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1 Introduction

Business angels aim at maximizing the benefit from the capitals to be invested. Profit maximization means collection of higher cash flows in a period. There are however two significant issues:

- The role of profit and the role of time

The role of profits, especially accounting profits, obeys a series of rules (legislation, accounting principles etc). The use of the concept of profit as a criterion of behaviour helps taking sound decisions as ignorance leads to losing a significant tool in understanding the progress of an enterprise and the ability to manage it.

Proper decisions for the enterprise’s resources lead to maximization of its (accounting) profits. The role of time is especially significant. Every capital asset is evaluated on the basis of the profits and losses of its holders. Profits and losses, though, are created in periods of time, so the dimension of time plays a very significant role in decision making.

Decision making presupposes the existence of:

- A decision center;
- Alternative proposals and comparisons;
- A target to be achieved;
- Resources a business angel can engage in investments

When a business angel decides to invest an amount of money, automatically the business angel is deprived of this amount today in order to increase its future value. As a consequence, the future return must have a higher value than the one which the business angel is deprived of so that this decision is rational.

If we aim at a 20% benefit in the future for the capitals invested today, the criterion for this investment decision is that this investment must be equal to or higher than 20%. It is also logical that the higher risk we undertake, the higher the returns we demand.

What is the ratio between investment and return today (ideal investment) for a business angel to make a decision, in the meaning that the investment will provide the ideal marginal quantity of resources in the next period? The balance point in the capital market is the one where the marginal time value of the business angel’s money is equal to the rate of the ideal capital market.

The following equation is usually valid in the balance point:

\[
\text{Marginal Value of Time} = \text{Marginal Investment Return of Physical Investments} = \text{Rate of Ideal Capital Market}
\]
The above rule states that the business angel can undertake all the investments whose marginal investment return is higher than the marginal time value of the money and the rates of the ideal capital market.

There is the idea in daily practice that the average time value of money in conditions of an unregulated market is shown in the market rate above the rate of treasury bills which is compared with the average investment return.

2 Investment as financial flow

The basic economic definition of investment is related to being deprived of equal resources today in the expectation of maximized future returns.

This approach, although accurate, does not help understanding the procedure of taking the final decision for the employment of capitals in an investment proposition. The proper approach is the calculation of money inflows and outflows, directly or indirectly caused by the implementation (or not) of the investment.

The investment causes a money outflow in the first (or more) periods and usually in a series of money inflows in the next periods. In reality, many times there are investments which cause in the beginning an inflow (investment capitals or loan) and then outflows. In order to understand, therefore, the investment’s basis concept, the important thing is neither the series nor the type of inflows-outflows.

The important thing is to realize that investment means financial flow.

For the evaluation of investments, an investment proposition is not the construction of a factory (walls, equipment, workers etc) but the outflow of a series of financial resources and the inflow of another series of financial flows:

Investment as financial flow

<table>
<thead>
<tr>
<th>Period</th>
<th>Q0</th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
<th>Q5</th>
<th>....</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outflows</td>
<td>-150 thousand €</td>
<td>-40 thousand €</td>
<td>-20 thousand €</td>
<td>40 thousand €</td>
<td>50 thousand €</td>
<td>65 thousand €</td>
<td>....</td>
</tr>
<tr>
<td>Inflows</td>
<td>Investment expenditure</td>
<td></td>
<td></td>
<td>Net inflows from the enterprise’s operation</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Usually half the problem in the procedure of taking financial decisions related to the implementation or not of an investment is to properly determine the financial flow directly or indirectly associated with the investment. This is why taking investment decisions is a very serious economic problem requiring rationalism, realism and acuteness in its organisation. The evaluation problems of investment decisions usually lie in the procedure of decision taking and not the required technical methods of approach. There could be some software which with the help of computers could give indications whether the return of an investment is higher than the market rate and, thus, take a positive or negative decision about the investment. The question raised, though, is what data of financial flows to feed the computer for the relevant software to work.

The problem of insecurity is added to the determination of the proper financial flows, that is, if the expected events associated with the defined financial flows are going to happen according to our forecasts.

The more common mistakes made during the procedure of determining financial flows associated with an investment are the following:

- The initial amount of the investment is not properly calculated. For example, we are estimating the construction cost of a unit, but we do not calculate the cost of the road that we had to make with own funds in order to have access to it.
- We do not take into account that the operational deficits that might appear in the course of an enterprise require financing, which practically means complementary investment actions.
- We do not properly calculate interests, depreciations and opportunity cost of utilizing inflows.
- We do not properly calculate investments in human resources and research and technology.
- We have the tendency to underestimate or overestimate inflows-outflows depending on our position. If we are the ones proposing the investment, we tend to hide, even from ourselves, negative issues (deficits) associated with the implementation of an investment.

### 3 Insecurity and time value of money

A decision about an investment financing must take into account the time value of money. We cannot ignore the dimension of the time value of money or the importance that the lack of exact forecast of future events have. Are there are reasons why we pay more attention to the present compared to the future? The answer is that:

- Whatever we are collecting today has real value while whatever will be collected in the future has hypothetical value.
- There is uncertainty about the future. However much we try through the use of high time value of money to decrease the risks of future developments, there will always be the risk of having events that will not take place either because these events will
not happen or because we will not exist, when they will take place.

- When we are collecting a Euro today, we can choose and implement alternative ways to further evaluation. On the contrary, a Euro in the future is difficult to be utilized in alternative ways. With the development of course of the future markets there are similar possibilities.

What determines though the mean time value of money and, therefore, the investment rate? In an economy in crisis and recession it is difficult for someone to decide to place money in investments. Such an economy pays very much attention to today. This is why it will indefinitely borrow from future generations!!!

Practically, when we use the high time value of money for discounting, we result in minimizing future inflows. The higher the discounting coefficient and the more remote the money inflows, the less impact they have on the evaluation procedure.

On the other hand, the use of high discounting rates may hide a conservative character of decisions, as it weakens anything future and insecure to the benefit of the present and secure ones. If the banking system systematically uses unnaturally high discounting rates, then the economy is led to de-investment as the future flows would become zero or be reduced and no positive investments would be made. This does not mean that if investments were to be made, new wealth would not be generated. This is why, the use of criteria with integrated time value of money requires attention and maturity.

### 4 Criteria of taking investment decisions

There are criteria on the basis of which we can classify investments into groups or categories. These criteria are numerous (according to the type of resources employed, to the sector they are active, the enterprise’s scope of activities, production, technology etc). We are interested, though, in classifying investments according to the characteristics influencing the procedure of taking investment decisions.

#### 4.1 Cash flows of investments in implementation periods

The first significant criterion is the sign of the cash flows in the implementation periods of the investment. The relevant typology is shown below:

<table>
<thead>
<tr>
<th>Type</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Straight investment</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>
4.2 Comparison of investment results

A second very important classification is associated with the way the results caused by two or more investments influence each other.

We can distinguish two extreme conditions between the investments in this sector. The first extreme condition refers to investments where practically the one is a compulsory condition of the other. You cannot have investment A if you do not have investment B. For example, a printing unit needs a workshop responsible for the form of the publications. In reality it is one investment and this is the way to be treated. On the other extreme, we have mutually exclusive investments, where the implementation of one excludes the implementation of the other.

4.3 Number of payback periods

The criterion for payback periods of the capital employed practically determines how fast the benefits from the enterprise’s operation can pay back the initial capital.

Two cases are distinguished:

In the first case the criterion is a given number of periods. Therefore, when the number of periods during which the specific investment pays back the capital is less than or equal to the specific limit, we accept this investment. In the second case, in the mutually exclusive investments, we accept the one that has the faster payback or the smaller number of payback periods.

Let’s say that we have to decide between investments A and B with the following data:
If the accepted minimum of payback periods is 2, then we will agree on investment B. If we compare the two investments, because B has a faster payback rate than A (2 years compared to 3 years in the case of A), we will choose investment B. Note that when working capital is employed for the operation of an investment, it must not be taken into account for the determination of the payback periods as theoretically this is returned by the enterprise’s operation during its lifetime.

The advantages of this method, of the payback periods of the capital employed, are that it is simple and automatic in its calculation, and we do not need to calculate the cash flows during the whole period of its lifetime and, in general, it is a useful method when we take decisions in conditions of restriction of available capitals. The main problems associated with the use of this method are firstly related to the fact that it focuses on the payback period without taking into account what can happen later when the picture of the mutually exclusive investments can change. The second and most important problem is related to the absence of the time value of money from the analysis.

### 4.4 ROCE (return on capital employed) criterion

The return on capital employed criterion (ROCE) is calculated in many ways.

It is usually calculated on the basis of accounting profits.

Let’s say that the enterprise makes an investment of 100,000 € and 20,000 € as working capital. This investment has a lifetime of 4 years and, consequently, annual depreciations of 25,000 €.

The cash flow, depreciation and profits are shown below:
<table>
<thead>
<tr>
<th>Year</th>
<th>Cash flow</th>
<th>Depreciations</th>
<th>Profits</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-100,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>+50,000</td>
<td>25,000</td>
<td>25,000</td>
</tr>
<tr>
<td>2</td>
<td>+60,000</td>
<td>25,000</td>
<td>35,000</td>
</tr>
<tr>
<td>3</td>
<td>+30,000</td>
<td>25,000</td>
<td>5,000</td>
</tr>
<tr>
<td>4</td>
<td>+20,000</td>
<td>25,000</td>
<td>(5,000)</td>
</tr>
</tbody>
</table>

Total profit: 60,000

The average annual profit is 60,000/4=15,000 €. The initial capital employed is: 100,000+20,000=120,000 €

Consequently, ROCE in the initial and mid capital employed is:

15,000 / 120,000 =0.125 or 12.5%

ROCE can be used in investment plans irrespective of whether they are mutually exclusive. Also the ROCE of a specific investment can be compared with an alternative possibility of returns (deposits or other form of investment etc).

Its advantages are that:

- a percentage expressing return is calculated;
- it is widely accepted, as a criterion of management effectiveness; and
- profitability is used as an acceptance criterion of an investment.

Its disadvantages are that:

- there is difficulty in agreeing about the exact nature of the figures used. It is possible to choose “elements” of ROCE which service specific targets (such as the hidden objective for the implementation of the investment) without having the required objectivity.
- it ignores the size of the investment, as it is expressed as a percentage. A very small investment (10,000 €) can have 25% return and a very big investment (1,000,000 €) only 5% and at first sight it seems that we have to accept the first one. In the first case, though, the investment pays back 2,500 € and in the second 50,000 €. It can lead us to draw a wrong conclusion about the result of the investment.
- it is practically an indicator mainly using accounting figures while, on the contrary, an investment decision is a decision related to the distribution of resources of economic nature.
- it ignores the dimension of the time value of money and, what is more, there is no way to change and take this factor into account.
4.5 Criteria of discounted cash flows

The criteria based on discounted cash flows are the internal return ratio (IRR) and the net present value (NPV).

The evaluation process of an investment plan with the method of the net present value is based on the idea that it is worth undertaking the investment if the resources employed in this plan will be less than or equal to the resources returned in its lifetime. All cash flows generated in the future are evaluated in the same period (let’s say the present one) using the appropriate time value of money expressed in the discount rate. The discount rate is, thus, the factor via which we equate the value of the flows of all the periods into the value of one period so as to have comparable figures and take a decision.

If $A_t$ is an investment’s cash flow with a lifetime ranging from 0 to n periods and $r$ is a stable time value of money and the discount rate, then the present value of the investment is:

$$PV = \sum_{t=0}^{n} \left[ \frac{A_t}{(1+r)^t} \right]$$

If $I$ is the initial payment for the investment’s implementation, then:

$$N.P.V = \sum_{t=0}^{n} \left[ \frac{A_t}{(1+r)^t} \right] - I$$

The use of different discount rates does not change the order of preferences of investment plans. If we have, that is, four different investments and we calculate their NPV, then the derived order, that is, which investment we prefer more, does not change irrespective of the level of the discount rate used.

If we have an investment with a 10% discount rate with the following cash flow:

<table>
<thead>
<tr>
<th>Year</th>
<th>Cash Flow</th>
<th>Discount factor</th>
<th>Present value of cash flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-100,000</td>
<td>(1+0.10)^0</td>
<td>-100,000</td>
</tr>
<tr>
<td>1</td>
<td>+40,000</td>
<td>(1+0.10)^-1</td>
<td>36,364</td>
</tr>
<tr>
<td>2</td>
<td>+40,000</td>
<td>(1+0.10)^-2</td>
<td>33,058</td>
</tr>
<tr>
<td>3</td>
<td>+50,000</td>
<td>(1+0.10)^-3</td>
<td>37,566</td>
</tr>
<tr>
<td>4</td>
<td>+25,000</td>
<td>(1+0.10)^-4</td>
<td>17,075</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>NPV</strong> 24,063</td>
</tr>
</tbody>
</table>
The specific result can have three different interpretations:

- The 100,000 € investment generates 24,063 € more than what was employed in the investment. Practically, that is, the amount of 24,063 € is the investment’s economic profit.
- The return resulting from the investment plan is higher than 10%, higher that is from the used discount rate.
- If for the investment’s implementation, we borrow 100,000 € with a 10% rate, then we could pay back the loan and have an additional benefit of 24,063 €.

Based on the following, we could take it that the use of the criteria of the net present value has three different interpretations:

- A negative present value in an investment plan is not acceptable because it shows that the investment plan generates losses compared to what would happen if an investment of equal amount was made in the capital market.
- A similar investment plan is not acceptable because it will not generate enough cash flow to pay back the financing costs it generates.
- A positive net present value shows the net increase of the wealth of the holder of the resources made available.

The Internal Rate of Return (IRR) of an investment is the discount rate equating its net present value to zero. The IRR can be also described as an investment’s growth rate.

<table>
<thead>
<tr>
<th>Period</th>
<th>Cash flow of a period’s beginning</th>
<th>Return</th>
<th>Return %</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>200,000</td>
<td>20,000</td>
<td>20,000/200,000=10%</td>
</tr>
<tr>
<td>1</td>
<td>220,000</td>
<td>22,000</td>
<td>22,000/220,000=10%</td>
</tr>
<tr>
<td>2</td>
<td>242,000</td>
<td>24,200</td>
<td>24,200/242,000=10%</td>
</tr>
<tr>
<td>3</td>
<td>266,200</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

Another way to describe the IRR can be that it is the highest borrowing rate that a borrower can pay for the specific investment without losing money when paying his/her liabilities (capital plus interest) as generated by the investment.

This discount rate is determined trough a trial period.
<table>
<thead>
<tr>
<th>Period</th>
<th>Cash Flow</th>
<th>Discount Rates</th>
<th>Present Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-22,839</td>
<td>10% 15% 18%</td>
<td>1 1 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-22.839 -22.839 -22.839</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>10,000</td>
<td>0.9091 0.8696 0.8475</td>
<td>9.091 8.696 8.475</td>
</tr>
<tr>
<td>2</td>
<td>20,000</td>
<td>0.8264 0.7561 0.7182</td>
<td>16.528 15.122 14.364</td>
</tr>
<tr>
<td></td>
<td>NPV</td>
<td></td>
<td>2.780 979 0</td>
</tr>
</tbody>
</table>

As a consequence, in order to calculate an investment’s IRR a repeating trial and divergence procedure is required, where each time a rate is tested as a discount rate of the cash flows with the aim of finding the rate that equates the NPVs to zero and there is no divergence from this value.

4.5.1 The use of IRR and NPV in order to take investment decisions

There are usually two types of decisions in the procedure of taking investment decisions. We can have one or more economically independent investment and must decide about their implementation. We can also have two more more mutually exclusive investments and must decide which of the two to implement. Generally, in an independent investment of normal behaviour, the implementation of the IRR and NPV criterion gives the same results with regard to the acceptance perspective of this investment.

Diagram: NPV and IRR criteria

If the minimally accepted discount rate is 18%, then we accept the specific investment. An investment can have more than one IRR or no IRR at all.
When we have an investment, we must decide whether to implement it or not or when we have independent economic investments, we can use the IRR method with the following reservations:

- The IRR obviously does not take into account the size of the investment. It has, therefore, a similar problem with ROCE.

- We must have a criterion for taking decisions, that is, a specific discount rate or a given time value of money.

- The specific cash flow has a discount rate. If it has more than one, then their relation with the discount rate we use in order to take decisions is of special importance.

4.5.2 Examples of cash flows (A and B) with more than one IRR

- The evaluation procedure based on the IRR is meaningful when the discount factor does not change overtime. The time value of money must not change, therefore, because otherwise the calculation of one single discount factor would be meaningless.

- When we use the IRR, we must know if it is a regular investment or an investment in the form of a loan. In the second case, it is important whether we are borrowers or lenders.

- The calculation of IRR is technically feasible.

- The IRR measures the average growth percentage of the capital.
As a consequence, as we see that there are many problems during the IRR use as an investment criterion, the prevalence of the criterion of the net present value is obvious. The use, though, of the NPV must take into account certain parameters: In a group of mutually exclusive investments we will accept the one with NPV > 0.

In investments with NPV > 0 we will choose the one with higher NPV.
Between two investments with the same positive NPV, we will choose the one having (after a test) the smallest sensitivity to the rate’s change.

It is obvious that when using the NPV technique, a change in the discount rate causes changes in the preference order of the investment.

Let’s see the following diagram – example to understand the last remark better.

When the appropriate time value of money is less than 0.28, the investor prefers investment B to A. If, though, the appropriate time value of money is higher than 0.28, the investor will prefer investment A to B.

The **annual equivalent cost** or annual equivalent payment practically refers to investments with cash outflows (expenses or cost for the enterprise) and different time frame.

During the evaluation procedure of two investments, instead of repeating the flows of the shortest investment plan until its time frame becomes equal to the one of the over investment plan, we can look for the annual equivalent cost of each one. We then choose the investment with the higher annual equivalent cost. The terms annual equivalent cost means the one whose present value is equal to the net present value of the under examination investment, that is:

**Annual equivalent cost = NPV of the Investment/ Net Value Coefficient of Cash Flow**
4.5.3 Cash flows

The cash flow used for the evaluation of an investment plan is not related with the results of the business action or with accounting perceptions of the financial figures.

An investment and its cash flow is the engagement of resources in the wider possible meaning, leading to possible benefits that will appear overtime. In this meaning, neither the engaged resources nor the benefits must compulsorily be in the form of specific cash flows. Nevertheless, the cash flows must be measurable.

Cash flows are not necessary to be identified with an enterprise’s or investment’s profits and revenues or an investment’s cost. Cash flows comprise the inflows and the outflows of resources associated with an investment. All inflows and outflow are entered in the analysis at the time they occur.

When we use a discount rate, e.g. 10%, and we are analyzing a specific investment, we can have an absolute cash flow for which we must decide. When we compare two investments, we can create a relevant cash flow which is nothing more than the difference of the two cash flows and take intermediate decisions. It is noted that the NPV of a relevant cash flow is the difference of the NPVs of two individual cash flows. That is, \( \text{NPV (relevant cash flow)} = \text{NPV}(1) - \text{NPV}(2) \)

**Example**

Let’s say that there is a small shop operating making 100,000 € per year and we are thinking of renovating it. After the renovation, which will cost 300,000 €, we will earn 30% of the initially invested capital and the money cost will be 20%.

The absolute cash flow for the renovated shop is:

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-300,000</td>
<td>90,000</td>
<td>90,000</td>
<td>90,000</td>
</tr>
</tbody>
</table>

The absolute cash flow before the renovation is:

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>100,000</td>
<td>100,000</td>
</tr>
<tr>
<td>1</td>
<td>100,000</td>
<td>100,000</td>
<td>100,000</td>
</tr>
<tr>
<td>2</td>
<td>....</td>
<td>....</td>
<td>....</td>
</tr>
</tbody>
</table>

And the relevant cash flow is:

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-300,000</td>
<td>60,000</td>
<td>60,000</td>
<td>60,000</td>
</tr>
</tbody>
</table>
Our decision must be based, obviously, on the relevant flow and the renovation will not be carried out.

### 4.5.4 Claim management

A claim (e.g., from sales) generated by an investment in the future is a significant economic event whose real impact on the investment’s cash flows is recorded when it occurs. This happens for many reasons. A claim is always a claim but at the moment of its realization many things and various events might have taken place that we do not know today. As our analysis is related to the future we will include these impacts the moment they occur.

We have to note here that it is not an issue of risk (that could be dealt with through the change of the discount factor) but an issue of proper methodology. The same applies in the case of undertaking liabilities in relation to cash flows.

### 4.5.5 Management of working capital

The working capital is used for the enterprise’s operation for mainly liquidity reasons.

The working capital is defined as the difference between the increase of the current liabilities and the increase of the relevant capital assets. It is assumed that the working capital does not increase the degree of risk of the financial management. When there is inflow of new working capital, then the cash outflows increase. When it is paid back, the cash inflows increase.

In two cases, there are significant changes of the working capital employed, in the case of reserve increase and in the case of increase of third-party receivables.

Let’s say that the reserves increase by 150,000€ (assets’ increase) and, as a consequence, liabilities also increase by 150,000€. However, the cash flow in the period that the change takes place neither increases nor decreases. If, though the increase of reserves by 150,000 € requires outflows of 50,000€ (working capital), then the cash flow changes by this amount (-50,000€).

Let’s say now that the third-party receivables increase (after an increase of sales on credit) by 150,000 € after an increase of the production cost by 30,000 €. The impact on the used cash flow will be -30,000€, the same, that is, with the marginal increase of the production cost.

### 4.5.6 Management of installments on loans and interests

The management of installments on loans and interests as parts of the cash flows is one of the most usual causes of mistakes and confusion in the evaluation of investment plans. We must distinguish between cash flows associated with installments on loans and cash flows of the investment plan. The first consists of the principal and interests and the second include the other parts of the investment plan. In general, installments on loans and interests must not be
included in our analysis. If we include it, we make a very common mistake of over-conservative evaluation.

We practically, that is, double estimate the cost arising from the time value of money as in the following example:

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1</th>
<th>NPV (10%)</th>
<th>IRR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash Flow of Investment Plan</td>
<td>-1,000</td>
<td>1,130</td>
<td>27.283</td>
<td>13%</td>
</tr>
<tr>
<td>Interest</td>
<td></td>
<td>-100</td>
<td>-90.91</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-1,000</td>
<td>1,030</td>
<td>-63.627</td>
<td>3%</td>
</tr>
</tbody>
</table>

If we wish to include the meaning of installments on loans and the interests in the cash flow, then the above example must be organized as following:

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1</th>
<th>NPV</th>
<th>IRR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash Flow of Investment Plan</td>
<td>-1,000</td>
<td>1,130</td>
<td>27.283</td>
<td>13%</td>
</tr>
<tr>
<td>Financing Flow</td>
<td>1,000</td>
<td>-1,100</td>
<td>0.00</td>
<td>10%</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>30</td>
<td>27.283</td>
<td></td>
</tr>
</tbody>
</table>

### 4.5.7 Tax management

All the decisions must be taken after the calculation of taxes. In other words, taxes comprise an important outflow which must shape the total of our cash flows.

Income taxes are calculated on the basis of the tax rate on the enterprise’s income after subtracting the interests paid. If the enterprise’s income is 1,000,000 € and the tax rate is 40% then taxes are 400,000 € and the net income 600,000 €.

Taxes decrease the real cost of money. Therefore, if the cost of money is 10% given that the payments of interest are subtracted from the profits, the cost of money after the taxes is: 0.06=0.10 x (1-0.40).

On the basis of the tax rate, we must calculate the generated tax liabilities and subtract them from our cash flows and, at the same time, calculate the tax benefits and add them to the cash flows.
Therefore, if an investment requires an outflow of 1,000,000 € in period 0 and its IRR is 8% and the tax rate 40%, then in period 1, the inflows will be 1,080,000 € (if its time frame is 1 period), 400,00 € tax benefit (1,000,000 x 0.40) (tax benefit is transferred from period 0 to period 1) and 432,000 € tax obligation. (432,000 € is the result of 1,080,000 x 0.40). The net present value must be calculated though with 6% discount rate. The whole problem is organized, thus, as follows:

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1</th>
<th>NPV (6%)</th>
<th>IRR</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Investment Cash Flow</strong></td>
<td>-1,000,000</td>
<td>1,080,000</td>
<td>18.8679</td>
<td>8%</td>
</tr>
<tr>
<td><strong>Tax Obligation</strong></td>
<td></td>
<td>-432,000</td>
<td>-407,547.2</td>
<td></td>
</tr>
<tr>
<td><strong>Tax Benefit (Reserves)</strong></td>
<td></td>
<td>400,000</td>
<td>377,358.5</td>
<td></td>
</tr>
<tr>
<td><strong>Cash flow after Taxes</strong></td>
<td>-1,000,000</td>
<td>1,048,000</td>
<td>-11.3208</td>
<td>4.8%</td>
</tr>
</tbody>
</table>

If there are loans, the picture changes, because the enterprise benefits from the application of the tax coefficient on the taxes. Let’s say that in the previous example, we finance the investment by 100% with a loan. Then, the new picture will be the following as interests are 100,000 and the tax benefit 40,000=0.40 x 100,000.

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1</th>
<th>NPV (6%)</th>
<th>IRR</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cash Flows of Investment Plans</strong></td>
<td>+1,000,000</td>
<td>-1,100,000</td>
<td>-37.74</td>
<td>10%</td>
</tr>
<tr>
<td><strong>Tax Benefit</strong></td>
<td></td>
<td>40,000</td>
<td>+37.74</td>
<td></td>
</tr>
<tr>
<td><strong>Final Cash Flow</strong></td>
<td>1,000,000</td>
<td>-1,060,000</td>
<td>0,00</td>
<td>6%</td>
</tr>
</tbody>
</table>

The final correct table of cash flows on which the final decision is based is the following:
The investment plan must finally be rejected.

4.5.8 Management of depreciations

Depreciations are used for the gradual capital recovery engaged in investment uses. It is practically the application of coefficients less than a unity as the capital recovery periods are more than one (period is usually one year). On the basis of these coefficients, the recovery of a specific amount of capital in three, five, seven, ten or twenty years is calculated.

There are various ways of calculating the depreciation coefficients (linear method, non linear method etc). The calculation way of the depreciation coefficients depends on the type of equipment and the taxation policy of each economy. Usually, some types of fixed assets (software etc) and faster economically depreciated types of investments require the depreciation to be short-term. The calculation way of deprecations might allow in the beginning the faster recovery of capital or the opposite.

Depreciations constitute accounting elements and not data of real cost and, therefore, are entered in the cash flow with a positive sign only to the extent they decrease the payable taxes.

There are three basic methods of calculating depreciations:

- **Linear method**

According to this method, the amount of the annual deprecations is calculated if we divide the total cost of the machine acquired minus the estimated salvage value by its economic life.

That is:

\[
\text{Depreciations} = \frac{\text{(acquisition cost – salvage value)}}{\text{economic life}}
\]
Excel has a function integrated for the calculation of depreciations according to any method we wish to use. For the linear method, the most appropriate function is the following: =SLN(cost; salvage; life)

**Example 1:**

<table>
<thead>
<tr>
<th>Annual depreciations with the linear method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example: Acquisition cost of a machine 25,000 € and salvage value 850 € after 15 years. Calculate the annual depreciations with the linear method.</td>
</tr>
<tr>
<td>Acquisition cost</td>
</tr>
<tr>
<td>Salvage value</td>
</tr>
<tr>
<td>Time (economic life)</td>
</tr>
<tr>
<td>Annual depreciations with the linear method</td>
</tr>
</tbody>
</table>

Where cost is the initial acquisition cost of the asset, salvage is the residual value of the fixed asset (that is the final cost of the asset after concluding its depreciation) and life is the total depreciation time of the fixed asset.

A method based on the **double declining balance**. This *method* is also called **accelerated depreciation** method. It requires the application of a depreciation rate above the residual value of the asset. This value arises at the end of the previous year after subtracting the depreciation of this period. Comparatively with the linear method, the rate of depreciation according to the double declining balance method is:

\[
\text{Rate of Depreciations (\%)} = \frac{2}{\text{economic life} \times 100}
\]

The Excel function calculating depreciations with the double declining balance is: =DDB(cost;salvage;life;period;factor)

**Example 2:**

<table>
<thead>
<tr>
<th>Calculation of annual depreciations with the double declining balance method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
</tr>
<tr>
<td>Acquisition cost</td>
</tr>
<tr>
<td>Salvage value</td>
</tr>
<tr>
<td>Time</td>
</tr>
<tr>
<td>Period</td>
</tr>
<tr>
<td>Year</td>
</tr>
</tbody>
</table>

1 Double click on the icon to open the tool
2 Double click on the icon to open the tool
where cost is the initial acquisition cost of the asset, salvage is the residual value of the fixed asset (that is the final cost of the asset after concluding its depreciation), life is the total depreciation time of the asset, period is the period for which we want to calculate the depreciations (period must use the same units with life) and factor is the rate the balance decreases.

- The method of depreciations with the reverse order of life time. This method, as the previous one, is also called method of accelerated depreciation. These two methods have in general favourable tax impacts.

The integrated Excel function for the calculation of depreciations with the reverse order of life time is the following: $=\text{SYD}(\text{cost}; \text{salvage}; \text{life}; \text{per})$

**Example**: 

<table>
<thead>
<tr>
<th>Calculation of depreciations with the reverse order of life time</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Data</strong></td>
</tr>
<tr>
<td><strong>Acquisition cost</strong></td>
</tr>
<tr>
<td><strong>Salvage value</strong></td>
</tr>
<tr>
<td><strong>Time</strong></td>
</tr>
<tr>
<td><strong>Period</strong></td>
</tr>
</tbody>
</table>

where cost is the initial acquisition cost of the asset, salvage is the residual value of the fixed asset (that is the final cost of the asset after concluding its depreciation), life is the total depreciation time of the asset, per is the period for which we want to calculate the depreciations (period must use the same units with life).

With the knowledge of how to calculate annual depreciations of an enterprise’s fixed asset, we must realize the way to treat them in an investment decision taking procedure. In order to analyze an investment situation, we need to calculate the annual cash flows that this situation entails. Depreciations have an indirect impact on these cash flows. If we examine at first the accounting treatment of depreciations, we will see that they are subtracted from the Profits before Taxes, Interests and Depreciations. This is carried out before calculating the taxable income as depreciations are deducted. After calculating the tax paid by the enterprise (taking into account both depreciations as well as interests which are exempted), we subtract it so as to calculate Net Profits.

The accounting, though, net profits do not constitute the cash flow we use in the procedure of taking investment decisions because while depreciations are subtracted from the profits for

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3 Double click on the icon in order to open the tool
taxation reasons, practically they do not constitute a real cash flow. Therefore, we must add again depreciations to the net profits so as to have the investment’s cash flows.

Concluding, the procedure we apply in dealing with depreciations is the following:

- We subtract depreciations from the profits before taxes, interests and depreciations.
- We calculate the taxable income (after subtracting the payable interests).
- We calculate net profits by subtracting the taxable income from the profits before taxes, interests and depreciations.
- We calculate the investment’s cash flows by adding the depreciations to the net profits.

4.5.9 Management of salvage value
The salvage value of an investment good is the residual value when its economic life expires. Let’s say, that is, that we buy a machine producing computer spare parts. We know that these spare parts will be incorporated into computers which after five years will not be produced any more. At the end of the five years, this machine could produce the spare parts (so it has some value) but it does not have any value for our enterprise. Therefore, we must sell it to someone that could use it. Its value will be determined on the basis of some data. This value for us is called salvage value.

Obviously an investment’s salvage value influences its cash flow as in the simplest case the increase of the cash flow of the last period is obvious related to the salvage value.

If we replace an old machine with a new one, we are going to be concerned about the salvage value of the old machine today. There is also, though, another salvage value of the same old machine which we must take into account. It is the salvage value the machine will have in the future if we do not replace it today.

When standardizing the cases where salvage value is involved, we will have the following cases in order to calculate an investment’s absolute cash flows when replacing an old machine with a new one:

- Salvage value of the new equipment: It increases the cash flow of the last year of utilization.
- Present salvage value of the old equipment: It increases the cash flow of this year.
- Salvage value of the old equipment in the physical removal time: It increases the cash flow at the removal time.

Example
Let’s assume that the salvage value of a machine today is 2,000 € and after five years its expected salvage value is 800 €. In the tenth year of its physical removal, its salvage value is 1,000 €. All the figures are calculated after taxes. The cash flow organisation will be the following:
4.5.10 Inflation management

When prices change in the future, the purchasing power of a currency unit also changes resulting in the change of the economic evaluation of an investment plan. The adaptation of an investment evaluation under inflation conditions requires the conversion of the nominal values into real ones and, as a consequence, the conversion of nominal cash flows into real ones.

5 Evaluation Model of an Investment Plan

An investment plan can be evaluated by creating the appropriate model and entering the required quantitative figures.

We will create a model in the Excel by using the following example.

Data:
We examine the implementation of an investment for the production of a new product.

This investment presupposes the purchase of equipment with a value of 600,000 €, and salvage value after 6 years 300,000 €. The businessman’s equity comes up to 250,000 €, and you have to contribute the remaining capital.

According to your estimates, the purchase of the specific product will correspond to 350,000 items for the next 3 years, with an annual increase of 5% in the next years.

Correspondingly, it is estimated that the market share of the product will be 50% for the 3 first years, while there will be an increase of 10% in the next years.

The cost for each item of the produced product is 1.25 € in the first year and will increase by 8% annually.

Its selling price is calculated at 3.25 € for the first 3 years and then there will be a 10% increase. The maximum production capacity of the equipment is 250,000 items.

The tax rate is 35%, the borrowing rate 11% and the discount rate of the company 14%. The straight line method is used for the depreciations. The duration of the loan and the economic life of the equipment are 6 years.

5.1 Data entering

We will start designing our model by entering our data.
Three fields will be created:
1. Revenues
2. Loan break down
3. Operational costs

5.1.1 Calculation of revenues
First of all we have to record the concept of time. Our investment, as shown in the description of the business status, lasts for 6 years.

Use Row A to enter time. Name cell A1 Year and cells B1:G1 the corresponding periods. Use the automatic filling of rows provided by Excel. Fill in value 1 in cell B1 and with right double click on the bottom right corner of the cell, drag the cursor to cell G1. Choose Fill Rows. In this way, row 1-6 will be automatically filled.

We then enter primary data. The acquisition cost of the machines (which we assume is the only cost for undertaking the investment) is 600,000 Euros for the first period and for the other periods it is 0. Name cell A3 Initial Cost and enter the appropriate values in the field B3:G3.

Don’t forget to format cells. In the case of row 3, enter the currency form. The investment’s initial cost is a key variable to which we will have to make reference when we have created various formulas.

For this reason, give cell B3 a name. For example, invest.
Enter the amount of the share capital in the next row. Give cell B4 the corresponding name and enter the amount of 300,000 Euros in cell B4. Enter value 0 in the next cells (C4:G4). Enter the concept of salvage value exactly below. Give cell B5 the appropriate title. The salvage value, as it is natural, in the first 5 years is 0 and in the last year it is 250,000 Euros.

Name cell G5: salvage.
We will then enter the data of sales, production cost and revenues from the expected sales. Enter the forecasts regarding the market size of the specific product for the next 6 years in row 7.

Name cell **A7 Market Size** and enter the corresponding values to cells **B7:G7**.
We will calculate exactly below the market share we are expected our product to gain. Give a name to cell **A8**. The share in the first year will be 0.50, so enter this value in cell **B8**. The share stays the same for the next two years, so connect the corresponding cells with their previous ones. We have, that is:

C8 = B8  
D8 = C8  

There will be an increase of 10% in the next years in the market share. The share, therefore, of each period must be equal to the previous one multiplied by 1.10. This means that cell **E8** must be equal to **D8*1.10**. Copy this to the other cells.

We can now calculate the quantity of sales expected to be made by the company. This quantity is nothing more than the market size multiplied by the market share of the product. We have, though, another restriction: the maximum production capacity of the mechanical equipment is 150,000.

We must, therefore, enter this restriction in the relation we will make. The sales made by the company must be the minimum figure between the share market multiplied by the market size and the maximum production capacity. The above when translated into an Excel function is as follows:

\[=\text{MIN (Market Share } \times \text{ Market Size}; \text{ Production Capacity)}\]

For the first period, we will have:

\[B9 = \text{MHN(B8*B7; 250000)}\]
Copy this relation to the other cells.

Enter the selling price of the product for each period in row 10. The price is 3.25 Euros for the first three years and then it is increased by 10%. Enter value 3.25 Euros in cell B10 and connect C10 and D10 with their previous ones (as we did with the market share). The value of the 4th period will equal the previous one multiplied by 1.10, that is:

\[ E10 = D10 \times 1.10 \]

Copy this relation to the other cells.

The value, then, of the sales is the quantity of sales multiplied by the selling price of each period. Use row 11 to calculate them. For the first period (B11), the sales are:

\[ B11 = B10 \times B9 \]

and correspondingly in the other periods.

We will then enter the production cost per product item. Follow the same procedure with the selling price in row 10. The cost does not remain fixed.

Each year there is an 8% increase. So, for the first period, we have:

\[ C12 = B12 \times 1.08 \]

and the same goes to the other periods. The production cost is, therefore, the cost per item of produced product (row 12) multiplied by the quantity of sales (row 9). Enter this relation in row 13 and name it Production Cost.
Calculate the **Revenues** below. It is the difference of **Sales** (row 11) minus the **Production Cost** (row 13).

Use rows 16-18 to enter the data about the **Borrowing Rate**, **Discount Rate** and **Tax Rate**. Their values are 11%, 14% και 35%, respectively.

### 5.1.2 Loan analysis

The next field to be designed is related to the analysis of the loan taken by the company. Give cell A20 the name **Loan Analysis**.

In order to calculate the amount of the annual installment, we will use the appropriate Excel formula.

\[ \text{PMT}(\text{rate}; \text{nper}; \text{pv}; \text{fv}; \text{type}) \]

We need two things for this formula: *the number of periods* remaining up to the full payment of the loan and the *balance of the loan capital* still outstanding from the last payment. Let’s first enter the number of periods.
Use row 21 for this purpose. Name **A21 Loan Duration** and enter value 6 in cell **B21** as there are 6 years in the 1st period. The number of periods decreases every year by one year after the 1st period.

The price of each year is therefore calculated if we subtract 1 from the price of the previous year. That is for the 2nd period, we have:

\[ C21 = B21 - 1 \]

and respectively for the other periods.

In the next row, we will calculate the amount of loan for each period. This changes every time we pay an installment. It is, however, important to understand the way the loan capital changes.

A possible mistake is to subtract the installment we paid (principle + interest) from the capital of the previous period. This is wrong. The installment does not include only the payment of capital (principle) but also the interest for the capital. It is divided that is to the principle and the interest. We have to subtract, therefore, only the principle.

The amount of the loan in the first year (give this name to cell A22) is 300,000 Euros and the next period equals to the previous one minus the principle.

We have not calculated the principle yet, so we cannot create the calculation relations of the amount of the loan for the periods 2-6. The only thing we can do is to enter the initial loan capital (300,000 Euros) in cell **B22=invest-B4**. We will fill in the rest of the row later.

We can now calculate the installment. Use row 23. Give an appropriate name to cell **A23**. We are going to use function **PMT**. However, as this function will give a negative figure, add a negative sign in the beginning. For the first period we have:

\[ B23 = -PMT(Rate; B21; B22) \]
and respectively for the other periods.

If you copy this relation in the other cells of the row, there will be no result. Zero value. Can you understand why? Because we have not yet calculated the amount of the loan for the remaining periods. It is, that is, zero! When we enter this amount, the installments for the other periods will be automatically calculated. Of course, we are expecting this installment to be the same for each year.

We can now distinguish the installment into its two parts: interest and principle. The interest is simply the borrowing rate multiplied by the amount of the loan. For the first period, we have:

\[ B_{24} = \text{Rate} \times B_{22} \]

and respectively for the next periods. Again we will have zero value for the same reason we show before in the case of installments.

On the other hand, the principle is nothing more than the installments paid minus the interest we just calculated. For the first period we have:

\[ B_{25} = B_{23} - B_{24} \]

and respectively for the next periods which for the time being will have a zero value.
Now it is time we calculated the loan balance. It is equal to the initial amount of the loan (as entered in row 22) minus the interest we have calculated. For the first period we have:

$$B_{26} = B_{22} - B_{25}$$

and respectively for the next periods.

We should not forget, though, a pending issue: row 22. The amount of the loan capital of each period, as we have already said, is the balance of the loan after subtracting the interest. So, we will connect this line with the appropriate cells of row 26. More specifically:

$$C_{22} = B_{26},$$
$$D_{22} = C_{26},$$ etc.

All zero values are now automatically filled.

5.1.3 Calculation of operating expenses

Up to now we have dealt with the analysis of revenues from the expected sales and the loan. Now we will organize the operating expenses of the investment. Give the name Operating Expenses to cell A28. Use rows 29-31 to enter the values the following variables take for each period:

- Advertising expenses
- Market research
- Administrative expenses
- Equipment maintenance

The result will be a spreadsheet like the following:
Row 34 presents the total Operating Expenses. Use the following formula:

\[ = \text{SUM}(B29:B32) \]

for cell B34 and copy the relation to the rest of the line as usual.

We can now calculate the **Profits of the enterprise before Taxes, Interests and Depreciations**. We are using this phase in our calculations because payable interests and depreciations of assets enjoy tax exemption, as we have already said. We must, therefore, subtract these two elements from the profits in order to calculate the tax paid by the enterprise.

Use row 36 to calculate profits before taxes, interests and depreciations. The formula for the first period is:

\[ = \text{B14-B34} \]

It is equal, that is, with the revenues minus operating expenses. Copy this relation to the rest of the row’s cells.

Then we have to calculate the depreciations and the impacts on the taxable income. We have analyzed the basic calculation methods of the depreciations in sub-section 1 and the tax impacts in sub-section 2. In our example, we apply the straight line method. Enter, therefore, the following relation in cell B37:

\[ = \text{SLN}(\text{invest}; \text{salvage}; 6) \]

as we have named cell B3, including the investment’s cost for the purchase of machines, invest and cell G5, including the estimated salvage value of the fixed asset, salvage.
If you copy this relation to the other row’s cells, the connection with cells B3 and G5 will remain fixed, contrary to the case that no names are given to the cells but only a simple reference to their coordinates. We have seen how this procedure works. If we subtract, then, in the next row, the depreciations before taxes, interests and depreciations, we will have the profits before interests and taxes. The following formula is entered:

\[ B38 = B36 - B37 \]

and copy to the other cells.

You then enter the annual interests in row 39, connecting the cells with the relative ones of row 24. Calculate the profits before taxes subtracting the interests from the profits before taxes and interests in the next row. Use the following formula:

\[ B40 = B38 - B39 \]

and copy to the other cells.
Finally, we must calculate the interests in order to subtract them from the profits before taxes. Calculate in the next row the amount of taxes of each year. The tax rate of the company is 35%. We have entered this variable to cell B18, which we named Tax. The tax is simply the profits before taxes multiplied by the tax rate. Not so simple though! What will happen in the case the profits before taxes are negative? Are we going to collect tax instead of paying? Of course not! In this case, the tax will be zero. We must enter this restriction in our relation. We use the following formula for the first period:

\[ \text{B41} = \text{MAX}(0; \text{B40} \times \text{Tax}) \]

and copy to the other cells.

The calculation of the investment’s Net Profits is very simple. The only thing we have to do is to subtract the payable tax from the Profits before Taxes. Use row 43. For the first period, enter the formula:

\[ \text{B43} = \text{B40} - \text{B41} \]

and copy to the other cells.
However, as we have already said we are not interested in accounting profits when we are in the procedure of taking an investment decision. We are interested in the real cash flows generated. For this reason, we must calculate them. First of all, we must add the annual depreciations. As we saw in sub-section 1, depreciations are subtracted from the enterprise’s profits for tax reasons but they do not constitute really an outflow. Furthermore, we must take into account the salvage value of the machines in the last year as well as the annual interests as these constitute outflows. The real cash flows, therefore, equal to:

\[
\text{Cash Flows} = \text{Net Profits plus Depreciations minus Interest plus Salvage Value}
\]

Calculate the Cash Flows in row 45. For the first period, enter the relation:

\[
B45 = B43 + B37 - B25 + B5
\]
5.2 Payback Period

The payback period is one of the simplest measuring methods of an investment’s economic value. A payback period is the length of time required between the initial investment and the recovery of the initial capital via its cash flows. If an investment is expected to generate a series of cash flows which are fixed from one year to the other, the payback period can be defined when we divide the total initial cost by the amount of the expected annual cash flows:

\[ \text{Payback Period} = \frac{\text{Initial Cost}}{\text{Annual fixed flows}} \]

For example, if an investment requires an initial outflow of 500 Euros and is expected to generate annual inflows of 100 Euros for the next 7 years, the payback period is:

\[ \text{Payback period} = \frac{500}{100} = 5 \text{ years} \]

If the series of the expected cash flows is not fixed from year to year, the payback period must be determined from the addition of the individual inflows expected in successive periods until their total equals the initial cost.

5.2.1 Calculation of Cumulative Cash Flows

Let’s see how we are going to apply the criterion of the payback period in the example mentioned above:

At first, we must calculate the Cumulative Cash Flows for each year.

This means that for each period we have:

- Cumulative cash flow of the 1st period = 1st period cash flow
- Cumulative cash flow of the 2nd period = 1st period cash flow + 2nd period cash flow
- Cumulative cash flow of the 3rd period = 1st period cash flow + 2nd period cash flow + 3rd period cash flow etc.

It is a good idea to have the calculation model of the payback periods in a different sheet but in the same workbook. We must connect, however, this sheet with the cash flows already calculated in Sheet 1. For this reason, choose the area B45:G45 and give the name CashFlows.
Choose the tab in the bottom of the screen named Sheet 2. Name the first cell Payback Period and enter the time in row 3. Give the name Cash Flows in cell A4.

Choose the range B4:G4 and type =CashFlows.

Then, while keeping Ctrl pressed press Enter. In this way, you have connected this part with the corresponding one of Sheet 1. Any changes in Sheet 1 that will affect the Cash Flows will automatically be transferred to Sheet 2 without our intervention being required.

You can also rename the worksheet from Sheet 2 to Payback Period. In order to this, double click the tab Sheet 2 and choose from the dropdown list Rename.

Type the new name and press Enter.
We must then calculate the net cash flows. Use row 5 for this. Give the corresponding name to cell A5. In net cash flows, the only thing we must do is to add the initial outflow of the investment. This is nothing more than the share capital (which we have named stock). For the first period, the net cash flow is:

\[ B_5 = B_4 \text{stock} \]

There are no additional outflows in the next periods. Therefore, simply equate them with the corresponding cash flows exactly above.

Choose the range B5:G5 and name it NetFlows.

We can now calculate the cumulative cash flows for each period. For this reason, we will use the OFFSET function. Let’s see first how this function operates.

The OFFSET function gives the values in a range of cells. The coordinates of this range are determined on the basis of an initial reference cell or a range of reference cells. The range the OFFSET function returns a reference is determined by a given number of columns and rows above, below, right or left from the reference point. The returned reference can be simply a cell or a whole range of cells. We can determine its exact dimensions.

The syntax of the function is:

\[
\text{OFFSET(} \text{reference; rows; cols; height; width) }
\]

where: \text{reference} is the point of reference for the offset.

This argument must be a reference to a cell or a range of cells. Otherwise, the function gives a \#VALUE! error.

\text{Rows} is the number of rows higher or lower than the top left cell of the argument reference, where we want the top left cell of the result.

If, for example, the argument reference is cell B5 and the argument row is 5, the cell we want the function to show is 5 rows below. That is, cell B10.
Comparatively, if the argument reference is a range e.g. A3:E5, the offset will be based on the top left cell, that is, A3. If the argument rows are again equal to 5, the cell returned will be A8 or, if we want a range of cells, this will start from cell A8.

**Cols** is the number of columns, on the right or left from the top left cell of the argument reference, where we want the top left cell of the result. In the above example, where reference = B5 and rows = 5, if cols = 3, then the cell we want the function to show is 5 rows below and 3 on the right. It will be that is cell E10.

If arguments rows and cols take the cells of the argument reference beyond the borders of the worksheet, then the function gives a value error #REF!.

> **height** is the height of the rows we wish the returned reference to have. This argument must be a positive number.

> **width** is the width of the columns we wish the returned reference to have. This argument must also be positive.

If one of the arguments height or width is omitted, it automatically receives the height and width of the argument reference, respectively.

Let’s return to the investment programme of our example. We wish to calculate the cumulative cash flows in row 5. This will be done based on a range of cells which includes the annual net cash flows of our investment. This range is B5:G5, or otherwise:

<table>
<thead>
<tr>
<th>B5</th>
<th>C5</th>
<th>D5</th>
<th>E5</th>
<th>F5</th>
<th>G5</th>
</tr>
</thead>
</table>

This is the range of reference on the basis of which the offset will take place. Let’s see how we will manually calculate the cumulative cash flows of each period. In the first period, it will simply be the net cash flow of this period.

```
=OFFSET(B5;G5;0;0;1;1)
```

Let’s take this to the function **OFFSET(B5;G5;0;0;1;1)** which is translated as follows:
We have B5:G5 as a reference point. Therefore, the top left cell of the reference point is B5. We want to move 0 rows and 0 columns (since B5 is the cell we are interested in) and the return to be a range of 1 row and 1 column. That is cell B5!

Let’s see now the 2nd period where there are two cells, B5 and C5. In a graph form this is represented as follows:

\[
\begin{array}{cccccc}
B5 & C5 & D5 & E5 & F5 & G5 \\
\hline
\text{Cumulative cash flow} & & & & & \\
\end{array}
\]

\[= B5 + C5\]

and in the function:

\[= \text{OFFSET}(B5:G5; 0; 0; 1; 2)\]

The only thing it has changed is the width of the range to be returned. Now it is 2, as we wish to include 2 cells: B5 and C5. This function will return these two cells. But this is not exactly what we wanted. In order to calculate the cumulative cash flows we must add these two values. We simply have to use the SUM function with the OFFSET function as an argument. We have, therefore:

\[= \text{SUM}(\text{OFFSET}(B5:G5; 0; 0; 1; 2)) = \text{SUM}(B5:C5) = B5+C5\]

Note that the argument width follows the value of the period. We can, thus, replace it with the respective cell. The function for the 1st period is, therefore:

\[= \text{SUM}(\text{OFFSET}(B5:G5; 0; 0; 1; B3))\]

or in other words

\[= \text{SUM}(\text{OFFSET}(\text{NetFlows}; 0; 0; 1; B3))\]

Enter the above relation in cell B6 and copy it to the rest of the cells. The result will be like the following:
Just by looking at the cumulative cash flows, you can see that, at some point after the 3\textsuperscript{rd} year, this investment plan will have recovered its initial cost. It is the point where the cumulative cash flow becomes positive from negative. This is the payback period for this example. Nevertheless, we cannot say exactly when the payback period finished. The only thing we can say is that it finished at some point during the 4\textsuperscript{th} year.

5.2.2 Calculation of the Percentage of the Total Capital Recovered every year

In order to calculate the exact point the capital will be recovered, we have to know the percentage of the total capital recovered every year. In other words, what percentage of the specific recovered capital of each period is represented in the cash flow of this period? This is the ratio of the cumulative cash flow of a period to the net cash flow of the same period. That is:

\[
\text{Cumulative Cash Flow} \quad \text{Net Cash Flow}
\]

Use row 8 in order to calculate the percentage of each period. Initially choose range B6:G6 and name it CumFlows.

Then type the following for the first period:

\[B8 = \text{CumFlows}/\text{NetFlows}\]

and copy to the other cells.

Let’s see what exactly these percentages we just calculated mean. The only meaningful percentage is the percentage of the year during which the payback period is concluded. Practically, it expresses the ratio of this year during which the cumulative cash flow has
exceeded the initial investment’s cost. In other words, what percentage of the year has gone by until the capital is recovered.

In our example, the cumulative cash flow becomes positive in the 4th year. The percentage of this cumulative cash flow to the net cash flow of the 4th year is:

\[ 122,652 \times 0.3152 \text{ or } 31.52\% \]

### 5.2.3 Calculation of Payback Period

Let’s assume that the cash flows are uniformly distributed in time, the initial investment will have been paid back after 68% (100% - 32%) of the 4th year has passed. In other words, when approximately 68% of the 4th year has passed, the cumulative cash flow becomes zero. Therefore, the initial cost of the investment has been recovered. Let’s see it in another way. When 68% of the year has passed, then only 32% of the time still remains. Therefore before the end of the 4th year, at a point in time when 32% would be still remaining till the end, the capital is recovered. Therefore, 3 years and 68% of a year are required, in total, so that the investment’s capital is recovered. In other words:

\[
\text{Payback period} = 3 + 0.6848 = 3.6848 \approx 3.68 \text{ years}
\]

Or 4 years minus 32% of the last year.

\[
\text{Payback period} = 4 - 0.3252 = 3.6848 \approx 3.68 \text{ years}
\]

Use row 9 in order to enter the above relation of our example for each period. For the first period, we have:

B9 = B3-B8

and copy to the other cells.
Choose range B9:G9 and give a name:

**PaybackPer.**

As we have already said, we must choose the value of the period during which the cumulative cash flow becomes positive. We wish, then, to create a rule according to which, our model will decide which of the values of row 9 represents the real payback period. The payback period cannot have finished before the sign of the cumulative cash flow becomes positive. We wish, therefore, our model to ignore all the years until the cumulative cash flow is positive.

In our example, we wish to have a rule to choose the 4th value of row 9; to choose, that is, the cell with the 3 periods with negative cumulative cash flow plus 1. We want, therefore, the periods with positive sign to have value 1. In order to determine the above, use row 11. For the first period, enter the relation:

=IF(B6<=0;1;0)

and copy the relation to the other cells. You will notice that the periods with negative sign have value 1, while the others 0. This is exactly what we wanted.
We will then add these values and after adding one more unity, we will have the payback period. So, type the following in cell B12:

$$=\text{SUM}(B11:G11)+1$$

We have, that is, three unities for the years with negative sign plus one equals 4, which is the payback period.

No our model “knows” which cell includes the payback period (practically it knows that the value we want is included in the 4th cell of a row). We want, now, to create a rule choosing this cell and mentioning its value. For this reason, we will use the INDEX function. This function returns the value of an element from a table. This element is chosen according to the coordinates (row and column) which we have set. The syntax of the function is the following:

$$\text{INDEX}(\text{array}; \text{row\_num}; \text{column\_num})$$

where:
- **array** is a range of cells comprising a table. A specific element will be chosen from this range.

- **row_num** is the argument choosing the table’s row where the value to be returned is. If the argument row_num is omitted, it is compulsory to fill the argument column_num. Then the whole row will be returned.

- **column_row** is the argument choosing the table’s column where the value to be returned is. If the argument column_num is omitted, it is compulsory to fill the argument row_num. Then the whole row will be returned.

Back to our example. The argument array, in our case it is row 9 (or PaybackPer, as we have named this range), includes the year minus the ratio of cumulative cash flows to net cash flows. The element of the table we want to be returned is in the first row and the column where the cumulative cash flow is positive. The latter has been determined in cell B12.

The relative arguments, therefore, are row_num = 1

\[ \text{column_row} = B12 \]

The function that returns the payback period of the investment is the following:

\[ = \text{INDEX(PaybackPer; 1; B12)} \]

Therefore, the payback period of the investment in our example is 3.68 years.

### 5.3 Net Present Value

Our analysis until now has not taken into account the time value of money. This criterion is a direct implementation of the concept of present value. It requires the following steps:

1. Choosing the appropriate interest rate
2. Calculation of the investment’s cash flows and
3. Calculation of the net present value of the cash flows
We could, alternatively, calculate the present value of inflows and outflows of the investment and add them. Either way, the result will be the Net Present Value of the investment. The criterion, according to which we decide if an investment is acceptable or not, base on if its net present value, is bigger or smaller than zero. More specifically:

➢ If Net Present Value < 0, we reject the investment, while
➢ If Net Present Value ≥ 0, we accept the investment

Let’s see an example about how a model of the criterion of Net Present Value is applied.

**Calculation of NPV**

We will use again the investment used in the previous example and will expand the model we have already designed so as to calculate its Net Present Value.

According to the problem, the discount rate of the specific investment is 14%. We have already entered this data in cell B17 of the first spreadsheet of the model.

Use now, the third worksheet for the calculation of the Net Present Value. Give another name to Sheet 3. For example: NPV (Net Present Value).

Give a name to cell A1 and use row 3 to record time. Enter cash flows in row 4.
Remember that we have named them CashFlows.
Then, we will use the appropriate Excel function to calculate the net present value. This function is NPV. Its syntax is as follows:

\[ =NPV(rate; value1; value2; \ldots) \]

Where

- **rate** is the discount rate during a period and
- **value1, value2, \ldots** are 1 to 29 arguments representing cash flows. They must be at equal time distances and occur at the end of each period.

The calculation, therefore, of the net present value is very simple. Provided we have already calculated the cash flows, the only thing we have to do is to apply them in NPV function and subtract the initial outflow which is the share capital (the variable with the name stock). Note that the cash flows we wish to discount must be in successive cells, in horizontal or vertical arrangement. Use, then, cell A6 to give the name **Net Present Value** and type in cell B6:

\[ =NPV(DiscountRate; NetFlows) - stock \]

The result is 265,982.15 Euros.

According to the criterion of the net present value, the investment is acceptable provided the net present value is a positive number. We can incorporate this criterion into our model, so that the proper decision is automatically taken. Choose at first cell B6 and name it **NPV**. Use row 8. Give a name to cell A8 and type in B8:

\[ =IF(NPV>0; \text{"We accept the investment"}; \text{"We reject the investment"}) \]
5.4 Discounted Payback Period

In the criterion of the payback period, we did not take into account the time parameter. On the contrary, in the criterion of the net present value, the time value of money played a basic role. We can extend the first criterion, so that this concept can influence the result.

**Calculation of DPP**

When we calculated the payback period, we used the non discounted net cash flows in order to calculate the accumulative cash flows. The only thing that will change in our calculations is that we will use discounted cash flows.

Use a new worksheet to calculate the discounted payback period. Usually a new Excel workbook has only three worksheets. In order to add one more, right click a sheet tab and choose Insert. Click Worksheet and then OK in the insert menu. Rename the new Sheet to Discounted Payback Period. Enter the time again and the Cash Flows.

Remember how we calculated the accumulative cash flows in the model we designed. We used the OFFSET function. More specifically, we used:

\[=\text{SUM} (\text{OFFSET(NetFlows}; 0; 0; 1; \text{B3}))\]

In order to calculate the cumulative cash flow of each period, we chose a number of cells from the range of net cash flows equaling the digits of this period (via the OFFSET function) and we added them. Now we want to add the discounted cash flows (not the net ones) and subtract the initial outflow. Instead of using the SUM function we will use the NPV function. We will have that is:

\[=\text{NPV} (\text{DiscountRate}; \text{OFFSET(CashFlows}; 0; 0; 1; \text{B3})\text{-stock)}\]

Give the name **Discounted Cumulative Cash Flows** to cell A5 and type in B5:

\[=\text{NPV} (\text{DiscountRate}; \text{OFFSET(CashFlows}; 0; 0; 1; \text{B3})\text{-stock)}\]
The discounted cumulative cash flow of the 4\textsuperscript{th} period, -61,461 €, is the net present value of the cumulative cash flows for the first 4 years of the investment, including the initial outflow.

The remaining procedure is exactly the same with the one we applied in the model of the payback period. Apply it so as to calculate the discounted payback period.

There is, however, \textit{a point that requires special attention}. You must not use the same names in the fields of this worksheet. For example, instead \textbf{CumFlows}, use \textbf{NetCumFlows}, etc. Otherwise, your functions will connect with the data of the model of the non discounted payback period. The result must be a model like the following:

![Image of a spreadsheet with calculations]

The investment’s payback period was 3.68 years. Now the discounted payback period is 4.08 years. Can you understand why? The reason is very simple. In the first case we did not take into account the time value of money. On the contrary, when we took it into account, all cash flows decreased, as the real Euros recovered are worth less the more we get away from their inflow in present. Recovery, therefore, takes more time.

5.5 \textbf{Internal Rate of Return}

Now we will examine a criterion directly connected with the criterion of net present value. It is the Internal Rate of Return (IRR) criterion.

The net present value, as we have seen, is simply the discount of all cash flows minus the initial outflow.

The criterion of this method for the acceptance or rejection of an investment is the comparison of the \textit{Internal Return Rate} with an alternative return faced by the enterprise. It is the so-called \textbf{capital cost} of the enterprise. If the investment brings a return higher than the alternative one, then we accept it, otherwise, we reject it. That is:

- If IRR > alternative rate, we accept the investment
- If IRR < alternative return, we reject the investment
Also, between the two mutually exclusive investments, we chose the one with the higher Interest Return Rate.

Excel has a function for the calculation of this co-efficient.

Its syntax is the following:

\[ = \text{IRR(values; guess)} \]

where values is the table or the cell reference contained

Let’s see how this criterion works with an example.

**Calculation of IRR**

Add one more worksheet in the file you have created for the investment programme we are examining in this section. Name it **IRR**, so as to use it in order to build a calculation model of the Internal Return Rate.

Type a name in cell A1 and enter time in row 3. This time, however, start from period 0, instead of period 1, as we have to include the initial outflow of the investment.

We enter the cash flows in row 4. Give the relevant name to cell B4.

Enter the initial outflow in period 0, that is, the stock variable. You have, though, to give a negative sign so that our model will understand that this is an outflow.

Therefore,

\[ B4 = -\text{stock} \]

We will enter the cash flows for the remaining periods we have calculated in the first worksheet. Pay attention as we cannot use the name we have given to the cash flows range (**CashFlows**), as there is dependence with the column with the initial data. If you type, therefore, \[ =\text{CashFlows} \] in cell C4, we will not have the value of cell B45 of the 1\textsuperscript{st} worksheet, as we would like to happen, but of cell C45. We have, therefore, to enter this relation on our own.

Choose, thus, cell C4 and type symbol =.

Choose then the tab with the initial model (Sheet 1) and click on cell B45. The following relation will automatically be filled in:

\[ C4 = \text{Sheet1!B45} \]

or
C4=CashFlows!B45

if you have renamed Sheet 1 to CashFlows. Copy this relation to the other cells.

We have now created the series we need in order to calculate the internal return rate. We use row 6 for this purpose. Give a name to cell A6 and enter the following formula in cell B6:

=IRR(B4:H4)

The internal rate, therefore, of the investment programme is 32.87%. This must be compared with an alternative return in order to decide if we are going to accept or reject the investment. Create the rule for the above decision. Enter the decision criterion in row 8. It is simply the investment’s capital cost. We are going to create the rule in the next row. Enter the following formula in cell B9:

=IF(B6>B8; “We accept the investment”; “We reject the investment”)

We accept the investment
5.6 Sensitivity analysis

5.6.1 Table with a variable data

Quite often, we can have one or more variables which are influenced by a common key variable. For example, in the financial diagram of a loan, the loan’s installment, the total of all payable installments and payable interest have as a common key variable the periodic interest rate. In such a case we can create a table with data so as to simultaneously calculate the formula/s for the different values of the common key variable. The values of the variable are determined by us.

Let’s see in an example how we can create a table with a variable data and what kind of information we can draw from it.

In order to create a table with the sensitivity analysis of the amount of payable installment, the total payable installments and the total payable interest we will use the following example with regard to the changes of the interest rate.

**Example**

You have concluded a loan of 120,000 Euros. The payment period is 15 years and the nominal rate is 4.6%. You pay with monthly installments. What is the ratio of interest and principal of the first and last installment? Initially we enter the data in a worksheet as shown below:

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Data</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Amount of Loan</td>
<td>120,000.00 €</td>
</tr>
<tr>
<td>4</td>
<td>Payment period in years</td>
<td>15</td>
</tr>
<tr>
<td>5</td>
<td>Annual payments</td>
<td>12</td>
</tr>
<tr>
<td>6</td>
<td>Nominal annual rate with monthly compound interest</td>
<td>4.60%</td>
</tr>
<tr>
<td>7</td>
<td>Type of payments</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Calculations</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Number of periods</td>
<td>180</td>
</tr>
<tr>
<td>11</td>
<td>Interest rate per period</td>
<td>0.0038333333</td>
</tr>
<tr>
<td>12</td>
<td>Amount of installment</td>
<td>-924.14 €</td>
</tr>
<tr>
<td>13</td>
<td>Calculation period of interest/Principal</td>
<td>1</td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Payment analysis</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Interest payment</td>
<td>-460.00 €</td>
</tr>
<tr>
<td>17</td>
<td>Principal payment</td>
<td>-464.14 €</td>
</tr>
<tr>
<td>18</td>
<td></td>
<td>-924.14 €</td>
</tr>
</tbody>
</table>
### Excel tool:

<table>
<thead>
<tr>
<th>Data</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount of Loan</td>
<td>120,000,00 €</td>
</tr>
<tr>
<td>Payment period in years</td>
<td>15</td>
</tr>
<tr>
<td>Annual payments</td>
<td>12</td>
</tr>
<tr>
<td>Nominal annual rate with monthly compound interest</td>
<td>4,60%</td>
</tr>
<tr>
<td>Type of payments</td>
<td>0</td>
</tr>
<tr>
<td>Calculations</td>
<td></td>
</tr>
<tr>
<td>Number of periods</td>
<td>180</td>
</tr>
<tr>
<td>Interest rate per period</td>
<td>0,003833333</td>
</tr>
</tbody>
</table>

We will then create a simple model in order to draw our calculations. The number of periods is nothing more than the years multiplied by the number of annual payments:

\[ B10 = B4 \times B5 \]

The periodic interest rate is the result of dividing the nominal rate by the number of annual payments:

\[ B11 = B6 / B5 \]

The monthly installment is calculated using PMT function as we have already learned. Use row 12:

\[ B12 = \text{PMT}(\text{rate};\text{nper};\text{pv};;\text{type}) \]

The above function will operate provided you have given the appropriate names to the corresponding cells.

---

4 Double click on the icon to use the tool
Finally, we add an additional variable: the period for which we wish to calculate the amount of interest and principal. Use row 13 for this.

Then, using formulas IPMT and PPMT, we will analyze the payment we are interested in regarding the interest and the principal.

If you give value 1 in field “Calculation Period of Interest/ Principal” we have:

- For the 1st payment:
  - Interest: \( B16 = \text{IPMT}(rate; \text{per}; \text{nper}; \text{pv};;; \text{type}) = -460 \text{ Euros} \)
  - Principal: \( B17 = \text{PPMT}(rate; \text{per}; \text{nper}; \text{pv};;; \text{type}) = -464.14 \text{ Euros} \)

- Principal: \( B17 = \text{PPMT}(rate; \text{per}; \text{nper}; \text{pv};;; \text{type}) = -464.14 \text{ Euros} \)
If you give value 180 in field “Calculation Period of Interest/Principal” we have for the last installment:

- Interest: -3.53 Euros
- Principal: -920.61 Euros

In both cases, the total of interest and principal equals the amount of the installment:

\[ B18 = \text{SUM}(B16:17) = -924.14 \text{ Euros} \]
As expected, the ratio interest/principal changes.

The functions we studied might be useful, but not enough. Usually we want to know the interest and principal for a group of successive periods. In this case, we use two other Excel functions:

- **CUMIPMT (rate; nper; pv; start_period; end_period; type)**
  It returns the cumulative interest paid for a loan between two set periods. It is necessary to fill all the fields.

- **CUMPRINC (rate; nper; pv; start_period; end_period; type)**
  It returns the cumulative principal paid for a loan between two set periods. It is necessary here as well to fill all the fields.

Let’s see another example:

You have concluded a mortgage loan of 120,000 Euros. The payment period is 15 years and the nominal rate is 4.6%. The payment is monthly installments. What will be the payments of interests and principal in the first and last year of the loan?

We start again by entering our data in a worksheet as shown below:

The new element in the sheet is these two variables: start period and end period in cells B12 and B13 respectively. Name them: **start_period** and **end_period**.

We use then these two functions we saw above to calculate the cumulated interest and principal in the two periods of interest: the first and last year. For the first year, we have:

- **Interest**: -5,401.06 Euros
- **Principal**: -5,688.58 Euros
And for the last year we have:

- Interest: -271.44 Euros
- Principal: -11,818.20 Euros

In both cases, the sum of the cumulative interests and principal equals the total of twelve annual payments.

In order to study the behaviour of dependent figures, we will first enter the values of the key variable.

In our case, this variable is the interest rate. We have two choices with regard to the table:

1. We can enter the values of the variable in a column one below the other, or
2. We can enter the values in a row, one next to the other.

Enter the values in a row, starting from cell E8. Give values for the real periodic interest rate from 0.30% to 0.70% at 0.05 steps. The cells containing the values of the key variable are called input range (E8:M8). In this case, we can again take advantage of a feature of Excel. Enter values 0.30% and 0.35% in cells E8 and F8, respectively. Choose the range of these two cells. There is a black square in the bottom left corner of cell F8. Move the cursor over it, and it will become a black cross. Click on this corner and, while holding the left mouse button down, drag the cursor to the right until you see value 0.70%.
Release the mouse and the row will be automatically filled.

We must now enter the formulas we are interested in. If the input range is in a horizontal configuration, the formulas must be vertical and vice versa. So, in our case, use cells E9:E11. Connect these cells with the corresponding ones containing the calculation’s functions. That is, E9=B12=pmt, E10=B16 and E11=B17.

Give the corresponding names to cells D9:D11.

Finally, we will create the data table using the corresponding option of Excel. Choose the range of the table (which includes the values of the input variables and the formulas for calculation) which in our case is E8:M11.

Then choose Data Table.
The dialogue box that will appear asks us to determine the cell with the key variable used by the formulas for the calculation. In our case, this cell is B11, which contains the borrowing rate. The window has two fields:

- If the input range is downwards, down a column, enter the range in the text box named **Column input cell**.
- If the input range is across a row, enter the range in the text box named **Row input cell**.

In our case, we use the row input cell = B11. Click OK.

A data table will automatically be created. Make the necessary changes so that all data are correct (format the currency). Now, you can use this table to get an idea about the impact on the monthly installment, the total of interests and installments to be paid, from the change of the interest rate.

### 5.6.2 Data Table of Two Variables

Many times we wish to know the sensitivity of a relation if we change not only one but two key variables. In this case, we must create a data table of two variables. Let’s see how this works through an example.

**Example**

We use again the financial diagram of the loan of the previous example. We want to create a table analyzing the sensitivity of the amount of the payable installment related to the interest rate and debt capital.

We now have two variables and a function determined by them. For this reason, we must create a data table of two variables. Data tables of two variables use only one formula with two lists of input values. The formula we examine must return two separate input cells containing the two key variables that determine it. The values of these variables are entered horizontally for one variable and vertically for the other.

Let’s see in practice how such a table is designed. Enter the formula that returns the two input cells in cell E3. In our case, the formula is the one calculating the amount of payable installment:
We will then enter the values for the two variables for which we are interested in creating a sensitivity analysis:

- The rate and
- The debt capital (pv)

We type horizontally the rate values starting from cell F3 (the same row with the formula we are examining). We enter the following values:

<table>
<thead>
<tr>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
<th>K</th>
<th>L</th>
<th>M</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.30%</td>
<td>0.35%</td>
<td>0.40%</td>
<td>0.45%</td>
<td>0.50%</td>
<td>0.55%</td>
<td>0.60%</td>
<td>0.65%</td>
<td>0.70%</td>
</tr>
</tbody>
</table>

We then type vertically the values of the debt capital, starting from cell E4 (in the same column with the formula we are examining). We enter the following values:

100,000 125,000 150,000 175,000 200,000 225,000 250,000 275,000 300,000

We will have a result as the following:
We are now ready to create the data table. Choose the range including both the calculation formula of the installments as well as the row and column with the values of the key variables. In our case, this range is E3:N12. From the menu Data, click Table. The following dialogue box will appear:

We will use both text boxes: **Row input cell** and **Column input cell**. In the first we will type the cell with the key variable of the rate and in the second the cell with the amount of the loan. We will have, therefore:

Type the appropriate data and click OK. Automatically you will have the data table we designed. Format the table appropriately so that you will have all the data correctly.

Using this table, you can draw conclusions about the sensitivity of the amount of the payable installment of the loan in relation to the changes of both the rate and the debt capital. If, for example, the periodic rate is 0.35% and the debt capital is 275,000 Euros, the installment will be equal to 2,062 Euros.
5.7 Scenario management

5.7.1 Introduction to Scenario Management

A way to approach sensitivity analysis is to make data tables. Another approach is Scenario management. This procedure comprises the examination of a series of variables and the determination of a series of values for them. Every combination of values results in a different scenario or approach. In this way the procedure of decision making can focus on each scenario and evaluate the sensitivity of the most possible data (initial data) in changes in the hypotheses determining the business plan.

Let’s examine the example of the business plan of the production unit we created in the first example. We have copied the calculation models of the criteria of investment decisions in the sheet containing the calculation model of the cash flows of the investment program because the scenarios we will create operate only in the active worksheet. We cannot connect the other worksheets of the same book. Some of the variables that determined the model were the following:

- Market size
- Market share
- Selling price
- Production cost per product item
- Loan rate
- Discount rate
- Advertising expenses
- Market research
- Administrative expenses
- Equipment maintenance

By looking at the above variables, we can say that the two elements that we would trust less in our assessments for the values they will take is the market size and the share our product is going to get. For the other variables, there is a higher trust level, as they are more controllable quantities.

The variable, therefore, which we cannot control directly or assess with a higher precision the values it will take, are Sales. In order to examine the sensitivity of the business plan, both in over-estimations as well as in under-estimations of the sales (or the data that determine them), we must create scenarios determined by various conditions. These conditions can reflect optimistic or pessimistic evaluations. We will examine four hypotheses in our example:

- Double market size
- Half market size
- Double advertising expenses resulting in 30% increase of market share
➢ Half advertising expenses resulting in 45% decrease of market share

We will create scenarios for the above hypotheses. Let’s start with the optimistic scenario regarding the market size with the following procedure:

1. Choose **Tools** from the menu and click on **Scenarios**. A dialogue box like the following will appear:

![Scenario Manager Dialogue Box](image)

2. Click **Add**.

3. In the text box named **Scenario name**, type a name for the scenario we will create. For example, for the first hypothesis, type “Market Size 200% of the initial hypothesis”.

4. Click **Changing cells**.
5. You can fill this text box in two ways: either by choosing with the mouse the cells to be changed or by typing the appropriate cells. In our case, the field that will change is the market size and its range is B7:G7. If the changing cells are not adjacent, you can choose them by pressing Ctrl clicking on the appropriate cells.

6. If you wish, you can enter some comment in the text box Comment in order to give information to possible users of your model or for your facilitation.

7. Choose what you want in the section under Protection. Choose Prevent changes if you want to protect the scenario from any alterations by others or even you. You can also choose Hide so that the title of the scenario does not appear in the text box Scenario Management.
We must note that none of the above choices will make any difference if you have not activated the protection of the worksheet. In order to do it, choose **Tools, Protection, Protect Sheet**.

8. Choose **OK**. Do the same for the warning dialogue box that will appear.

9. The dialogue box “**Scenario values**” that will appear, type the values that you want the changing cells to take. In our example, we want to double the initial values. So simply multiple each one by 2. You will have this result:

   ![Scenario Values dialog box]

Excel will automatically transform the above relations into values the scenario will create.

10. Choose **OK**. You will see again the dialogue box **Scenario management**. But now we will have in the scenario list, the scenario we have just created.

    Do not press **Show**, at least not for the time being, because before going one, we must protect the initial values of the variables that reflect our initial hypotheses. We can do it, by simply creating a different scenario for these values. Follow the same procedure giving another name to this scenario. For example: “**Initial Values**”.
In this scenario, we must protect the initial values both for the market size as well for the market share and advertising expenses. Therefore, you must include these three variables in the 5th step in the changing cells. Remember that in order to choose non adjacent changing cells, keep Ctrl pressed. The result will be as follows:

![Edit Scenario Dialog Box]

The above address comprises a range of adjacent cells (B7:G8) and another one of non-adjacent cells (B29:G29). The two ranges are separated with a semi-colon (B7:G8;B29:G29).

In the 9th step, the initial values of the variables will automatically appear. Leave them as they are and click OK.

We have, therefore, created two scenarios, as we see in the scenario list. Let’s create the appropriate scenarios for the other cases. The next scenario is related to a pessimistic forecast with regard to the market size of the product. Specifically, let’s assume that the market size is half the size of the initial hypotheses. Follow the above steps, with two differences. First of all, use a different title for this scenario. In the 3rd step, therefore, give the title “Market Size 50% of the initial hypothesis”.
The changing cells are the same of the first scenario. In the 9th step, however, change the values of the variables. Specifically, divide each of the initial values by 2 or multiply by 0.50. The result will be as follows:

We have created, therefore, three scenarios: a pessimistic and an optimistic one. Then, we will create a scenario for the double advertising expenses that will result in a 30% increase in the market share. Use again a different title for this scenario. In the 3rd step, thus, type the title “Double advertising expenses – increased market share by 30%”. Choose two ranges in the text box changing cells. Market share and advertising expenses. The first variable is in row 8 and the second in row 29.

Change the values of the variables in the 9th step. Specifically, multiply the values of the market share by 1.30 and the advertising expenses by 2.

Finally, create a scenario for the hypothesis of half of the advertising expenses leading to a decreased market share by 45%. Give the appropriate title to the 3rd step (“Half advertising
expenses – decreased market share by 45%”). The changing cells are the same with the ones of the previous scenario of the double advertising expenses.

Change the values of the variables in the 9th step. Specifically, multiply the values of the market share by 0.45 and the advertising expenses by 0.50.

We have, thus, created five different scenarios which must appear in the scenario list.

5.7.2 Scenario Summary
It is useful now we have created the scenarios to make a summary of their results in a worksheet. In order to do it, choose Scenario summary in the dialogue box Scenario management. The following Scenario Summary dialogue box will appear:

Choose Scenario summary as a reference type. In the text box result cells, we will type the cells whose results we want to appear in the summary. Choose the cells containing the results of the individual criteria of the investment decisions. Specifically, choose cells B60, B68, B84 and B92. For non-adjacent cells, keep Ctrl pressed, as we have already said.
Then click **OK**. A new worksheet will automatically be created called “**Scenario Summary**”, with three horizontal sections:

- Changing cells
- Result cells

The table is divided vertically in the separate cells. You will see in the range of changing cells the some values have been highlighted with a grey colour. These are the values that change in each scenario.

This table is very useful as we can draw conclusions immediately. For example, we can see the present value of the investment program under optimistic or pessimistic expectations. See that some of the result cells have an error value #REF!. This happens because in these hypotheses, we cannot calculate the payback period as the cumulative cash flow of each period is negative.

In order to see the above, go back to the worksheet with the name “**Cash Flows**”. Choose **Tools, Scenarios**. Highlight the scenario of the pessimistic scenario about the market size and choose **Show**.
In this way, the proper cells will be automatically replaced and the criteria will be calculated again. If you go to row 53, where the cumulative cash flows have been calculated, you will see that the sign is negative. This means that in a period of 6 years, the investment’s capital cannot be recovered. The payback period cannot be thus calculated.

Repeat the above procedure for the scenario of half advertising expenses.

5.7.3 Confidence Intervals
The hypotheses we have set in each scenario are a sample of the possible values that the variables will take. We can, therefore, evaluate their maximum and minimum value using the Excel Analysis Package. The procedure is as follows: Choose the worksheet with the name “Scenario Summary” which we created in the previous sub-section. Then, choose Tools, Data Analysis. In the dialogue box that will appear, choose the analysis tool “Descriptive Statistics” and click OK.
Type the address of a row of the result cells you wish to make the analysis in the **Input range**. Specifically, choose the row that contains the internal return rate below each scenario. Do not choose cell D28 as it is the same with cell F28. Therefore, choose the range E28:Ι28.

Choose grouping by **Rows**. Check the option **Summary Statistics** and **Confidence Level for mean** 95%. Click **OK**. A new worksheet will be created with the summary statistics we want. Rename it to “**Summary Statistics**”.

![Data Analysis](image1.png)

![Descriptive Statistics](image2.png)
It is useful to study these statistics; especially the means, the width, the maximum and minimum value in order to better understand how the internal return rate of the investment in relation to the various hypotheses. In order to have a better picture, however, of our expectations about the internal return rate, we will create a confidence level. The confidence level is the following:

Confidence Interval = (Average – Confidence Degree, Average + Confidence Level) Use rows 19 and 20 in order to calculate the higher and lower limit of the interval. Give the appropriate names to cells A19:A20 and then type the following formulas:

B19 = B3-B16 = -12,01%
B20 = B3+B16 = 57,43%

The confidence interval means that, if you repeat the sensitivity analysis 100 times, using similar hypotheses but not the same ones already used, then the internal rate of the 95 out of the 100 analyses will be within the confidence interval (-12,01%, 57,43%) we calculated above.
<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Row 1</strong></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Mean</td>
<td>0.227102282</td>
</tr>
<tr>
<td>4</td>
<td>Standard Error</td>
<td>0.125036312</td>
</tr>
<tr>
<td>5</td>
<td>Median</td>
<td>0.3267201</td>
</tr>
<tr>
<td>6</td>
<td>Mode</td>
<td>#N/A</td>
</tr>
<tr>
<td>7</td>
<td>Standard Deviation</td>
<td>0.279689694</td>
</tr>
<tr>
<td>8</td>
<td>Sample Variance</td>
<td>0.078170397</td>
</tr>
<tr>
<td>9</td>
<td>Kurtosis</td>
<td>-2.206628925</td>
</tr>
<tr>
<td>10</td>
<td>Skewness</td>
<td>-0.098778838</td>
</tr>
<tr>
<td>11</td>
<td>Range</td>
<td>0.647652204</td>
</tr>
<tr>
<td>12</td>
<td>Minimum</td>
<td>-0.078450752</td>
</tr>
<tr>
<td>13</td>
<td>Maximum</td>
<td>0.559201252</td>
</tr>
<tr>
<td>14</td>
<td>Sum</td>
<td>1.135511411</td>
</tr>
<tr>
<td>15</td>
<td>Count</td>
<td>5</td>
</tr>
<tr>
<td>16</td>
<td>Confidence Level (95.0%)</td>
<td>0.347166457</td>
</tr>
<tr>
<td></td>
<td><strong>Calculation of Confidence Interval</strong></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Average - Confidence Degree</td>
<td>-12.01%</td>
</tr>
<tr>
<td>20</td>
<td>Average + Confidence Level</td>
<td>57.43%</td>
</tr>
<tr>
<td>21</td>
<td>C.L. = (-12.01%, 57.43%)</td>
<td></td>
</tr>
</tbody>
</table>
6 Appendixes

6.1 Investment Evaluation Model – Excel Tool
(Separate attachment tool)

6.2 Table of data 1 and 2 variable – Excel Tool
(Separate attachment tool)

6.3 Examples

6.3.1 Example 1: Payback Period, NPV, IPR
Taking into account the inputs of an investment with cost of 30,000 € from a company with economic life 10 years and discount rate 8%, calculate:
   a) The Payback Period
   b) The Net Present Value
   c) Internal Rate of Return

Excel tool:

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input</td>
<td>1000</td>
<td>2000</td>
<td>3000</td>
</tr>
<tr>
<td>Net Cash Flows</td>
<td>-29000</td>
<td>2000</td>
<td>3000</td>
</tr>
<tr>
<td>Cumulative Cash Flows</td>
<td>-29000</td>
<td>-27000</td>
<td>-24000</td>
</tr>
<tr>
<td>Cumulative Cash Flows/ Net Cash Flows</td>
<td>1</td>
<td>-13.5</td>
<td>-8</td>
</tr>
<tr>
<td>Year - Cumulative Cash Flows/ Net Cash Flows</td>
<td>0</td>
<td>15.5</td>
<td>11</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>1</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Payback Period</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time of Payback Period</td>
<td>7.25</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6.3.2 Example 2: Payback Period of Capital, NPV, IPR, Discounted Payback Period
You are considering an investment. The initial cost is 30,000 euros and the economic life is 11 years. Analyzing the data on investment, you conclude that the inputs will be the following. Calculate:
   a) The Payback Period of Capital
   b) The Net Present Value
   c) The Internal Rate of Return
   d) The Discounted Payback Period

5 The tools are available in separate files

6 The tool is available in separate file- Double click on the icon to use it.
### Excel tool:

<table>
<thead>
<tr>
<th>Year</th>
<th>Cash Flow</th>
<th>Internal Rate of Return</th>
<th>Discount Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-30000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>4800</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>5000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>5500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>6220</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>6900</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>7450</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>7950</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>8220</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 6.3.3 Example 3: Sensitivity Analysis

You are considering an investment whose financial details are as follows: initial cost (year 0) of investment 50,000 euros. From the first year and then the inputs provided are the following:

<table>
<thead>
<tr>
<th>Inputs</th>
<th>10,000,00 €</th>
<th>15,000,00 €</th>
<th>17,500,00 €</th>
<th>25,000,00 €</th>
<th>36,000,00 €</th>
</tr>
</thead>
</table>

The residual value of equipment, the fifth year is estimated at 40,000 €, while the discount rate is 20%.

1. Create a model to calculate the net present value and internal rate of return on investment.
2. Consider the changes in NPV and internal rate of return on investment as a result of the changes in the discount rate. Create for this purpose an appropriate Sensitivity Table for the following interest rates:

<table>
<thead>
<tr>
<th>Interest rate</th>
<th>8%</th>
<th>12%</th>
<th>16%</th>
<th>20%</th>
<th>24%</th>
</tr>
</thead>
</table>
3. Consider the changes in NPV and internal rate of return on investment as a result of the changes in the residual value of equipment. Create for this purpose an appropriate Sensitivity Table for the following residual values:

---

7 The tool is available in separate file- Double click on the icon to use it.
4 Consider the changes in the NPV of the investment, as a result of the changes in the amount of the discount rate and the residual value of the equipment. For this purpose create an appropriate Sensitivity Table for the following prices, interest rate and residual value:

<table>
<thead>
<tr>
<th>Interest rate</th>
<th>8%</th>
<th>12%</th>
<th>16%</th>
<th>20%</th>
<th>24%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residual value</td>
<td>0,00 €</td>
<td>10.000,00 €</td>
<td>20.000,00 €</td>
<td>30.000,00 €</td>
<td>40.000,00 €</td>
</tr>
</tbody>
</table>

Excel tool⁸:

You want to create a budget, but you are not sure for the revenues. You can, however, predict different values for the variables that determine it. An initial scenario, for these values, includes the following considerations:

Gross revenues: 50.000 €
Cost of sales: 13.200 €

1. Create a model which will calculate the Gross profit.
2. Create different scenarios for a range of estimates of the price that they will get the variables which determine the gross profit. Specifically, create scenarios for the following estimates:

Gross revenues: 30.000 40.000 60.000 75.000 100.000
Cost of Sales: 7.800 10.400 15.600 19.500 26.000

---

⁸ The tool is available in separate file- Double click on the icon to use it.
Create a report which will summarize these scenarios, so you can compare them. Use a PivotTable.

3. Calculate the average, the range, the maximum and minimum value of the gross profit.

4. Calculate a confidence interval for the value that will get the gross profit with confidence degree 95%.

Excel tool:

<table>
<thead>
<tr>
<th>Gross Revenues</th>
<th>50.000 €</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of Sold Items</td>
<td>13.200 €</td>
</tr>
<tr>
<td><strong>Gross Profit</strong></td>
<td><strong>36.800 €</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gross Revenues</th>
<th>30000</th>
<th>40000</th>
<th>60000</th>
<th>75000</th>
<th>100000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of Sold Items</td>
<td>7800</td>
<td>10400</td>
<td>15600</td>
<td>19500</td>
<td>26000</td>
</tr>
</tbody>
</table>

9 The tool is available in separate file- Double click on the icon to use it.