TÉCNICO LISBOA

DECISION SUPPORT MODELS – 2020/2021 – P1
Group Work 2 assignment

Rules for the assignment

Rules

This work has two exercises aiming to explore and consolidate the knowledge achieved during the lectures and software labs. Each group will need to prepare and submit:

- A **Pdf** file presenting the information used, the "print screen" of the problem formulation, results, and brief conclusions. This file should have, at most, 8 pages in total for both exercises, excluding front page and eventual appendixes. Clear understanding will be evaluated along the results.
- The **Excel** file used to solve the exercises, with appropriate formatting for clear understanding, in which quality will be evaluated along the results.

All the files will be electronically submitted **in one zipped file, via IST-Fenix**, till the **19 of November, 2021, 23:00h**

Important: to solve the exercises you have two options:

a) use the lab in which classes take place

and/or

b) install the Palisade Decision Tools software in your PC (free trial for 15 days available at: http://www.palisade.com/).

Exercise 1 (Influence Diagrams and Decision Trees):

The pharmaceutical company ***Covizer*** develop a vaccine against the Covid19 "Corona" virus. The *Covizer* faces a tough decision, since the research costs were so high, meaning that the success of the business is not granted, because in the meantime other pharmaceuticals companies also developed vaccines against Covid19. So, commercialize the vaccine or not is a key decision, having the company the possibility, if they do not commercialize the vaccine, to sell the patent for **700 M€.**

If they launch the vaccine, they predict that the probability of achieving strong sales is **A**%, achieving moderate sales is **B**% and achieving weak sales is **C**%. They translate these outcomes in Net Present Value (NPV) for the project respectively in **D** M€, **E** M€, **F** M€.

However, *Covizer* can order a specialized market research to understand the odds of successes, receiving one of three possible outcomes from the research, regarding the vaccine launching: Favourable opinion, Neutral opinion, and Unfavourable opinion.

The market research historic records in terms of level of sales and a favourable, neutral, or unfavourable opinion for other vaccines launches are presented in the next table:

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Probability that the report has a:	strong sales	moderate sales	weak sales
Favourable opinion	0,7	0,2	0,1
Neutral opinion	0,2	0,5	0,3
Unfavourable opinion	0,1	0,3	0,6

Using the "***Precision Tree***" software:

a) Represent the initial problem with an influence diagram and generate the corresponding decision tree; (1/20 val)

b) Calculate the value of the perfect information; (2/20 val)

c) Calculate the maximum value the company should pay for the market research, and represent it with an influence diagram and the correspondent decision tree; (4/20 val)

d) If *Covizer* is not risk neutral but risk averse with a risk tolerance of **G** M€, how this risk profile could affect the decision with the market research information? Apply "*utility function*" option in "*Precision Tree"* for the tree obtained in c) (1/20 val)

Exercise 2 (Monte Carlo simulation):

You have to support the ***Covizer*** company to evaluate more accurately the risk of the investment project to produce hundreds of millions of the Covid19 vaccine.

The yearly *Earnings*, are:

Earnings = Sales Volume x (Selling Price – Unit cost) – Fixed costs.

<u>For each container with a 1 million vaccines</u>:

- **Selling price**: follows a **uniform** distribution with values between **4** MEUR and **5** MEUR per container;
- **Unit Cost**: follows a **triangular** distribution with the following values: Minimum cost **2.5** MEUR per container; most likely cost **3** MEUR per container; maximum cost **4** MEUR per container;
- **Fixed costs (per year)**: follows a **discrete** distribution where the probabilities are **H%**, **I%** and **J%** for respectively cost of **350** MEUR per container, **250** MEUR per container and **150** MEUR per container.

- **Sales (per year)**: follows a **normal** distribution with a mean of **K** containers and a standard deviation of **K/10** containers.

After a market research the Company concluded that the **selling price** and **sales** volume could be correlated by the following matrix:

Correlations	Sales	Selling Price
Sales	1	-0,9
Selling Price	-0,9	1

Questions:

a) Structure the problem, defining the **Earnings** expression (4/20);

b) For **Earnings** simulate and calculate the following statistical measures directly in excel cells, using the @Risk functions "*=@riskmean, =@riskstdev, =@rispercentile, =@risk target*": (5/20 val)

- Mean
- Standard deviation;
- 5th percentile;
- 95th percentile;
- Probability (Profit <0);

c) Use the tornado graph to discover the most important variables affecting **Earnings** and explain synthetically; (3/20 val)

Groups variables assignment:

	Variables										
Groups	A	B	C	D	E	F	G	H	I	J	K
1	10%	58%	32%	1 707	1 375	-413	115	29%	47%	24%	404
2	19%	57%	24%	1 616	1 392	-441	84	34%	48%	18%	421
3	22%	56%	22%	1 630	1 303	-387	146	33%	49%	18%	415
4	26%	52%	22%	1 750	1 344	-398	71	31%	53%	16%	407
5	21%	66%	13%	1 610	1 377	-399	123	26%	46%	28%	389
6	23%	61%	16%	1 695	1 396	-435	126	32%	49%	19%	384
7	13%	56%	31%	1 686	1 363	-410	130	28%	55%	17%	419
8	19%	51%	30%	1 682	1 370	-377	139	26%	49%	25%	391
9	17%	56%	27%	1 643	1 350	-402	102	34%	50%	16%	403
10	29%	67%	4%	1 698	1 333	-384	87	32%	53%	15%	407
11	20%	69%	11%	1 696	1 304	-413	119	32%	52%	16%	387
12	27%	64%	9%	1 750	1 359	-412	150	25%	45%	30%	414
13	24%	52%	24%	1 613	1 381	-403	80	33%	45%	22%	394
14	21%	56%	23%	1 613	1 314	-385	82	28%	47%	25%	389
15	11%	63%	26%	1 631	1 332	-437	94	30%	47%	23%	420
16	16%	61%	23%	1 714	1 395	-420	103	27%	53%	20%	388
17	26%	51%	23%	1 696	1 400	-390	131	30%	55%	15%	420

Note: group #17 is the group from MEGE course: ist192725, ist192723, ist192697, ist192653