Application of Management based on Mathematical Models to Solve Investment Strategy Problems

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Abstract: - This article analyzes the emergence of large investment opportunities for the development of different areas of the economy in the context of political and economic changes in a competitive environment of the market economy and its relevance shows itself in the underdevelopment of risk analysis and its experimental methodology with the need to improve quality of investment activity, as well as project decision making, the contradictions between the possibility and impossibility of achieving the planned outcome and application of management based on mathematical models to solve investment strategy problems of firms and companies in this field. Application of management based on mathematical models to solve investment strategy problems, development and intensification of risk analysis theory and specification of strategy for purpose, the introduction of practice to the process of making investment decisions and efficient recommendations were developed and ways to reach the goals were designated for all the activities and measures taken in this direction. The action process is established based on the solution of made decisions and proved its compatibility with the pre-defined trajectory based on strategic opinions and occurrence time of the existing and principally indefinite, mentioned relevant events, the efficiency of application of management based on mathematical models to solve investment strategy problems. Analysis methods have been establishetod to apply management based on mathematical models to solve relevant problems in the market economy and suggestions and recommendations for its practical usage in investment-project activity have proved that economic-mathematical models are efficient tools.

Key-Words: - financial category of risk, risk capital investment, management strategy, risk management strategy, classification of mathematical models of forecasting.

Received: August 17, 2021. Revised: March 15, 2022. Accepted: April 18, 2022. Published: May 6, 2022.

1 Introduction

It should be taken into account in the investment strategy that the presence of risk assumes the accuracy of one of the possible options, therefore, all the possible alternatives should be analyzed in their acceptance process, so that it is possible to choose the most efficient and risk-free one. Application of management based on mathematical models to solve investment strategy problems, the specific content of risk situations, and related alternatives have a different range of challenges and are solved in different ways and with the help of different tools. Based on investment and relevant experience, the application of management based on mathematical models is possible to solve investment strategy problems. The optimal volume of demand

should be considered in any and other complex production issues, for example, investment requires the usage of special tools and risk analysis methods. In this regard, the operation of the complex probability analysis investigated with the model, i.e. notwithstanding negative outcome or loss, any and other risks are considered the last special (engine of development) outcome of the project and possible profitable source in the end.

Calculation within the framework of the project is made with economic-mathematical methods and models develop performing application of management based on mathematical models to solve investment strategy problems. it can be defined as an important tool in making decisions under uncertain conditions. The main attention should be directed to the application factors of management based on mathematical models to solve investment strategy problems while conducting relevant applied research based on analysis. Furthermore, all of their sets are structured by conditionally controlled and uncontrolled sets.

Thus, the main point at this stage is the plication of management based mathematical models to solve investment strategy problems, choosing a special tool based on objective criteria and as we can see it plays an important role in rational decision making under uncertain conditions.

2 Using Relevant Management Based on Mathematical Models to Solve Strategic Problems

The financial category of risk has already been proved and therefore, the level and scale of risk can be impacted by financial mechanis. We cannot forget that the process is conducted with the help of financial management and key strategy methods. Strategy and tactics together create special management mechanism of risk and it is risk management.

Management strategy comprises of usage methods and direction of means in reaching the set target and tactics is specific method and way to achieve the goal set in the specific conditions. Choosing the most relevant and optimal solution among management methods and ways in specific economic situation is the goal of the management tactics. [1. P. 396].

In this regard, the following rules are used in risk management strategy:

- appropriation limit;
- probability of optimal outcome;
- optimal variable of the outcome;
- optimal compatibility of efficiency and risk magnitude.

The essence of appropriation limit rule is for investor to choose an option that ensures efficient outcome (revenue) with minimum risk among possible options of risk capital investment. Optimal compatibility rule of the magnitude of appropriation and risk is that the manager evaluates the projected volume of benefit and risk (damage, loss) and can make a decision about making the capital investment to the firm or company which enables him to get the projected benefit and at the same time to avoid big risks. [2. P. 103].

The rule for making risk capital investment decision is completed with the selection methods of solution options:

Method 1. Selection of solution, in case the probability of possible economic situations is known;

Method 2. Selection of the relevant solution option, on the condition that the probability of possible economic situations is not known, but they have relative prices;

Method 3. Selection of the solution option, on the condition that the probability of possible economic situations is not known, but the main directions of the result rates of capital investment are known;

The permanent management system can happen in the condition of circulation of relevant information through management channels and it consists of the acquisition, development, and usage of the information [7.p.129]. In this regard, information acquisition that is accurate, reliable, and sufficient in the given conditions plays an important role in the specific decision-making process in risk management.

We need to consider that risk management function has two types:

- functions of management facility;
- functions of management entity.

In this regard, functions of the management facility shall comprise of the following:

- risk solution;
- risk capital investment;
- works on risk level reduction;
- risk insurance process;
- economic relationships and connections with the processes between economic entities.

Entity functions shall include:

- forecasting;

- organization;
- management;
- coordination;
- stimulation;
- control;

It should be remembered that forecasting is the ability to foresee the event within the certain time frame and is one of the main functions of risk management. [8.p. 63]. At the same time, forecasting features having alternative in the establishment of financial indicators and parameters. It defines different development options of management facility's financial position according to pre-established tendencies.

Several mathematical methods, which are based on the analysis of the relevant series (in this case, it means the set of discrete observations) and fixed in a time-consistent manner are widely used in forecasting process. The main purpose of statistical analysis of time series is to learn about compatibility between regularities and details in formation of series' values and in forecasting with the extension of the credible interval. [3. P.239].

According to regularities that explain the dynamics of the previous indicators, it is used in forecasting of the future value; coincident relevance of accounting allows to define the probability of deviation from the regularity and its possible volume. The formation of series' values should be determined by 3 main types of regularity:

- inertia of tendencies;
- inertia of the interconnection between consecutive series' values;
- under research;
- inertia of the connection between the indicator and the factors that affect it.

Based on this situation, there are following issues in analysis and modelling:

- trends;
- interconnectivity between consecutive series' values;
- causal connection between the indicator under study and the factor indicators.

It was proposed that the first problem be solved with modelling of growth curves, the second with the adaptive methods and the third with econometric methods.

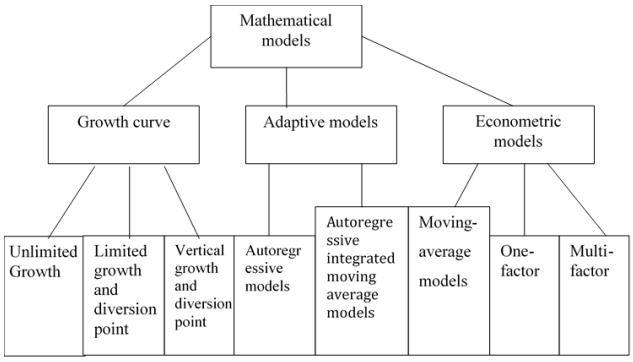

Fig. 1: Classification of mathematical models of forecasting

Growth curves are mathematical functions used in in the analytical equation of time series. Growth curves are frequently used in practical works and processes; there are three main types of growth curves, these are unlimited growth, limited growth with bend point, and limited growth with bend point [9. p.69]. It should be remembered that there are functions that describe unlimited growth processes. These are linear, quadratic, power, exponential, genetic curve, first and second degree linear-logarithmic functions.

The foundation of this type of development processes comprises of linear-logarithmic functions of volume indicators. The foundation of this type of development processes is characteristic to volume indicators but they also frequently comply with the development of the relative indicators.

It is rather rational to use Johnson graph and modified practice in order to describe limited growth indicators which characterize many relative indicators. Rational curves characteristic to the demand of some new commodities can be used to describe limited growth procedures with bend point.

Parameters of growth curves are evaluated with least-squares method, i.e. they are chosen in a way that graph of growth curve function is located from the given points in a minimum distance. According to least-squares method, all observations are considered in the same value in the evaluation process of model parameters, i.e. their information value is considered the same but development tendencies remain the same in all observation areas [10. P. 130].

Changes in growth curve tendencies can be recorded, therefore, outdated tendencies are frequently used as applicable during forecasting.

Unlike growth curve models, while evaluating the parameters of adaptive models they are given different values depending on the impact of observations to the current rates. This is observed in all changes and regularities occurring in tendencies and allows to consider any changes.

All adaptive models are based on two layouts:

- moving average;
- auto regression.

According to the layout of moving average, rate of the current observation is the center of all the previous observations' values, and it should be noted that the values are getting lower as they get far away from the last observation, i.e. the value of observational information increases with their proximity to the last interval of observations [11. P. 193]. The main models of moving average are considered Holt's and Brown's models (zero, first and second order), the latter is the special scenario case of the former. First-order Holt model is as follows:

$$Y_P(t_1 k) = A_0 + A_1(t)k$$

Where $A_0(t)$ - current growth rate;
Yp(t1k) – current observation rate;
$A_1(t)$ - current growth;
k - number of steps-ahead.

Then, their separation level is defined and model parameters are modified as applicable:

$$A_0(t) = A_0(t-1) + A_1(t-1) + \alpha_1(t),$$
$$\boldsymbol{A_1(t) = A_1(t-1) + \alpha_1\alpha_2 e(t),}$$

Where: $\alpha_1\alpha_2$ - adaptation coefficient that varies between 0 and 1.

Parameters are calculated consecutively and their last observation value defines the final outline of the model. Starting values of the parameters are evaluated with the least-squares method based on several primary observations of series. [12. p.66].

Moving average models reflect the changes in tendencies more accurately and at the same time they can reflect the waves.

Current observation value in autoregressive layout is the sum of previous observations' values, however, weight ratios are not reflected. Information value of the observations is not defined with their proximity to the value, but the connection between them. Autoregressive models are not designated for the depiction of procedures with the tendency but they reflect the waves well and this is important in reflecting the development of unstable processes.

In order to make the application of autoregressive models possible, switch should be made from $Y(t)$ time series to $Z(t)$ time series:

Taking this into account the outline of autoregressive model will be as follows:

$$Z(t) = A_0 + A_1 Z(t-1) + \ldots + A_p Z(t-p),$$

where, p - model sequence.

$A_1, \ldots A_p$ model parameters are calculated with the least-squares method. The difference based on the structure model should be calculated with forecast value in k steps-ahead series.

For the difference sequence $d = 1$:

$$Y(N+1) = Y(N) + Z(n+1); \text{ for } \quad k = 1$$

,

$$Y(N+2) = Y(N+1) + Z(n+2), \text{ for } \quad k = 2$$

One of the most successful (therefore, famous) adaptive models for making short-term forecasts is autoregressive integrated moving average model (ARIMA). It reflects positive features of both moving average and autoregressive models, therefore can forecast on any series.

Autoregressive integrated moving average model allows to describe time series with less parameters and taking into account latest changes in tendency, we can forecast on that. ARIMA model is frequently called as Box-Jenkins model by the authors and it is suggested that this model should be used in analysis and description of time series of observations on process parameters in economy, nature and technics.

Model in seasonal variation is described through 6 whole-number structural parameters:

- sum of autoregressive terms *p*;
- difference sequence *d*;
- sum of moving average terms *q*;
- sum of seasonal autoregressive terms *P*;
- seasonal difference sequence *D*;
- sum of seasonal moving average terms *Q*;
- seasonal S and these ARIMA are written like $(p_1 d_1 q)$ x $(P_1 D_1 Q)_S$.

Formally, ARIMA model should be written like this:

$$\boldsymbol{\varphi(B)\Phi(B^S)Z(t) = \vartheta(B)\theta(B^S)a_t;}$$
$$Z(t) = \Delta_S^D \Delta^D (Y(t),)$$

$$\varphi(B) = 1 - \varphi_1 B - ..... - \varphi_P B^P$$

where; $\vartheta(B) = 1 - \vartheta_1 B - .... - \vartheta_q B^q$

$$\Phi(B) = 1 - \Phi_1 B - .... - \Phi_p B^{sp}$$

$$\theta(B^S) = 1 - \theta_1 B^S - .... - \theta_Q B^{SQ}$$

Where:

- Δ - differencing operator;
- Δ_S - seasonal differencing operator;
- $BZ(t) = Z(t-1), B^s$ - is such a differencing operator that $B^S Z(t) = Z(t-S), \quad a_1$ - is considered discrete white scale factor.
- φ_i parameters-autoregressive parameters;
- ϑ_i - moving average parameters;
- Φ_i - seasonal autoregressive parameters;
- θ_i - seasonal moving average parameters.

The model must be stationary and rotating and must meet the requirements of the conditions, therefore, there are some limitations to the model and those limitations include that the roots of the denominations must be within a single circle [13.p.191]. In that condition, a error is the one step-ahead error of relevant decision. It is impossible to analyze the model with implementation of stationary and rotating conditions.

Non-seasonal ARIMA model is considered special when it is seasonal. In case of absence of seasonal components, model is described with three whole-number structural parameters - $-p,d,q$, and seasonal vectors of the model get worse. Non-seasonal ARIMA model's special case is autoregressive model $-AP(p)$ and moving average model - $-CO(q)$ B, they have been reviewed in the economic literature before. ARIMA model has the ability to implement in several levels in computer program case scenario.

In risk management, the regulatory process has the ability to influence the management facility and thus, the stability of this facility can be ensured in the conditions of deviation from the given parameters. As a management system, risk management system should consist of risk purpose development and risk capital investment, determination of probability of event, designation of risk level and volume, analysis of environment, selection of risk management strategy and selection of risk management tricks based on this strategy and risk level reduction, implementation of purposeful impact.

In the following layout, we described organization of risk management directed to rational concentration of all elements of the risk management process in a single technology.

Thus, we cannot forget about the unpleasant circumstances related to the aspects which lead to the utilization of the project in risk condition during the investigation of investment project management problems in risk and uncertainty conditions and arise from inaccurate and incomplete information about project implementation and operation. These risks include the ones detected during their research process, as well as the ones suddenly emerged, and this can be required in the duration of risk analysis and their implementation and operation phase.

In that case, management of project risks which embody themselves in practice can be implemented in an efficient way. Implementation of risk solution concept, which may occur in execution of investment projects has to happen through project risk analysis, evaluation and management according to the integration of the procedural complex.

3 Introduction of Risk Management in Solution of Strategic Problems of Investment Project

Two case scenarios are possible in the process of project management:

- good understanding of project risks;
- understanding of occurrence of new unexplored project risks.

In the first case, relevant risk concept can be used and in the second case, development of negative scenarios. The success of the effective implementation of relevant project is defined with the professionalism of its manager in the first place and its organizational structure (which comprises of organizational forms, and organizational forms of project management and organizational structure of the project management) in the second place.

The concept of organizational structure of project management is established by multi-level hierarchical system of interconnected management bodies, and it should be remembered that the organizational form is a matter of organization of mutual activity and relationships between all the participants of investment process. [4. p. 190].

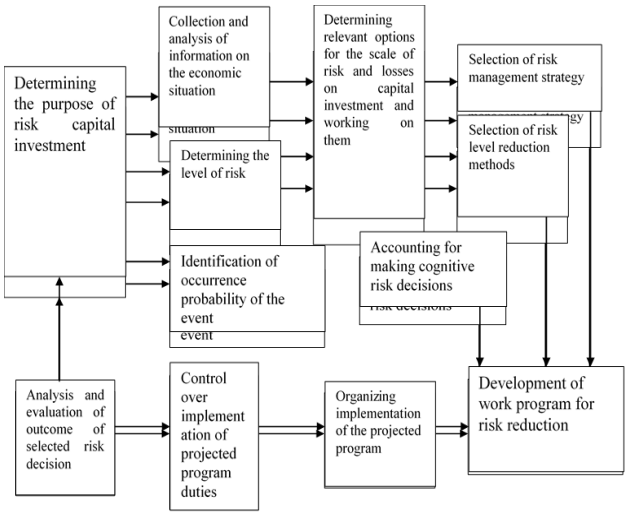

Fig. 2: Layout of risk management organization

The important tool for project management is its business plan and it is rational and also allowed to have consistency of work organization proposed for risk analysis and management and to include a special section to business plan of the project. This section may describe risks, their interaction mechanism and general efficiency, risk protection measures, interest of all parties in removing risk danger, assessment of risk analysis experiments and utilization of original offers they used, description of the risk distribution structure between project participants, special measure regarding insurance policy or guarantees on risk aspects that need certain conditions. [5. p. 131].

Project risk management methods are dynamic and constantly evolving organisms in all hierarchical levels, regional, local and mainly chain management phases throughout implementation of the project, their life cycles are meant to implement the following six functions:

- project selection;
- planning;
- implementation;
- evaluation;
- control;
- outcome.

As risk is considered a financial category, it is possible to impact risk level and volume by financial mechanism, and this process can be executed by means of financial management and specially developed strategy. In that case, strategy and tactics together create risk management, which is specific risk management mechanism [6. p. 116].
From this point of view, it is important to define the exact purpose of using risk management as a management system, and removing or reducing the risk. It largely depends on risk capital investment procedures, determining the probability of event, designation of risk level and scale, environmental analysis, and accurate selection of risk management strategy. It is possible to have a purposeful impact on risk for especially this strategy based on the selection of important risk management methods and level reduction methods.
It should be noted that forecasting should be accepted as one of the main functions of risk management because it is possible to foresee a certain event in this case. Alternative feature of forecasting includes the establishment of financial indicators and parameters that helps us identify different development options for main financial position according to pre-established tendencies of the management facility.

3.1 Back Payment Time method

Investments in 4 projects with varying incomes over the years amounts and annual incomes are given in the table below. Project payback period by please sort and suitable Specify the project.

Table 1. Four investment projects and 10 yearly income

Years	Project A	Project B	Project C	Project D
Investment in the amount of (PB)	2000	2000	4000	4000
one	500	one thousand	4000	800
2nd	500	one thousand	200	800
3	500	200	200	800
4	500	200	200	800
5	500	200	0	800
6	500	one hundred	0	800
7	500	one hundred	0	800
8	500	one hundred	0	800
9	500	one hundred	0	800
10	500	one hundred	0	800

Solution

Back payment of the duration determination for the purpose, yearly revenues investment to the amount equal It is collected until it is collected, that is, cumulative addition (CA) is done. Total annual revenues investment equal to the amount is year paid back gives the time.

Table 2: Four investment projects and 10 yearly income

Years	Project A	IT (A)	Project B	IT (B)	Project C	IT (C)	Project D	IT (D)
Investment the amount of (PB)	2000	0	2000	0	4000	0	4000	0
One	500	500	one thousand	one thousand	4000	4000	800	800
2nd	500	one thousand	one thousand	2000	200	0	800	1600
3	500	1500	200	0	200	0	800	2400
4	500	2000	200	0	200	0	800	3200
5	500	0	200	0	0	0	800	4000
6	500	0	one hundred	0	0	0	800	0
7	500	0	one hundred	0	0	0	800	0
8	500	0	one hundred	0	0	0	800	0
9	500	0	one hundred	0	0	0	800	0
10	500	0	one hundred	0	0	0	800	0
Back Payment Time (Year)	4		2nd		one		5	
Priority Sequence	3		2nd		one		4	

According to the results of the evaluation, the C project with the lowest payback period of 1-year alternative is chosen first. However, the business will continue to invest in investments that will pay for itself in 2 years. fund allocation if it will B project also investment alternatives between should think.

Back payment time of the method Some beneficial the sides are:

- Implementation and understanding simple a is the method.
- allows the selection of projects that pay back the invested capital as soon as possible, for risk and less uncertainty.
- To ensure that the funds of the enterprises with insufficient funds are returned in a short time provides provided.

well short in time themselves paying to projects priority by giving your active for necessary your funds allow it to be created.

Back payment of the duration beneficial next to them opposite objectionable the sides in has. This drawback below by example is explained.

Static a method the one which... back payment time method of money time its value consideration does not take.

3.2 Net Present Value and IRR method

Net present value (NPV) is the present value of a series of cash flows condensed into a single number. If the net result is negative, the investment project cannot be done, if it gives a non-negative result, it can be done.

Sample Problem -1: A B C Company cost 350,000 $ the one which... a casting workshop will set up. The company expects annual returns of $74,000 after establishing the foundry. To be established the facility's economic lifespan is 10 years. facility economic lifespan finally scrap has no value. If the expected profitability is 20%, according to NPV and IRR methods of the company the implemented and will not apply Please evaluate.

Solution

NPV Method:

Cash of entries the current value is found.

$$P(A) = A[\frac{(1+r)^{n}}{r(1+)^{n}}]$$

$$P(A) = 37000x[\frac{(1+0{,}20)^{10}}{0{,}20x(1+0{,}20)^{10}}]$$

$P(A)$ = 310.282 $

NPV = P(A) − C

NPV = 310.282 – 350.000

NPV = −39,718 $
NPV = −39718 <since it is 0 investment make significant is not.

IRR method
In this method, the internal rate of return is found, which equates revenues with expenses. try for it make no mistake method applied; with revenues your expenses net current values each other is synchronized.
r $_1$ = For 0.21:

$$P(A) = A[\frac{(1+r)^{n}-1}{r(1+)^{n}}]$$

$$P(A) = 74000x[\frac{(1+0{,}21)^{10}-1}{0{,}21x(1+0{,}21)^{10}}]$$

$P(A)$ = 299.996 $
NPV = 299.996 – 350.000 = −50.004$

$$P(A) = 74000x[\frac{(1+0{,}16)^{10}-1}{0{,}16x(1+0{,}16)^{10}}]$$

P (A) = 357.642 $
NPV = 357.642 – 350,000 = $ 7,642
NPV = 7.642> 0 because r value should be increased.

interpolation makes:

$$IRR(r) = 0{,}16x\frac{7.642}{7.642+(-50.004)}$$

IRR(r) = 0.1666
IRR(r) < Since 0.20 investment make is not meaningful.

Sample Problem-2: An investment of the project a yearly establishment in the period of investment expenditure is 22000 PB. The useful life of the project is 4 years. 7500 per year during the operational period The salvage value of this project with a fixed income of 12500 PB at the end of its useful life is 12500 PB. Production and care activities within business yearly 2500 PB business spending is done. The project management is in a position to accept the 12% discount rate. This data is according to the project NPV and IRR methods Please evaluate.

Solution
NPV Method:
Cash entry:

$$A=\frac{15000}{(1+0.12)^{1}}+\frac{15000}{(1+0.12)^{2}}+\frac{15000}{(1+0.12)^{3}}+\frac{15000}{(1+0.12)^{4}}+\frac{25000}{(1+0.12)^{4}}=614.428\ PB$$

A=614.428 PB
Cash output:

$$C=44.000+\frac{5000}{(1+0.12)^{1}}+\frac{5000}{(1+0.12)^{2}}+\frac{5000}{(1+0.12)^{3}}+\frac{5000}{(1+0.12)^{4}}=59.186\ PB$$

C=59.186 PB
NPV = A − C
NPV = 61448 – 59186 NPV = 2.262 PB
NPV = 2.262 > 0
because project acceptance can be done.

IRR Method:
r_1 = 0.10 inside n:

$$A=\frac{15000}{(1+0.10)^{1}}+\frac{15000}{(1+0.10)^{2}}+\frac{15000}{(1+0.10)^{3}}+\frac{15000}{(1+0.10)^{4}}+\frac{25000}{(1+0.10)^{4}}=32312\ PB$$

A=32312 PB

$$C=44.000+\frac{5000}{(1+0.10)^{1}}+\frac{5000}{(1+0.10)^{2}}+\frac{5000}{(1+0.10)^{3}}+\frac{5000}{(1+0.10)^{4}}=59.850\ PB$$

C=59.850 PB
A − C = 64624 – 59.850 = 4774 PB
NPV (r $_1$) = 4774 > 0 because r value should be increased.
r_2 = 0.15 inside n:

$$A=\frac{15000}{(1+0.15)^{1}}+\frac{15000}{(1+0.15)^{2}}+\frac{15000}{(1+0.15)^{3}}+\frac{15000}{(1+0.15)^{4}}+\frac{25000}{(1+0.15)^{4}}=57118\ PB$$

A=57118 PB

$$C=44.000+\frac{5000}{(1+0.15)^{1}}+\frac{5000}{(1+0.15)^{2}}+\frac{5000}{(1+0.15)^{3}}+\frac{5000}{(1+0.15)^{4}}=58274\ PB$$

C=58274 PB
A − C = 57.118 – 58.274 = −1.156 PB
NPV (r $_1$) = −1156 < 0 because r value should be reduced.

Interpolation:

$$IRR(r) = r_1+\frac{PV(\mathrm{r1})}{PV(\mathrm{r1})+\mathrm{PV}(\mathrm{r}^2)}$$

$$IRR(r) = 0{,}10+\frac{4774}{4774+1156}$$

IRR(r)=0,14
IRR(r)=0,14 > 0.12
IRR(r)=0,14 > since it 's 0.12 project acceptance can be done.
Excel from the program directly attempts to make no mistake with IRR can be found.

Sample Problem-3: An investment of the project a yearly establishment in the period of investment expenditure is 22000 PB. The useful life of the project is 4 years. 7500 per year during the operational period The salvage value of this project with a fixed income of 12500 PB at the end of its

useful life is 12500 PB. Production and care activities within business yearly 2500 PB business spending is done. The project management is in a position to accept the 12% discount rate. This data is according to the project NPV and IRR methods Please evaluate.

NPV Method:
Cash entry:
$A=\frac{15000}{(1+0.12)^1}+\frac{15000}{(1+0.12)^2}+\frac{15000}{(1+0.12)^3}+\frac{15000}{(1+0.12)^4}+\frac{25000}{(1+0.12)^4}=614.428\ PB$
A=614.428 PB

Cash output:
$C=44.000+\frac{5000}{(1+0.12)^1}+\frac{5000}{(1+0.12)^2}+\frac{5000}{(1+0.12)^3}+\frac{5000}{(1+0.12)^4}=59.186\ PB$
C=59.186 PB

NPV = A − C
NPV = 61448 – 59186 NPV = 2.262 PB
NPV = 2.262 > 0
because project acceptance can be done.

IRR Method:
$r_1 = 0.10$ inside n:

$$A=\frac{15000}{(1+0.10)^1}+\frac{15000}{(1+0.10)^2}+\frac{15000}{(1+0.10)^3}+\frac{15000}{(1+0.10)^4}+\frac{25000}{(1+0.10)^4}=32312\ PB$$

A=32312 PB

$$C=44.000+\frac{5000}{(1+0.10)^1}+\frac{5000}{(1+0.10)^2}+\frac{5000}{(1+0.10)^3}+\frac{5000}{(1+0.10)^4}=59.850\ PB$$

C=59.850 PB
A − C = 64624 – 59.850 = 4774 PB
NPV (r_1) = 4774 > 0 because r value should be increased.
$r_2 = 0.15$ inside n:

$$A=\frac{15000}{(1+0.15)^1}+\frac{15000}{(1+0.15)^2}+\frac{15000}{(1+0.15)^3}+\frac{15000}{(1+0.15)^4}+\frac{25000}{(1+0.15)^4}=57118\ PB$$

A=57118 PB

$$C=44.000+\frac{5000}{(1+0.15)^1}+\frac{5000}{(1+0.15)^2}+\frac{5000}{(1+0.15)^3}+\frac{5000}{(1+0.15)^4}=58274\ PB$$

C=58274 PB

A − C = 57.118 – 58.274 = −1.156 PB
NPV (r_1) = −1156 < 0 because r value should be reduced.

Interpolation:

$$IRR(r)=r_1+\frac{PV(\mathrm{r1})}{PV(\mathrm{r1})+\mathrm{PV}(\mathrm{r}^2)}$$

$$IRR(r)=0{,}10+\frac{4774}{4774+1156}$$

IRR(r)=0,14
IRR(r)=0,14 > 0.12
IRR(r)=0,14 > since it 's 0.12 project acceptance can be done.
Excel from the program directly attempts to make no mistake with IRR can be found.

4 Conclusion

Main component charts of project risk management:

- Risk identification
- Development of relevant risk concepts;
- Development of management system;
- Risk monitoring;
- Enhancement of management system;
- Identification of risk possibility;
- Making management decisions;

In the case of well-studied risks, the layout of project management comprises of the following sequence: project risk investigation; project audit (this proves that risk is well studied); deciding on either implementation of the project or refusal thereof; development of relevant risk concept; identification of unclear risk assumptions; development of necessary control methods and risk insurance happen if the assumption is right; then efficient control is implemented in project management process if control is possible.
In case of poorly studied risks, layout of project management includes the following stages: project risk investigation; project audit that proves that the project is poorly studied; deciding on either implementation of the project or refusal thereof; development of worst-case scenarios and if the worst scenario is unacceptable, then project is rejected, otherwise, it is important to acquire additional information for the development of necessary control methods; if accurate information is available, efficient control is implemented in the project management process, and if not, the project is rejected.

The sequence of organization of works for presented risk management and analysis includes:

- Selection of an experienced team of experts;
- Development of special question book and expert reviews, and selection of risk analysis techniques;
- Identification of risk factors and their importance.
- Establishing a risk action mechanism model and identification of the interconnection of individual risks and the joint effect of their influence;
- Distribution of risks among project participants;
- Review of the results of the risk analysis in the form of a specially-prepared report (paper).

The rational approach principle is based on the following methodological concepts.

- Use of planned (forecasted) features that are clearly expressed, understood, and measured in quantity and quality.
- Unambiguousness of designation of responsibilities of project manager and all participants in the process of solution of raised issues.
- Identification of interaction of main and lead project elements to construct them and facilitate project analysis and evaluation of its implementation.
- Enhancing the role of the person who makes decisions in the selection of more efficient measures to compensate and minimize project risks in the project implementation process.

As a management system, risk management includes;

- the process of determining risk and the purpose of risk capital investments;
- clarification of the probability of the event;
- Identification of risk level and scale;
- Environmental research;
- Selection of risk management strategy;
- Selection of risk management and reduction methods, which are important for this strategy;
- Implementation of purposeful impact on risk.

Mathematical models of forecasting applied in risk analysis and management includes:

- Growth curves (unlimited growth, limited growth with bend point, limited growth without bend point);
- Aligned models (autoregressive models, autoregressive integrated moving average models, moving average models);
- Econometric models (one-factor, linear-factor).

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