

2494 - COMPUTATIONAL THINKING & DATA SCIENCE

2019-20, Spring Semester

2nd Problem Set

Deadline: 17th March 2019

1. The Volkswagen Auto Europa (VAE) is trying to determine what type of compact car to develop. Two models (Car 1 and Car 2) are under consideration. Each model is assumed to generate sales for ten years. In order to determine which model should be built, information about the following quantities has been gathered through focus groups with marketing and engineering departments.

- **Fixed Cost of Developing Car:** This cost is assumed to incur at the beginning of Year 1 (or end of Year 0) before any sales are recorded.
- **Variable Production Cost:** The variable cost incurred in producing a car.
- **Sales Price:** The sales price is assumed to be 10 000€ for each model.
- **Sales of Car During Each of Next Ten Years:** for simplicity assume that all sales occur at the end of each year.
- **Interest Rate:** It is assumed that cash flows are discounted at 10%.

Fixed and variable costs and annual sales are not known with certainty. The views of marketing and engineering about these quantities are presented in table 1.

If a car sells well the first year, it probably will sell well during later years. VAE models this belief by assuming that:

$$\begin{cases} \text{Expected Year } t \text{ Sales for a Model} = \text{Actual Year } (t-1) \text{ Sales} \\ \text{Actual Year } t \text{ Sales for a Model} = \text{Expected Year } t \text{ Sales for a Model} + \text{Error Term} \end{cases}$$

For Model 1, VAE assumes that the error term is normally distributed with a mean of 0 and a standard deviation of 20000. For Model 2, VAE assumes that the error term is normally distributed with a mean of 0 and a standard deviation of 30000.

VAE also assumes for simplicity that the variable cost for each year's production is the same (ignoring the inflation).

Fixed Cost for Car 1		Fixed Cost for Car 2	
Probability	Value	Probability	Value
0.50	6 billion euros	0.25	4 billion euros
0.50	8 billion euros	0.50	5 billion euros
		0.25	16 billion euros
Variable Cost for Car 1		Variable Cost for Car 2	
Probability	Value	Probability	Value
0.50	4600 €	0.50	2000 €
0.50	5400 €	0.50	6000 €
Year 1 Unit Sales for Car 1		Year 1 Unit Sales for Car 2	
Probability	Value	Probability	Value
0.25	230000	0.25	80000
0.50	250000	0.50	220000
0.25	270000	0.25	390000

Table 1

For each model:

- Simulate 1000 trials and estimate the mean and standard deviation of the NPV for the ten years sales.
- Plot the histogram for those 1000 NPVs.
- Determine the probability that the NPV is negative and the probability that it will be less than -1 billion euros.
- Construct a 95% confidence interval for the expected NPV.

Using the results obtained with the simulations for the two models, compare the two proposed models.

- Auditors of a particular bank are interested in comparing the reported value of all 2265 customer savings account balances with their own findings regarding the actual value of such assets. Rather than reviewing the records of each savings account at the bank, the auditors decide to examine a representative sample of savings account balances. The population from which they will sample is given in the file Auditing.xlsx.

Select a simple random sample of size 100 and construct a 95% confidence interval for the total value of 2265 savings account balances within this bank. Does it include the (known) population total?

3. EDP wants to predict the peak power load (i.e., the maximum amount of power that must be generated each day to meet demand) as a function of the daily high temperature (X) in Setúbal. A random sample of 25 summer days is chosen and the peak power load (in megawatts) and the high temperature (in Celsius degrees) are recorded each day. The file `peakpower.xlsx` contains these observations.
- a) Create a scatterplot for these data and comment on the relationship between X and Y .
 - b) Estimate an appropriate regression equation to predict the peak power load for EDP.
 - c) Use equation from b) to predict the peak power load on a summer day with high temperature of 38 degrees.