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Monte Carlo Risk Analysis Summary

The full results of the analysis are supplied as an Excel worksheet. Parts of these results are summarized at the end of this report. First a few notes about probability (*P*) and the notation used in these reports. Rather than pile mathematical proof on the reader, I have offered some basic intuitive results of that formulation below.

1. If a process has a probability of P = 1.00, then the process will **certainly** occur.
2. If a process has a probability P = 0.00, then the process will **never** occur.
3. Any probability between 0.00 and 1.00 is a direct measure of the likelihood that the process will occur.
4. If P is the probability that a particular process will occur, then (1.00 – P) is the probability that the same process will not occur.

The first three statements are a result of the definition of probability. The fourth statement is a logical extension of the mathematics. In order to simplify the above notation for non-statisticians, we will always express probability as a percentage. Therefore P = 1.00 = 100% for an event that will certainly occur and P = 0.00 = 0.00% for an event that will never occur.

Therefore, the following notation has the meaning "There is a 57.22% Probability that the *Before Tax Net Profit in Year 4* will be at least $31,821,623."

P {BT Net Pr Yr 4 ≥ $31,821,623} = 57.22%

Thirty-three of these Probabilities are automatically calculated for each scenario run. They include three values for the BT Net Profit for each year, AT Cash Flow for each year and the Profitability Index. These three values are:
- The first calculated probability below 90.00%,
- The first calculated probability below 60.00%, and
- The first calculated probability below 50.00%.

Therefore, it is sometimes possible, based on the shape of the distribution functions for two of these calculated values to be identical.

Other definitions used in the data tables at the end of this summary are defined later. However, we first need to briefly discuss the Monte Carlo Risk Analysis Process illustrated by the Figure on the next page.

The first item we must have to utilize Monte Carlo Risk Analysis is a mathematical model that takes our input and provides an answer. Historically, we have a business plan and our mathematical model is the pro forma. In the past we have selected "our best" values for input to the pro forma and then calculated such parameters as the Before Tax Net Profit, After Tax Cash Flow, and the Profitability Index. Since we used carefully selected best values we always considered our pro forma to provide the "best" answers.

In the Monte Carlo Process, we first acknowledge that our input parameters for the pro forma not only have "best," or Most Likely values, but they also have uncertainty. Rather than ignore these facts, the Monte Carlo process uses this information and creates distribution functions to *realistically* represent all input values for the parameters in the pro forma. The Monte Carlo process then takes these representative distribution functions and uses a statistical sampling process to calculate a *collection* of answers for our mathematical model. We then sort this collection of "answers" into a form of a distribution function called a histogram. The key advantage of this process is that the form of the distribution of

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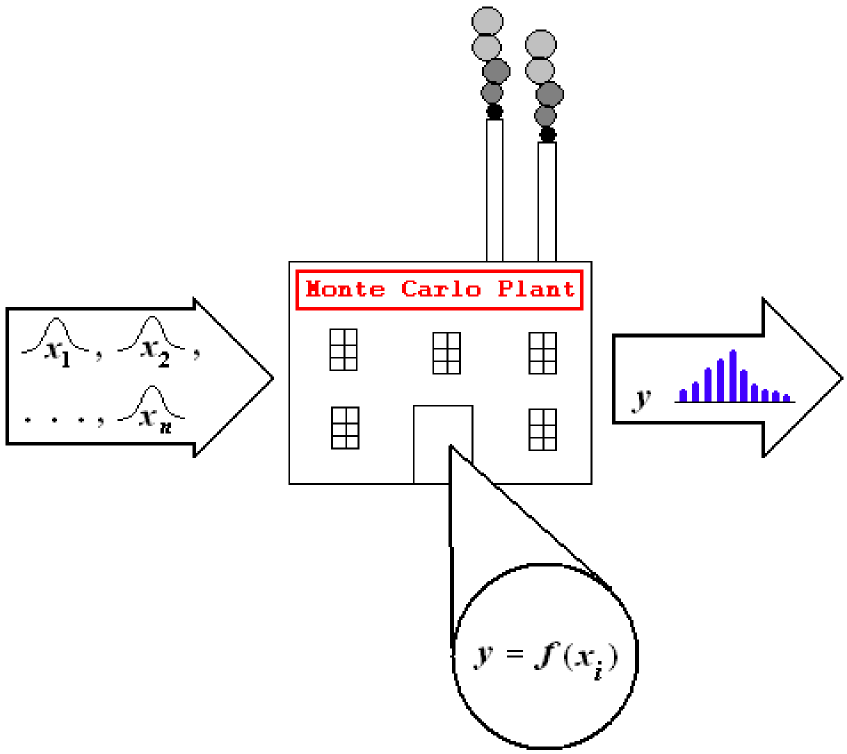
"calculated" answers is determined by the created realistic distribution functions of all of the inputs. Now we will relate this brief discussion to the Monte Carlo Engine schematic on the next page.

The heart of the Monte Carlo "Plant" is the equation, or mathematical model, that is used in our pro forma. The large arrow on the left-hand side of the Figure represents the input values (x_1, x_2, …x_n) for the mathematical model. It should be noted once again that these input values are actually represented by realistic distribution functions that contain errors and not just single values. The large arrow on the right-hand side of the Figure represents the collection of "answers" calculated by the Monte Carlo engine. This collection is finally mathematically transformed into a discrete distribution function that allows us to obtain the probabilities that certain levels of performance will be obtained in the future. Hence we have quantified the risk (or probability) of the project obtaining certain performance levels.



Other definitions used in our results are summarized below.

- *Mean* – this is the mathematical average of the results of all iterations in the Monte Carlo simulation (usually 50,000 iterations per scenario.
- *Most Likely* – this is the mid-point value of the Monte Carlo "bin" that contains the most results. Its value is very near the value that is the most likely.
- *99%*$_{min}$ – this is the lower boundary for the range for values that contain 99% of all calculated values. This can also be stated as either *99.5% of the calculated values lie above this value*, or *the middle 99% of all calculated values lie between the 99%*$_{min}$ *and 99%*$_{max}$ *values*.
- *99%*$_{max}$ – this is the upper boundary for the range of values that contain 99% of all calculated values. This can also be stated as either *99.5% of the calculated values lie below this value*, or *the middle 99% of all calculated values lie between the 99%*$_{min}$ *and 99%*$_{max}$ *values.*

The Excel Output worksheet contains all information on this sheet plus the raw data so Probabilities can be determined other than the ones less than 90%, 60% and 50% that are shown in the output tables below.

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Company: Technical Evaluations & Brokers, Inc.
Project ID: ABC Manufacturing Scenario 1
Date Stamp: April 1, 2003
Time Stamp: 13:11

Data for Before Tax Net Profit

Year (*n*)	*n* = 1	*n* = 2	*n* = 3	*n* = 4	*n* = 5
P{BT Net Pr Yr *n* ≥ X_1}	47.28%	47.77%	48.64%	49.29%	49.40%
X_1	-11,687,780	8,999,191	21,675,745	33,684,991	34,967,636
P{ BT Net Pr Yr *n* ≥ X_2 }	58.95%	57.66%	58.07%	57.22%	57.57%
X_2	-12,111,892	7,985,720	20,225,956	31,821,623	33,047,075
P{ BT Net Pr Yr *n* ≥ X_3}	86.26%	88.46%	85.84%	87.22%	89.12%
X_3	-13,384,228	3,931,833	14,426,799	22,504,780	21,523,707
Mean BT Net Pr Yr *n*	-11,574,203	9,197,325	22,118,511	34,282,573	35,579,719
Most Likely BT Net Pr Yr *n*	-11,687,780	10,012,663	21,675,745	33,684,991	34,967,636
(99% BT Net Pr Yr *n*)$_{min}$	-16,353,012	-4,175,939	-71,095	3,871,096	2,318,095
(99% BT Net Pr Yr *n*)$_{max}$	-7,870,772	20,147,379	41,972,796	61,635,518	65,696,616

Data for Cumulative After Tax Cash Flow

Year (*n*)	*n* = 1	*n* = 2	*n* = 3	*n* = 4	*n* = 5
P{AT Cash Flow Yr *n* ≥ X_1}	47.51%	46.78%	47.49%	45.65%	42.33%
X_1	5,440,606	7,925,065	10,535,931	14,436,398	16,865,953
P{AT Cash Flow Yr *n* ≥ X_2 }	59.94%	57.43%	47.49%	56.53%	51.91%
X_2	4,688,594	6,735,803	10,535,931	12,233,497	14,330,844
P{AT Cash Flow Yr *n* ≥ X_3}	88.04%	88.40%	88.64%	89.83%	89.85%
X_3	2,432,559	1,978,756	3,949,545	3,421,894	1,655,301
Mean AT Cash Flow Yr *n*	5,650,793	7,862,391	10,985,946	14,590,821	16,034,945
Most Likely AT Cash Flow Yr *n*	5,440,606	7,925,065	10,535,931	12,233,497	14,330,844
(99% AT Cash Flow Yr *n*)$_{min}$	-2,079,511	-6,346,076	-5,930,035	-9,795,510	-13,555,351
(99% AT Cash Flow Yr *n*)$_{max}$	12,208,711	18,628,421	25,355,301	34,262,504	44,752,149

Data for Profitability Index

P{Prof. Index ≥ X_1}	49.52%
X_1	1.46199
P{Prof. Index ≥ X_2 }	49.52%
X_2	1.46199
P{Prof. Index ≥ X_3}	85.26%
X_3	0.75070
Mean Prof. Index	1.57132
Most Likely Prof. Index	1.69909
(99% Prof. Index)$_{min}$	-0.43479
(99% Prof. Index)$_{max}$	3.35877