

Case study: Using the Monte Carlo method in Excel:

By using simulation and probabilities, the aim is to obtain a decision-making tool to help the manager to make decisions, despite the level of uncertainty in the different variables. In the case of this example, the goal is to estimate and simulate a profit and loss statement by knowing some distributions such as:

1. Unit sales 75,000 (30%) or 10,000 (70%). The average price follows the following distribution:
 - a. 1.5 usd - 25%
 - b. 2 usd - 50%
 - c. 2.5 usd - 25%
2. The cost of units sold follows the following distribution:
 - a. Normal distribution with a mean of 30 and a standard deviation of 5
3. The variable operating cost follows the following distribution:
 - a. Uniform distribution from 10% to 20%
4. Fixed operating costs of 6,000
5. Interest expenses : 3,000
6. Taxes: if EBIT - interest < 20,000, a rate of 35% is applied; otherwise, the rate is 55%.

The solution file for this case includes a sheet with the table of contents, one for parameter settings, the simulation of the profit and loss statement, and finally the risk profile

Table of Contents:

Here we find the Index of the worksheet.

Parameters:

This sheet shows the settings of the variables with the defined distribution. It will be useful for modifying or changing them in order to evaluate different scenarios.

Configuration de Parametros / Settings					
Sales					
		low	most likely		
Acum.Prob.			0,00%	30%	100%
%			30,00%	70%	
Units			75000	10000	0
Acum. Prob. Price			0,00%	25,00%	75,00%
%			25,00%	50,00%	25,00%
Avg. Price			1,5	2	2,5
Cost of goods sold expense					
		media	desv. Est.		
NormDist(U=30; S=5)			30,00	5,00	
Prob. Of COGS Expense %			100%	0%	
Variable Operating expenses					
Sales Volume Driven (VOESVD)		Min	Max		
Uniforme de 10 - 20%			10%	20%	
Sales Revenue Driven (VOESRD)					
Fixed Expenses					
Operating Expenses			6000		
Depreciation Expenses					
Interest expense			3000		
Income tax expense					
breakpoint			0	20000	
			35%	55%	

Simulation of the Profit and Loss Statement

This sheet contains the simulation of the profit and loss statement (n=100), with each record generated from random numbers and the distributions defined in the configuration section. The result will be used to create a histogram and define the risk profile of this case.

Simulation of the Profit and Loss Statement

PyG Sample (Loss&Profit Simulation)																	
Simulation																	
Obs	Unidades(U nits)	Precio(P rice)	Ingresos(Reven ues)	Costo de Unidades Ventidas(Cost of Goods Sold Expense) (%)	Costo de Unidades Ventidas(Cost of Goods Sold Expense) (USD)	Margin Bruto(Gross Margin)	Costo Variable Ventas(Sales Volume Driven) (%)	Costo Variable Ventas(Sales Volume Driven) (USD)	Contribucion Marginal(Cont ribution Margin)	Gasto Fijo de Peración(Fixed Cost Operating Expenses)	Gasto d(Depreciati on(Depreciation on Expenses)	GananciasPerdida Operativas(Operati ng Earnings) (EBIT)	Gasto Interés(In terest Expense)	GananciaPerdida antes de Impuesto(Earning s before income tax) (EBT)	Impuesto (Income Tax Expense) (%)	Impuesto (Income Tax Expense) (USD)	Superavit/D eficit(Net Income)
1	10000	1,5	15.000,00	25,05	3.757,51	11.242,49	14,38	2.156,59	9.085,90	6000	0	3.085,90	3000	85,90	0,35	30,07	\$55,84
2	10000	2	20.000,00	28,59	5.718,72	14.281,28	11,31	2.262,49	12.018,79	6000	0	6.018,79	3000	3.018,79	0,35	1.056,58	\$1.962,22
3	10000	2	20.000,00	29,61	5.921,99	14.078,01	15,23	3.046,98	11.031,03	6000	0	5.031,03	3000	2.031,03	0,35	710,86	\$1.320,17
4	75000	2	150.000,00	35,84	53.754,52	96.245,48	10,62	15.925,47	80.320,01	6000	0	74.320,01	3000	71.320,01	0,55	39.226,00	\$32.094,00
5	10000	2,5	25.000,00	27,31	6.827,72	18.172,28	18,42	4.603,89	13.568,39	6000	0	7.568,39	3000	4.568,39	0,35	1.598,94	\$2.969,45
6	10000	1,5	15.000,00	40,82	6.122,39	8.877,61	10,74	1.611,46	7.266,16	6000	0	1.266,16	3000	-1.733,84	0	0	\$-1.733,84

Summary of the Main Statistics

Statistics Summary	
Min	\$ -1.790,18
Max	\$ 55.839,09
X (Mean)	\$ 11.706,84
desv. Est (Est. Desv.)	\$ 15.690,45
Coef. Var. %(Var. Coef. %)	134,0281135
Rango (Range)	\$ 57.629,27
Conteo de pérdidas (loss count)	15
Conteo de Ganancia (profit count)	85
Nro de clases (# of Class)	10
Longitud del rango (Range interval)	\$ 5.762,93

It can be observed that the average is around 11,000 USD with a high standard deviation (15,000 USD), confirmed by the coefficient of variation of 142%, indicating a high dispersion of the data obtained.

Risk Profile

Below is the snapshot when capturing the surplus/deficit histogram, allowing to determine the probability of the business being profitable or not. Two distinct groups are observed, due to the range of unit sales shown in the case. However, 80% of the cases result in a profitable operation

Perfil de Riesgo Perdida y Ganancia

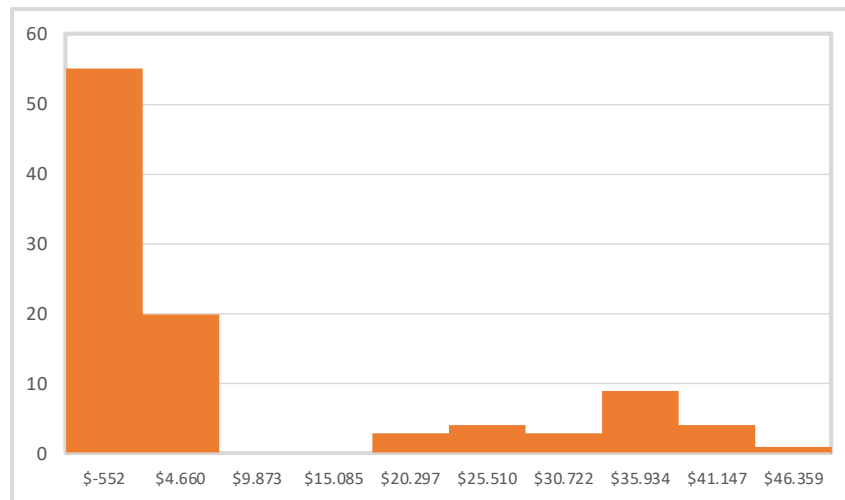


Tabla de Frecuencia (Frequency table)						
	Limite Inf. (Inc.)	Limite Sup. (No Inc)	Marca	Frec. absoluta		
	Low Limit	Upper Limit	Midpoint	Freq. Abs.	%	
1	\$ -3.158,38	\$ 2.053,98	-\$552	55	56%	
2	\$ 2.053,98	\$ 7.266,34	\$4.660	20	20%	
3	\$ 7.266,34	\$ 12.478,70	\$9.873	0	0%	
4	\$ 12.478,70	\$ 17.691,05	\$15.085	0	0%	
5	\$ 17.691,05	\$ 22.903,41	\$20.297	3	3%	
6	\$ 22.903,41	\$ 28.115,77	\$25.510	4	4%	
7	\$ 28.115,77	\$ 33.328,12	\$30.722	3	3%	
8	\$ 33.328,12	\$ 38.540,48	\$35.934	9	9%	
9	\$ 38.540,48	\$ 43.752,84	\$41.147	4	4%	
10	\$ 43.752,84	\$ 48.965,20	\$46.359	1	1%	

Conclusion:

The use of the Monte Carlo method provides us with a straightforward way to obtain a tool for modeling and analyzing complex and stochastic systems. Traditional analytical methods can lead to erroneous decisions or provide partial information in such scenarios. Monte Carlo simulation allows us to assess the impact of uncertainty and variability on results, facilitating the analysis of different scenarios and addressing uncertainties that managers may have, all without incurring in significant costs.

Source: Case taken from the book 'Excel Data Analysis – Modeling and Simulation' by Hector Guerrero.