Groupwork Assignment 2023

Rules

This work has one exercise aiming to explore and consolidate the knowledge achieved during the lectures and software labs on Monte Carlo simulation. Each group will need to prepare and submit:

- A word or pdf file with the answers. This file should have, at most, 6 pages in total, excluding front page and appendix. The readability of the presentation can influence your grade.
- A copy of the Excel files with the exercises. The readability of the Excel files can influence your grade.

The two files should be electronically submitted, **zipped in ONE file,** via **Fenix** till the **18th of June 2023 at 23:59**

Important: The Palisade Decision Tools software has a free trial available **only for 15 days**. You should carefully manage your schedule: http://www.palisade.com/). You can also use the Técnico **VPN connection to extend** your access (see instructions in the course webpage).

Exercise (Monte Carlo simulation):

You must support the ***White Gold*** mining company to evaluate more accurately the risk of the investment project to produce Lithium concentrate to build batteries for electric vehicles.

You should follow two steps:

a) calculate the **first year Earnings**
b) calculate the **Net Present Value (NPV)**.

Assumptions:

1. **The yearly *Earnings*, are:**

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

1.1 For each **container of lithium** (see the **Red** variables at the end of this assignment):

- **Selling price**: follows a **uniform** distribution with values between **A** MEUR and **B** MEUR per container; for static value, not mandatory, you can assume the mean value between A and B;
- **Unit Cost**: follows a **triangular** distribution with the following values: Minimum cost **C** MEUR per container; most likely cost **D** MEUR per container; maximum cost **E** MEUR per container; for static value, not mandatory, you can assume the value of D;

- **Fixed costs (per year)**: follows a **discrete** distribution where the probabilities are **30%**, **50%** and **20%** for respectively cost of **F** MEUR per container, **G** MEUR per container and **H** MEUR per container; for static value, not mandatory, you can assume the value of G;

- **Sales (per year)**: follows a **normal** distribution with a mean of **I** containers and a standard deviation of **J** containers. for static value, not mandatory, you can assume the value of I;

1.2 After market research the Company concluded that the **selling price** and **sales** volume could be correlated by the following matrix. Suggestion: use "*define correlation matrix*" menu.

Correlations	Sales	Selling Price
Sales	1	**K**
Selling Price	**K**	1

1.3 You should model an extreme risk event (like a market crash), happening every 10 years, which can diminish the Earnings by 80%. Suggestion: use the "*=@RiskBernoulli"* function (2/20)

1.4 You should consider 3 scenarios with the entry of competitors (1, 2 and 3 competitors). For each competitor incoming, the sales diminish by 10%. (2/20)

Suggestion: use "*=@RiskSimtable*" function.

2. The Net Present Value (NPV) of the investment during the **5 years considered**, is given by the following expression:

year 0	year 1	year 2	year 3	year 4	year 5
Investement	Earnings 1	Earnings 2	Earnings 3	Earnings 4	Earnings 5
Discounted Earnings	Earnings 1 $/(1+r)^1$	Earnings 2 $/(1+r)^2$	Earnings 3 $/(1+r)^3$	Earnings 4 $/(1+r)^4$	Earnings 5 $/(1+r)^5$

Net Present Value	= -Investment + Σ Discounted Earnings

2.1 You should assume a single **Investment in year 0** of **L** MEUR and assume a **discount rate *r*** of **10%.** (4/20)

2.2 to calculate **Earnings for year n=1,…,5**, you should assume that the **yearly earnings can fluctuate** according to the historic raw data at right picture. You should **fit the distribution** which can model better this data. The Earnings formula is given by:

Earnings Year $_{t+1}$ = (*Earnings Year* $_t$) x (*1+Fitted Distribution*)

t = 1,…,4

Year	yearly earnings variation
2012	-1,7%
2013	1,2%
2014	0,3%
2015	-1,1%
2016	2,2%
2017	-0,6%
2018	2,9%
2019	0,5%
2020	-0,4%
2021	1,2%

Questions:

a) Structure the problem, implementing the **Earnings** simulation (2/20);

b) Structure the problem, implementing the **Net Present Value** simulation (6/20);

c) For **Earnings in year 1** and **Net Present Value** simulate and calculate the following statistical measures directly in excel cells. (2/20)

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

Suggestion: use the @Risk functions "=*@riskmean, =@riskstdev, =@rispercentile, =@risk target*"

d) Present the graphs for the **probability density function** for both the **Earnings in year 1** and **Net Present Value** and present the **tornado** charts for **Earnings in year 1** and **Net Present Value**; This should be done for the <u>third</u> scenario from the competitor's entry. Briefly explain the main findings. (2/20)

The groups should follow the following values for the variables (see below):

		GROUPS																			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
uniform	A	4,4	4,3	4,0	4,5	4,4	4,2	4,2	4,2	4,1	4,4	4,2	4,0	4,5	4,4	4,0	4,4	4,5	4,0	4,1	4,5
	B	5,2	5,1	5,0	5,3	5,0	5,5	5,1	5,1	5,4	5,4	5,4	5,4	5,3	5,5	5,1	5,5	5,5	5,4	5,3	5,2
triangular	C	2	2,1	2,1	2,2	2,2	2	2,2	2,5	2,1	2,4	2	2	2,3	2,4	2,5	2,1	2,3	2,4	2	2,5
	D	3,4	3,4	3,4	3,1	3,3	3	3,1	3,2	3,2	3	3,5	3,4	3,2	3	3,1	3,3	3,4	3,1	3,1	3,4
	E	4	4,4	4,3	4,4	4,3	4,5	4	4,1	4,2	4,5	4,3	4,5	4,4	4,2	4,5	4,5	4	4,5	4,5	4,5
discrete	F	366	362	364	374	350	351	375	375	356	354	371	369	375	372	355	375	366	355	363	375
	G	259	209	269	275	262	267	263	261	232	262	214	253	234	253	233	205	261	257	214	201
	H	160	177	174	170	150	176	199	156	200	155	192	192	185	177	159	157	185	177	152	193
normal	I	398	386	412	378	393	423	376	399	382	399	423	375	403	381	395	387	405	380	400	414
	J	42	40	37	37	40	35	35	37	36	36	35	45	45	41	35	45	37	44	43	44
correl.	K	-0,8	-0,74	-0,78	-0,8	-0,7	-0,78	-0,79	-0,78	-0,79	-0,79	-0,73	-0,73	-0,75	-0,72	-0,73	-0,8	-0,79	-0,72	-0,8	-0,73
Investment	L	767	794	777	794	794	779	760	752	761	768	768	758	763	750	796	789	780	792	755	788