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FINANCIAL RISK EVALUATION BY THE "TREE OF PROBABILITY DECISIONS" METHOD

Mariya Bruseva
Varna Free University, Bulgaria
mariya.bruseva@gmail.com

Abstract:
Any enterprise activity is inextricably linked to the concept of 'risk'. Risk assessment - this is a risk degree calculation by qualitative or quantitative methods. Risk analysis can be divided into two complementary types: qualitative and quantitative. Quantitative analysis should allow for numerical determination of the individual risks and risks of the enterprise as a whole. In the work the model of the 'Tree of probability Decisions' method is presented theoretically and its application in calculating the net present value (NPV) and the internal rate of return (IRR), for which calculations are given the results of the financial functions use of MS Excel. The use of the 'Tree of probability Decisions' method allows investment projects to be evaluated in their dynamic aspect. The use of MS Excel for these calculations makes risk assessment easy and accessible as well supporting decisions in the investment process.

Keywords: method 'Tree of probability Decisions', risk assessment, net present value, internal rate of return, MS Excel.

1. INTRODUCTION

Any enterprise activity is inextricably linked to the concept of 'risk'. Depending on the specifics of their business, market and political conditions, as well as the business enterprise strategy development is facing with various types of risk. The reasons for the various risks can be economic crises, natural disasters, computer viruses and other phenomena and events that may lead to failure to achieve business goals. However, risks can be managed similarly as processes of production. For the successful existence of the enterprise, the developer must be committed to implement technical innovations to take bold, non-trivial action, which naturally increases the risk. Therefore it is necessary to correctly assess the risk degree and its management, which as result will lead to more efficient market outcomes. Making business without risk is impossible - or no profit which the shareholders require will be possible considering that the enterprise satisfaction of their level of profit on their capital.

2. ANALYSIS AND RISK ASSESSMENT

Risk analysis - these are the procedures of identification of risk factors and assessing their significance, analysis of the possibilities of undesirable events which can negatively affect the project objectives achievement. Risk analysis includes risk assessment and risk reducing methods or reducing the associated adverse effects. *Risk assessment* - this is a risk degree calculation by qualitative or quantitative methods.

Modelling is effectively used in the risk analysis. The same allows the study the dynamics of the external and internal environment of the enterprise, the replication of the actions of various factors and conditions of the economic environment, the study of the effectiveness of alternatives to the project, identification of possible errors and respective corrections without causing actual material losses.

General principles of risk analysis are: complete coverage of the particular area, enterprise strategy consideration, "time" factor consideration, received information reliability, effectiveness of the used methods for risk identification.

3. METHODS OF RISK ANALYSIS

Risk analysis can be divided into two complementary types: qualitative and quantitative. Qualitative aims to identify factors causing risk, areas of appearance and the types of risk. The final results of the qualitative risk analysis are used as input information to perform a quantitative analysis. Quantitative analysis should allow for numerical determination of the individual risks and risks of the enterprise as a whole. The quantitative risk assessment implementation is difficult due to the fact that this evaluation needs respective initial information (Slavov & Donchev, 2009).

4. QUANTITATIVE RISK DETERMINATION

Many and various methods of risk quantifying are used in the world practice of financial management. The most popular are as follows:

- Method of discount rate correction,
- Equivalents credibility method,
- Sensitivity analysis (the base is to analyze the sensitivity of the effectiveness criteria - PP, NPV, IRR, IP),

- Method of scenarios,
- Payment flow probability distributions analysis,
- Method “Tree of probability Decisions”,
- Monte Carlo simulation.

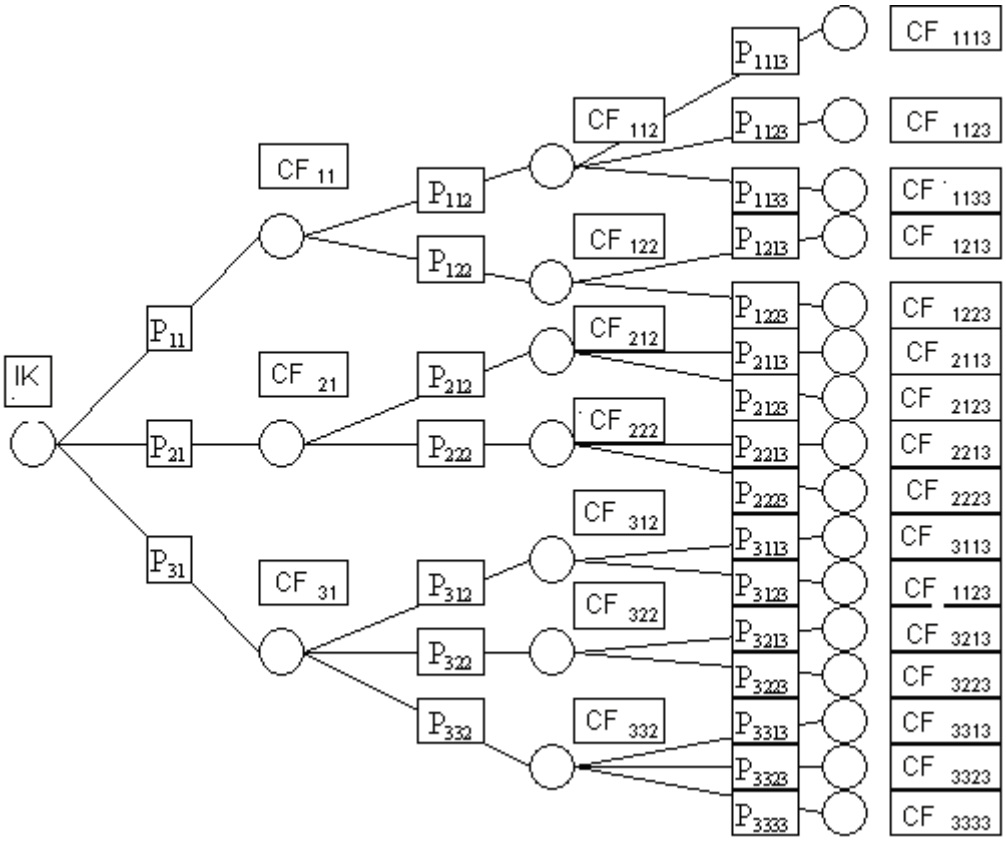
5. MS EXCEL – TREE OF PROBABILITY DECISIONS

The meaning of this method - any further decision is to be taken depending of the success or failure of previous, while the first decision to be taken depending on the expectations of the results of subsequent decisions. The tree of possible Decisions is a graphical representation of the coordinated in time possible calculations of cash flows and their representation by decision makers through schematic representation of the problem in stating all possible cash drains. Moreover, calculations and results are presented directly on the decision tree in order that information can be easily understood. The ‘Tree of probability Decisions’ method is closely related with simulation methods and supplements the same.

In the presented work the model of the ‘Tree of probability Decisions’ method is presented theoretically and its application in calculating the net present value (NPV) and the internal rate of return (IRR), for which calculations are given the results of the financial functions use of MS Excel. Illustration of the application of the ‘Tree of probability Decisions’ is shown in Figure 1.

Graphical representation of the tree is the first step. Construct a graph of initial investment and possible cash flows in the first year, also plotting and estimate probabilities of their achievement. The second step is continuation of the download of branches in a similar way so that each of the possible cash flows in each of the years is presented with a new branch, marked respectively with probability and value. These cash flows and related probabilities are known as conditional, since each subsequent year, they occur in the occurrence of the events in previous years. If we look at Fig. 1 it conditional cash flow CF_{3313} will occur with a conditional probability P_{3313} in the third year if in the second year occurred cash flow CF_{332} with a conditional probability P_{332}, precisely consequently of the conditional cash flow CF_{31}, with a probability of the first year P_{31}.

Figure 1: Graphical representation of the tree



Source: Bruseva, 2010, p. 104.

The product of all probabilities along the branch (in this case $P_{31} * P_{332} * P_{3313}$) is called total probability. While using the 'Tree of probability Decisions' the financial manager considering the expected net present value (NPV) for the investment, by the possible streams arrangements and with the respective list of the associated probabilities. Making decision by the 'Tree of probability Decisions' is not just acceptance of any project with a net present value greater than zero, as the required by the project net present value is still not suitable for risk. As a result, the financial decision-maker is to determine the full distribution of NPV and then, based on the examination to decide whether or not to accept the risk, considering that this distribution is enough to make the necessary conclusions that the net present value is positive and the project can be considered. The calculation of the expected net present value and its distribution is helping to the financial manager in the process of risk accounting (Bruseva, 2010).

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Example 1: Let a proposed investment that requires an initial cash investment 200 000 EUR and will create cash flows for the following three years, respectively during each of the three years there are three possible cash flow as shown in Table 1.

Solution: Building the tree of possible decisions in a table shape by the program MS Excel. For this example is to calculate the expected net present value of the project, by using the appropriate formula, with the rate – 5 %, 6 %, 7 % and 7.5 %. The obtained result shows that the total expected NPV (Smirnova E., Technique financial calculations on ExcelRussia, St. Petersburg, 2003) for the project at an interest rate: 5 % = 8,005.84 EUR, 6 % is EUR = 3508.82, 7 % = 330.23 EUR and 7.5 % = -1707.41 EUR.

Table 1: Scheme for Example 1

Initial cash investment	First Year		Second Year		Third Year	
	Probability	Cash flow	Probability	Cash flow	Probability	Cash flow
					30%	50000
			20%	50000	40%	80000
					30%	120000
					35%	40000
	30%	50000	45%	75000	30%	80000
					35%	110000
					85%	60000
			35%	100000	10%	75000
					5%	90000
					10%	50000
			10%	60000	70%	60000
					20%	70000
					40%	50000
-200000	50%	75000	50%	75000	40%	75000
					20%	100000
					50%	55000
			40%	90000	40%	80000
					10%	105000
					80%	90000
			80%	90000	10%	105000
					10%	100000
					30%	70000
	20%	100000	15%	95000	40%	90000
					30%	95000
					90%	80000
			5%	100000	8%	90000
					2%	100000

Source: Slavov & Donchev, 2009; Bruseva, 2011, p. 245.

The results are shown in Figure 2. From them we can see that if the investor is satisfied with the interest of not less than 7 %, this investment is worth (at an interest rate above 7 % obtained negative NPV).

Figure 2: Calculating NPV with MS Excel for Example 1

Related probability $P_{св}$	Net Present Value (NPV) at an interest rate 5%	NPV * Pсв	Net Present Value (NPV) at an interest rate 6%	NPV * Pсв	Net Present Value (NPV) at an interest rate 7%	NPV * Pсв	Net Present Value (NPV) at an interest rate 7,5%	NPV * Pсв
0,02	-63 837,60	-1 149,08	-62 593,78	-1 126,69	-64 284,30	-1 157,12	-65 091,83	-1 171,65
0,02	-37 922,47	-910,14	-38 830,97	-931,94	-41 397,44	-993,54	-42 627,81	-1 023,07
0,02	-3 368,97	-60,64	-7 147,22	-128,65	-10 881,63	-195,87	-12 675,79	-228,16
0,05	-49 800,24	-2 353,06	-49 524,23	-2 340,02	-51 505,80	-2 433,65	-52 455,82	-2 478,54
0,04	-15 246,73	-617,49	-17 840,48	-722,54	-20 989,99	-850,09	-22 503,80	-911,40
0,05	10 668,39	504,08	5 922,33	279,83	1 896,86	89,63	-39,78	-1,88
0,09	-9 847,75	-878,91	-12 691,88	-1 132,75	-15 840,45	-1 413,76	-17 355,79	-1 549,00
0,01	3 109,82	32,65	-810,47	-8,51	-4 397,02	-46,17	-6 123,78	-64,30
0,01	16 067,38	84,35	11 070,93	58,12	7 046,41	36,99	5 108,22	26,82
0,01	-30 957,78	-154,79	-31 947,67	-159,74	-34 285,35	-171,43	-35 408,91	-177,04
0,04	-22 319,40	-781,18	-24 026,74	-840,94	-26 656,40	-932,97	-27 920,90	-977,23
0,01	-13 681,03	-136,81	-16 105,80	-161,06	-19 027,45	-190,27	-20 432,89	-204,33
0,10	-17 352,34	-1 735,23	-19 353,38	-1 935,34	-22 040,88	-2 204,09	-23 334,50	-2 333,45
0,10	4 243,60	424,36	448,96	44,90	448,96	44,90	-4 614,48	-461,45
0,05	25 839,54	1 291,98	20 251,30	1 012,57	16 103,88	805,19	14 105,53	705,28
0,10	545,04	54,50	-2 798,63	-279,86	-5 981,94	-598,19	-7 516,09	-751,61
0,08	34 912,41	2 792,99	17 003,72	1 360,30	13 090,44	1 047,24	11 203,93	896,31
0,02	41 680,16	833,60	36 806,06	736,12	32 162,82	643,26	29 923,94	598,48
0,13	52 015,36	6 657,97	47 174,56	6 038,34	42 555,36	5 447,09	40 325,25	5 161,63
0,02	64 355,90	1 029,69	59 055,97	944,90	53 998,79	863,98	51 557,26	824,92
0,02	60 242,39	963,88	55 095,50	881,53	50 184,32	802,95	47 813,25	765,01
0,01	39 880,50	358,92	35 530,79	319,78	31 378,95	282,41	29 374,04	264,37
0,01	56 334,55	676,01	51 372,66	616,47	46 636,85	559,64	44 350,05	532,20
0,01	60 448,06	544,03	55 333,13	498,00	50 451,33	454,06	48 094,05	432,85
0,01	52 426,72	471,84	47 649,82	428,85	43 089,39	387,80	40 886,85	367,98
0,00	60 653,74	48,52	55 570,76	44,46	50 718,34	40,57	48 374,85	38,70
0,00	68 880,76	13,78	63 491,69	12,70	58 347,29	11,67	55 862,86	11,17
	Total expected NPV for the project at an interest rate 5% in EUR	**8 005,84**	**Total expected NPV for the project at an interest rate 6% in EUR**	**3 508,82**	**Total expected NPV for the project at an interest rate 7% in EUR**	**330,23**	**Total expected NPV for the project at an interest rate 7,5% in EUR**	**-1 707,41**

Source: Slavov & Donchev, 2009; Bruseva, 2011, p. 246.

In order to confirm the result obtained with the program MS Excel is calculated also the expected internal rate of return, which confirms the results of the initial calculations. In these calculations, MS Excel gives as result for a internal rate of return over the project which should be susceptible IRR value = 6.78 % (Figure 3)

Figure 3: Calculating IRR with MS Excel for Example 1

Branches of 'Tree of probability Decisions'	Initial cash investment	Cash flow			Related Probability Pсв	Internal Rate of Return - IRR	IRR*Pсв
		First Year	Second Year	Third Year			
1 branch	-200000	50000	50000	50000	1,80%	-13,11%	-0,24%
2 branch	-200000	50000	50000	80000	2,40%	-4,71%	-0,11%
3 branch	-200000	50000	50000	120000	1,80%	4,22%	0,08%
4 branch	-200000	50000	75000	40000	4,73%	-9,32%	-0,44%
5 branch	-200000	50000	75000	80000	4,05%	1,16%	0,05%
6 branch	-200000	50000	75000	110000	4,73%	7,49%	0,35%
7 branch	-200000	50000	100000	60000	8,93%	2,42%	0,22%
8 branch	-200000	50000	100000	75000	1,05%	5,78%	0,06%
9 branch	-200000	50000	100000	90000	0,53%	8,88%	0,05%
10 branch	-200000	75000	60000	50000	0,50%	-4,07%	-0,02%
11 branch	-200000	75000	60000	60000	3,50%	-1,30%	-0,05%
12 branch	-200000	75000	60000	70000	1,00%	1,26%	0,01%
13 branch	-200000	75000	75000	50000	10,00%	0,00%	0,00%
14 branch	-200000	75000	75000	75000	10,00%	6,13%	0,61%
15 branch	-200000	75000	75000	100000	5,00%	11,43%	0,57%
16 branch	-200000	75000	90000	55000	10,00%	5,16%	0,52%
17 branch	-200000	75000	90000	80000	8,00%	10,75%	0,86%
18 branch	-200000	75000	90000	105000	2,00%	15,66%	0,31%
19 branch	-200000	100000	90000	90000	12,80%	19,32%	2,47%
20 branch	-200000	100000	90000	105000	1,60%	22,08%	0,35%
21 branch	-200000	100000	90000	100000	1,60%	21,18%	0,34%
22 branch	-200000	100000	95000	70000	0,90%	16,53%	0,15%
23 branch	-200000	100000	95000	90000	1,20%	20,45%	0,25%
24 branch	-200000	100000	95000	95000	0,90%	21,38%	0,19%
25 branch	-200000	100000	100000	80000	0,90%	19,69%	0,18%
26 branch	-200000	100000	100000	90000	0,08%	21,57%	0,02%
27 branch	-200000	100000	100000	100000	0,02%	23,38%	0,00%
						Expected IRR of the project – $IRR_{project}$	**6,78%**

Source: Slavov & Donchev, 2009; Bruseva, 2011, p. 247.

6. CONCLUSION

The use of the 'Tree of probability Decisions' method allows investment projects to be evaluated in their dynamic aspect. In many cases, future Decisions are influenced by the present actions. Too often decisions are made without taking into account their long-term effects. As a result, Decisions that initially appear logical may make decision makers in a disadvantageous position in terms of future opportunities. For those solutions where the examination of the sequence of Decisions is important and where the possibility of the occurrence of future events are known, use the method 'Tree of probability Decisions' or the so called flow chart is very effective. The use of MS Excel for these calculations makes risk assessment easy and accessible as well supporting decisions in the investment process.

REFERENCE LIST

1. Bruseva, M. (2010). *Risk management*, Varna: VFU.
2. McCarthy, M. P. & Flynn, T. P. (2005). *Risk From the CEO and Board Perspective*.
3. Paskal, K. (2007). *Analysis of efficiency of investment method CROCI - experience of leading companies*. Tops.
4. Slavov, Z. & Donchev, D. (2009). *Methods for measurement of investment risk*. Scientific almanac, VFU, book 7.
5. Smirnova, E. (2003). *Technique financial calculations on ExcelRussia*. St. Petersburg. Retrieved from http://www.cfin.ru/finanalysis/smirnova/
6. *Управление рисками, риск-менеджмент на предприятии* (2011, February 15). Retrieved from http://www.risk24.ru/
7. *Financial risk* (2011, February 15). Investopedia. Retrieved from http://www.investopedia.com/terms/f/financialrisk.asp