,000$ customers will buy Asta (which is priced at \$22,000) and the rest will buy Aura.

You might expect that the money that you will receive later in time has lesser worth than the same amount if you receive it now. To capture this, 'discount factor' is used. It is used to calculate what the value of receiving \$1 in the future would be based on the discount rate assumption.

$$\text{Discount Factor (DF)} = \frac{1}{(1 + \text{Discount Rate})^{\text{Period Number}}}$$

Assume a discount rate equal to 10% per annum. That is, the \$100 that you receive after one year has a present worth of \$90.9 (DF * \$100, and DF = 0.909). Similarly, the \$100 that you receive after two years has a present worth of \$82.6 (DF * \$100, and DF = 0.826).

Deliverables:

Present a report (less than 6 pages, font size 12) describing what price you recommend for Aura, and why, using Monte-Carlo simulation. Your report should contain the following sections: Introduction, Model, Analysis, Results, and Conclusions. The analysis should be done in R, and the code should not be a part of the report (and needs to be separately attached). Set the seed equal to 1234 ("*set.seed(1234)*") at the beginning in R so that I can replicate your results. The figures and tables should be included in the report itself. Make sure to clearly define the notations that you use in your model. Clearly state any appropriate assumption(s) that you are making, along with the reasoning.