LISBON SCHOOL OF ECONOMICS & MANAGEMENT
UNIVERSIDADE DE LISBOA

VALUATION AND RISK ANALYSIS

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DECISIONS UNDER RISK AND UNCERTAINTY

RISK

- Unknown outcome in the future which can be attributed to the probability of the event

UNCERTAINTY

- Unknown outcome in the future which can not be attributed to the probability of event

SOURCES OF RISK AND UNCERTAINTY

Development of demand, prices and costs

No. of similar investments

Bias of individuals towards pessimism or optimism, or by factors which should not be considered

Changing economic environment that invalidates the past experience

Misinterpretation of data

Incorrect analysis

Dependence on management skills

Inflexibility of the investment

Asset obsolescence

METHODS FOR ANALYSIS OF RISK AND UNCERTAINTY

INTUITIVE APPROACH

Qualitative/Subjective

Payback period adjusted to risk

Discount rate adjusted to risk

Cash flow adjusted to risk

ANALYTICAL APPROACH

Probabilistic distribution

Decision trees

NPV break even-point

Sensitivity analysis

Scenario analysis

Monte Carlo simulation

Decision theory

NPV BREAK-EVEN

Use **Goal Seek** in EXCEL

SENSITIVITY ANALYSIS

Se **Data Table Analysis** in EXCEL

- One way
- Two ways

SCENARIO ANALYSIS

Scenarios can be based in most varied factors such as:

- Macro-economics (inflation, GDP growth, unemployment, etc.)
- Political (change of government, no change in government policy, etc.)
- Industry based (level of competition, innovation, etc.)
- Company (growth, sales gross margin, restructuring costs and savings, etc.)

See **Tools/Scenarios** in EXCEL

DEVELOPMENT OF SCENARIOS

1) Selection of critical variables

2) Selection of values for the variables in each scenario

3) Calculation of PV for each scenario

4) Analysis of value in each scenario

5) Decide on the asset valuation (or equity valuation) given the value of each scenario. You may attribute probabilities to each scenario and obtain a weighted valuation

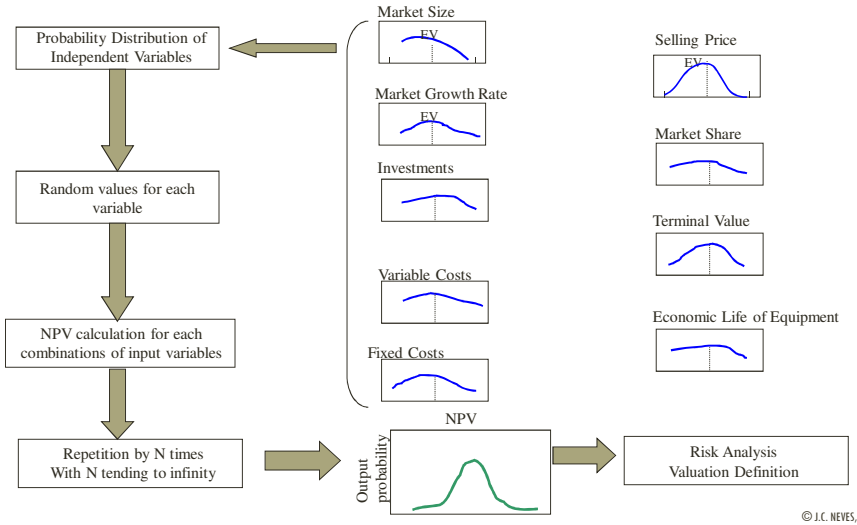
SCENARIO ANALYSIS LIMITATIONS

Scenarios are discrete - Optimistic, Most probable, Pessimistic

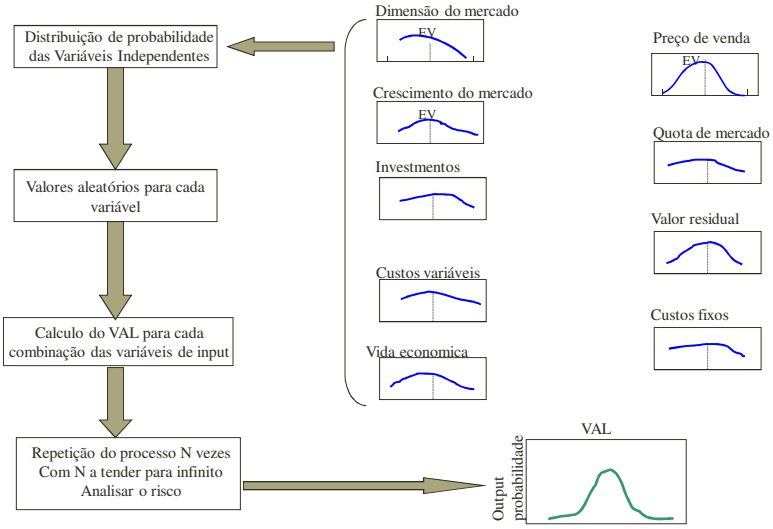
Complexity of analysis grows very quickly with the increase of critical variables (e.g.: 15 variables x 3 scenarios => 45 Expected values)

There is no optimal recommendation on how to use the results

MONTE CARLO SIMULATION



MONTE CARLO SIMULATION DIAGRAM



WHICH DISTRIBUTIONS SHOULD YOU USE?

Standard Crystal Ball® 2000 DECISIONEERING Professional Crystal Ball® 2000

Which distributions should I use?

Selecting a distribution for an assumption is one of the most challenging steps in creating a Crystal Ball model. Crystal Ball has 17 possible discrete and continuous distributions you can use to describe an assumption, including a custom distribution, which can be a combination of continuous and discrete ranges.

- A **continuous** distribution assumes all values in the range are possible, so any range contains an infinite number of possible values. These distributions are smooth, solid curves.
- A **discrete** probability distribution describes distinct, finite, commonly integer values. These distributions look like different-height columns set next to each other.

The first step in selecting a probability distribution is to use any available data. In the absence of data, use your understanding of the physics or conditions of the variable to help select a distribution. Finally, apply reasonable limits to a simple distribution.

Distribution	*Conditions*	*Applications*	*Examples*
Normal	• The mean value is most likely • It is symmetrical about the mean • It is more likely to be close to the mean than far away	Natural phenomena.	People's heights, reproduction rates, inflation
Lognormal	• Upper limit is unlimited but values cannot fall below zero • Distribution is positively skewed, with most values near lower limit • Natural logarithm of the distribution is a normal distribution	Situations where values are positively skewed, but *cannot* be negative.	Real estate prices, stock prices, pay scales, oil reservoir size

WHICH DISTRIBUTIONS SHOULD YOU USE?

Gamma	• The possible occurrences in any unit of measurement is not limited • The occurrences are independent • The average number of occurrences is constant from unit to unit	Applied for physical quantities, such as the time between events when the event process is not completely random.	Demand for expected number of units sold during lead time, meteorological processes (pollutant concentrations)
Logistic	Conditions and parameters are complex. See: Fishman, G. *Springer Series in Operations Research*. NY: Springer-Verlag, 1996.	Describes growth.	Growth of a population as a function of time, some chemical reactions
Pareto	Conditions and parameters are complex. See: Fishman, G. *Springer Series in Operations Research*. NY: Springer-Verlag, 1996.	Analyzes other distributions associated with empirical phenomena.	Investigating distributions associated with city population sizes, size of companies, stock price fluctuations
Extreme Value	Conditions and parameters are complex. See: Castillo, Enrique. *Extreme Value Theory in Engineering*. London: Academic Press, 1988.	Describes largest value of a response over time or the breaking strength of materials.	Largest flood flows, rainfall, and earthquakes, aircraft loads and tolerances
Neg. Binomial	• Number of trials is not fixed • Trials continue to the r th success (trials never less than r) • Probability of success is the same from trial to trial	Models the distribution of the number of trials or failures until the r th successful occurrence.	Number of sales calls before you close 10 orders

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WHICH DISTRIBUTIONS SHOULD YOU USE?

Triangular	• The minimum is fixed • The maximum is fixed • It has a most likely value in this range, which forms a triangle with the minimum and maximum	When you know the minimum, maximum, and most likely values, *popular for when you have limited data.*	Sales estimates, number of cars sold in a week, inventory numbers, marketing costs
Uniform	• Minimum is fixed • Maximum is fixed • All values in range are equally likely to occur	When you know the range and all possible values are equally likely.	A real estate appraisal, leak on a pipeline
Custom	• Very flexible distribution, used to represent a situation you cannot describe with other distribution types • Can be either continuous or discrete or a combination of both • Used to input an entire set of data points from a range of cells		
Less commonly used distributions are listed below and on the back side of the card.			
Binomial	• For each trial, only 2 outcomes are possible; usually, success or failure • The trials are independent • The probability is the same from trial to trial	Describes the number of times an event occurs in a fixed number of trials, also used for Boolean logic (true/false or on/off).	Number of heads in 10 flips of a coin, likelihood of success or failure
Poisson	• Number of possible occurrences is not limited • Occurrences are independent • Average number of occurrences is the same from unit to unit	Describes the number of times an event occurs in a given interval (usually time).	Number of telephone calls per minute, number of defects per 100 square yards of material

WHICH DISTRIBUTIONS SHOULD YOU USE?

DECISIONEERING

 Exponential	• The distribution describes the time between occurrences • Distribution is not affected by previous events	Describes events that recur randomly.	Time between incoming phone calls, time between customer arrivals
 Geometric	• Number of trials is not fixed • Trials continue until the first success • Probability of success is the same from trial to trial	Describes the number of trials until the first successful occurrence.	Number of times you spin a roulette wheel before you win, how many wells to drill before you hit oil
 Hypergeometric	• Total number of items (population) is fixed • Sample size (number of trials) is a portion of the population • Probability of success changes after each trial	Describes the number of times an event occurs in a fixed number of trials, but trials are dependent on previous results.	Chance of a picked part being defective when selected from a box (without replacing picked parts to the box for the next trial)
 Weibull	This flexible distribution can assume the properties of other distributions. When shape parameters equal 1, it is identical to Exponential. When equal to 2, it is identical to the Rayleigh.	Fatigue and failure tests or other physical quantities.	Failure time in a reliability study, breaking strength of a material in a control test
 Beta	• Range is between 0 and a positive value • Shape can be specified with two positive values, alpha and beta	Represents variability over a fixed range, describes empirical data.	Representing the reliability of a company's devices