GENERAL INSTRUCTIONS FOR THE PREPARATION OF A CASH FLOW

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ESALQ

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General instructions for the preparation of cash flow

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Presentation

This information channel, prepared by the coordination of the monograph stage of the USP/ESALQ specialization courses, aims to support the advisors, providing them with pedagogical support to assist in the advising and preparation of monographs in the area of economic feasibility. For the students who want to develop the monograph on this subject, these instructions offer a direction to the correct structure of a cash flow and the analysis related to the calculations of economic feasibility, presenting the main stages that compose their development, as well as the identification of the most frequent questions to eliminate doubts during its development.

Introduction

Cash flow and financial analysis ratios are important tools for project review and decision making. Several students from USP/ESALQ specialization courses develop monographs on the economic feasibility and apply these financial tools in a way that this is an element directly related to the quality of such work. Moreover, even students who are not interested in carrying out research projects related to economic feasibility may eventually need to know how to deal with the basic concepts of financial mathematics, as this approach is often used in the most diverse sectors, especially agribusiness and project management.

However, despite the great relevance of the subject, it is observed some difficulties in properly elaborating these analyses through the construction of adequate and structured cash flow among the students of the institution who write their monographs with this subject. By reading the articles and analyzing the spreadsheets used for the recently presented work calculations, it was possible to verify some patterns of errors made by the students. Although these errors ranged from simple details that could make the work more adherent to reality if considered to more fundamental errors that potentially compromised the results and conclusions presented, it is possible to group them according to the frequency with which they happen and the most basic conceptual problems they reveal.

Some examples of errors found with a certain frequency were:

a) Inadequate use of nominal and real interest rates, as well as, in most cases, the incorrect performance of series deflation;
b) Problems in formulating alternative scenarios that would make the analysis more realistic and adherent to reality;

c) Lack of organization and clarity in the elaboration and structuring of spreadsheets, such as the most appropriate positioning of the data, with the due discrimination of the variables;
d) Lack of clarity in the separation between fixed and variable costs, and lack of knowledge to consider opportunity cost. Also, in this regard, there was a lack of organization and discrimination of the quantities and prices that led to the revenues.

Moreover, the errors listed above show some conceptual problems in financial mathematics, as well as the inadequate use of MS Excel related tools, such as Internal Rate of Return [IRR], Net Present Value [NPV] and Payback.

Given this reality, the MBA USP / ESALQ instructions that address these deficiencies and provides elements that help the correct elaboration of such calculations was created, providing, in a didactic manner, basic subsidies for the proper elaboration of the calculations and even for a more consistent interpretation of the results obtained. In order to facilitate data search for students, some websites (Appendix) that can help in the research data were listed, according to the courses offered.

Objective

Given the previously presented context, the general objective of these instructions is to assist the students of the MBA USP/ESALQ courses to carry out their monographs in the area of economic feasibility. Such teaching material facilitates students' organization of data and calculations, with emphasis on the points where students have the most difficulty, alerting them to the mistakes often made in developing their papers.

As specific objectives, it is intended to instruct students to:

a) Correctly use the nominal and real interest rates, as well as teach them the deflation of the series used, in a clear and concise manner;
b) Expose the ways to formulate alternative scenarios that make the analysis more realistic and adherent to reality;
c) Provide more appropriate ways of organizing the data, so that they are clear in the structuring of cash flow spreadsheets, thus showing the proper way to distinguish them;
d) Separating costs between fixed and variable as well as differentiating them appropriately from investment, defining what opportunity cost is, and showing

the need to incorporate it into project analysis. For revenues, the same will be done in order to minimize the problems of lack of organization and incorrect discrimination of the quantities and prices that give rise to it.

Investment

The investment is the first stage to be considered for analyzing the economic feasibility of a project. It represents all the application of resources in the acquisition of assets and capital such as facilities and equipment intended for some productive purpose. For Bruni (2012), investments are unusable over a certain period, within the company assets and gradually used and incorporated into costs and expenses[1].

Therefore, investments should be introduced as the first component in the structuring of cash flow, according to Table 1, placed in the initial periods to indicate the initial disbursement for project elaboration.

Table 1. Positioning and breakdown of investments in a cash flow

Period	0	1	2	3	4	5	6	7	8	…	N
Investments											
- facilities											
- machinery											
- ...											

Zero is the period in which the investment should be considered. The student should be aware that there is no duplication where part or all the investment is funded: some students mistakenly account for funding both in the initial period and overtime by repaying the funding without the financed amount appearing as an input of resources. Therefore, the invested value is accounted as an exit of resources both in period zero and in the periods in which the interest and depreciation are paid.

In such cases, it is recommended to consider the amount received through financing as a positive amount that reduces the amount spent on the investment. It is possible to treat the financed amount in other ways, which varies according to the project and the funding used, but most importantly be careful that the financed value also appears as an input.

CAPEX and OPEX

Capital Expenditure [CAPEX] represents capital expenditures or capital investment, meaning the amount spent on the purchase of capital goods such as machinery, facilities, and equipment. In other words, all the costs that have incurred on investments in assets such as infrastructure and equipment, with a useful life period within the analyzed project. Usually, CAPEX is an item that composes the investment, since this type of expense is necessary for the project to start, occurring before the first period in which the project is implemented. However, it is possible that the project foresees the need to acquire a new capital asset during its execution, which causes this expense to enter the cash flow in subsequent periods. Operational Expenditure [OPEX], on the other hand, represents operating expenses related to the maintenance of equipment that is directly linked to production and other operating expenses. Therefore, OPEX represents operational expenditure and is considered as an item of operational costs.

An example may facilitate the applicability of such concepts: a company may purchase a car for the purpose of using it to prospect customers. In this case, the acquisition of the car would fit as CAPEX, and the expenses with fuel and revision, relating to the car use would fall under OPEX. It is interesting to point out that, depending on the structure of the project, it is possible that the company is interested to convert certain cash flow exits from covered as CAPEX to OPEX. In this case, this would happen if the company chose not to purchase the car but to rent it. In this case, there would not be expenses for the acquisition, but with its use, with OPEX.

Revenue

Revenue may be separated from operational and non-operational revenues. Operating revenues refer to cash inflows arising from the sale of products or sales with the purpose of the feasibility project. That is, operating revenues consist of the quantity produced that was sold at a certain price. Non-operating revenues are related to revenues derived from other activities not directly related to the project object, such as revenues from financial market investments, among others.

Total revenue is the sum of operating revenues and non-operating revenues. In most economic viability projects presented in the MBA USP/ESALQ, non-operating revenues are not considered, and the total revenue is given by the quantity sold times the price in most cases, as in Eq. (1):

$$\text{Total Revenue} = \text{price x quantity sold} \quad (1)$$

Table 2 shows how total revenue can be introduced to cash flow.

Table 2. Proper positioning of revenues in a cash flow

Period	0	1	2	3	4	5	6	7	8	…	N
Total revenue											

It is important to highlight that there is no operating revenue in zero period since at this moment the activities have not yet started. However, there may be non-operating income in this period, which may come from the financing provided, as highlighted in the previous section.

In many projects, it is difficult to project what operating income will be obtained. Unlike investment and costs, most of the factors that determine revenue are beyond the companies control. Depending on the project and the availability of information, some alternatives to circumvent this difficulty may be interesting. Examples already used successfully in economic viability work are: analysis of economic and social indicators of the region in which the project will be implemented; industry performance indicators such as sales, exports; specialized studies of demand projection; analysis of figures disclosed by other companies in the same or closely related sector in recent years; research through questionnaires; among others. There are several ways for obtaining this information and it may vary according to the objectives of the project. Therefore, it may be very useful to conduct a literature review to search for work that has already done similar economic feasibility analysis or even to find work that can provide relevant information about the market or activity is at stake.

Although the demand estimate is very well structured and based on detailed and reliable information, one must keep in mind that it is a projection and therefore subject to errors and inaccuracies. Hence the importance of analyzing alternative economic scenarios and making a sensitivity analysis, as discussed in the “Scenario and Sensitivity Analysis” section.

Fixed, variable and total costs

For better organization and structuring of data in cash flow, it is necessary to distinguish between the different cost components present in an economic viability project. After distinguishing the project investment figures and entering the revenues, the student should organize the operating costs. It is suggested that when constructing and

structuring a cash flow spreadsheet, the student should separate and discriminate the different cost components into two main branches, namely fixed costs and variable costs.

This is important, as it allows the student to identify precisely all costs that make up their project and monitor them over their life. Find the definition of fixed, variable and total costs below.

Fixed costs: It represents costs that do not vary according to the quantity produced in a certain period. According to Ribeiro (2009), they are defined as those that do not vary with the utilization of installed capacity and the amount produced of goods and services. That is, it exists even when the company does not produce, and maybe the fixed cost of the company installed capacity such as:

- Depreciation and amortization;
- IPTU, rent, and insurance;
- Board and/or labor fees;
- Administrative labor;
- Maintenance and conservation.

For Bruni (2012), it is important to note that fixed costs (and variable costs) are related to production and not to a period. Thus, if the telephone bill has different values over the months, for example, this cost is not related to production and should be classified as a fixed cost component regardless of its variation over time. According to Ribeiro (2009), it is common to include the item “Eventual”, with an estimate of up to 3% of the fixed costs listed above to cover other minor fixed expenses that may not be considered in the analysis.

Variable Costs: This cost component has its value modified as a function of the quantity produced by the company. The more the company produces, the higher its variable costs. For industrial enterprises, the most common variable cost examples are raw materials and packaging used in production (Bruni, 2012). For commercial enterprises, the most common variable costs are the costs of goods sold, and, according to Ribeiro (2009), for service enterprises, the variable costs are the materials and goods related to the provision of services. Variable costs also include salaries and social charges for employees directly engaged in productive activities, in addition to freight and commission on sales. As with fixed costs, Ribeiro (2009) recommends using an estimate of up to 3% on the variable costs previously listed as an estimate for any costs not considered.

Total Cost: total cost represents the sum of fixed costs and variable costs. As with fixed costs, Ribeiro (2009) recommends using an estimate of up to 3% on the variable costs previously listed as an estimate for any costs not considered.

After making this separation with their respective discriminations, it is suggested that the student adds both components into a third cost mode which is the total cost (payments). Table 3 shows an example of how cost separation can be performed in a cash flow spreadsheet.

Table 3. Adequate positioning of costs in cash flow

Period	0	1	2	3	4	5	6	7	8	…	N
Fixed Costs											
- Rent											
- IPTU											
- telephone											
-											
Variable Costs											
- inputs											
-											
Total Cost (Payments)											

Opportunity cost

Opportunity cost can be defined as the potential alternative return on a given resource employed (invested) in the project in question. If the investor has a certain financial resource and wishes to apply it to the project, for example, the opportunity cost of this resource is given by the return that the same resource would have had if it were applied in an alternative and lower risk operation.

In the case of the financial resource, the opportunity cost is easily observed, and it is incorporated into the economic viability calculations through the Minimum acceptable rate of return (TMA) used to bring the values to the present, as discussed in more detail in the “Feasibility Indicators” section. There is usually a problem, however, in cases where the resource employed is their own and the student does not consider it in their feasibility calculations. A producer who owns a certain area of his unused property and starts to use it, for example. Often the student mistakenly disregards the cost of this land because it already composes the property analyzed. In such cases, however, it must be considered that this land has alternative purposes. A good way to consider this opportunity cost from land is the value by which it could be rented or even an estimate of revenue obtained from its use for an alternative activity.

Another opportunity cost that is often overlooked by students is the cost of their time spent designing and implementing the project, which is given by *pro labore.* Imagine

that there is a project with some profitability to be implemented by a student who has great data programming skills, for example. The time the student spends on the project he ceases to spend applying his data programming skills. Therefore, it is necessary to estimate how much the student could earn from income if they were using the time spent in designing and implementing the project in an alternative activity.

Disregarding the opportunity cost is a very common mistake to be found in economic profitability monographs. This is because not all students pay attention to the difference between accounting costs and economic costs. Accounting costs do not consider opportunity costs and those are the ones actually spent by the company. Economic costs, which should be considered for the analysis of the economic viability of projects, consider the opportunity cost of all factors. The cases of land and *pro labore* were exemplified because these are the factors of production that are most often overlooked by students, but this concept must be applied to all factors of production applied in the project. For further details on the difference between accounting costs and economic costs, it is recommended to read Chapters 01 and 03 of Mankiw (2005).

Depreciation

For Camloffski (2014), depreciation [D] refers to the devaluation of a given asset due to its wear over time, be it a vehicle, a machine, equipment and utensils in general, etc. Thus, the student must consider the value of this devaluation being considered in the project in question. Thus, depreciation will be given through a value, calculated over a period that coincides with cash flow, reflecting the lost economic value of the budgeted investments within the viability project that the student intends to create. The most common depreciation method is given by the linear method that is defined according to Eq. (2):

$$\mathrm{D} = \frac{(\mathrm{VI} - \mathrm{VR})}{\mathrm{vu}} \qquad (2)$$

where D: depreciation; VI: initial value of the equipment; VR: residual value of the equipment; and vu: useful life of the equipment.

Depreciation can be calculated by the following example: a new machine was purchased R$19,000.00 [VI], having a Residual Value [VR] of R$ 3,800.00 at the end of

its useful life, ie 20% of the initial value. [VI]. Imagine that the equipment will be used for 20 years [vu], so the depreciation will be:

$$D = \frac{(19.000 - 3.800)}{20} = 760$$

This means that this equipment will have a devaluation of R$ 760.00 annually, over 20 years. Thus, depreciation refers to the difference between the purchase price of the new equipment (Initial Value) and its respective exchange price (Residual Value) after its use over a period within the project which in the example was 20 years.

There are alternative ways to calculate depreciation, such as applying a constant rate, for example. The method described above, however, is widely used to project an estimated value for cash flow inflow if non-operating income is expected to be earned through the resale of equipment used after project completion.

Regarding the inclusion of depreciation in cash flow, it is important to highlight that it should be taken from gross operating income, that is, from the result of subtracting operating revenue by operating cost; Discounted operating income from depreciation is taxable profit, which calculates the amount of tax to be paid; after the withdrawal of the tax, the net profit is obtained. Since depreciation has been taken for tax purposes only, it is added to net income to obtain the cash flow balance for that period. The proper way to account for cash flow depreciation is shown in Table 5 and the “Example of a Cash Flow Preparation”.

The opportunity cost of capital

Having made this brief presentation of opportunity cost and depreciation, you can combine the two concepts for calculating the opportunity cost of capital. Once the investment is made in fixed capital, it is interesting for the project developer to calculate what is the opportunity cost of the acquired assets, this value being given by the interest that could be obtained on the capital invested in an alternative application. Note that what we are looking for is an estimate of the opportunity cost of capital analogous to that made for pro *labore* in the case of the time spent by the project designer, ie, what would be the value that an alternative application of capital could bring if it were not employed in the project in question. As discussed in the “Opportunity Cost” section, in the case of work, this value is given by a monthly remuneration for using the project developer's skills in an alternative activity; in the case of capital, similarly, we seek to estimate how much

would be obtained by applying the amount invested in fixed capital at a given interest rate from a lower risk investment.

One way to calculate this alternative return is by considering the following eq. (3):

$$j = \frac{(VI+VR)}{2} * r \quad (3)$$

where j: interest value over the period; VI: initial value of the equipment; VR: residual value of the equipment; and r: the interest rate.

The calculation of interest [j] given in R$ year-1 can be calculated by the following example: If a new machine was acquired R$ 19,000.00 [VI], having a Residual Value [VR] of R$ 3,800.00. Suppose that the interest rate [r] is 8%:

$$j = \frac{(19.000 + 3.800)}{2} * 0{,}08 = 912$$

It is important to note that this opportunity cost of capital is implicitly calculated when calculating a project's economic feasibility indicators as outlined in the “Viability Indicators” section. Therefore, this amount should not be considered when structuring a cash flow.

Although it offers a good approximation of the opportunity cost of capital, this is not the most appropriate way to estimate it. The most appropriate is to perform the calculation of interest and can be done through the equivalent uniform annual cost. This means calculating the cost of noncurrent capital over a time horizon using an interest rate along with the Initial Value [VI] (defined as Present Value VP, given with the negative sign2), and the Residual Value [VR] (defined as Future Value FV). Thus, the amount of the periodic payments equivalent to the initial disbursement and the final receipt of the capital useful life is obtained. This payment can be set to PGTO as eq. (4):

$$PGTO = D + j \quad (4)$$

where PGTO: payments; D: depreciation; and j: the amount of interest in the period.

Thus, the interest [j] given in R$ year$^{-1,}$ can be calculated according to eq. (5):

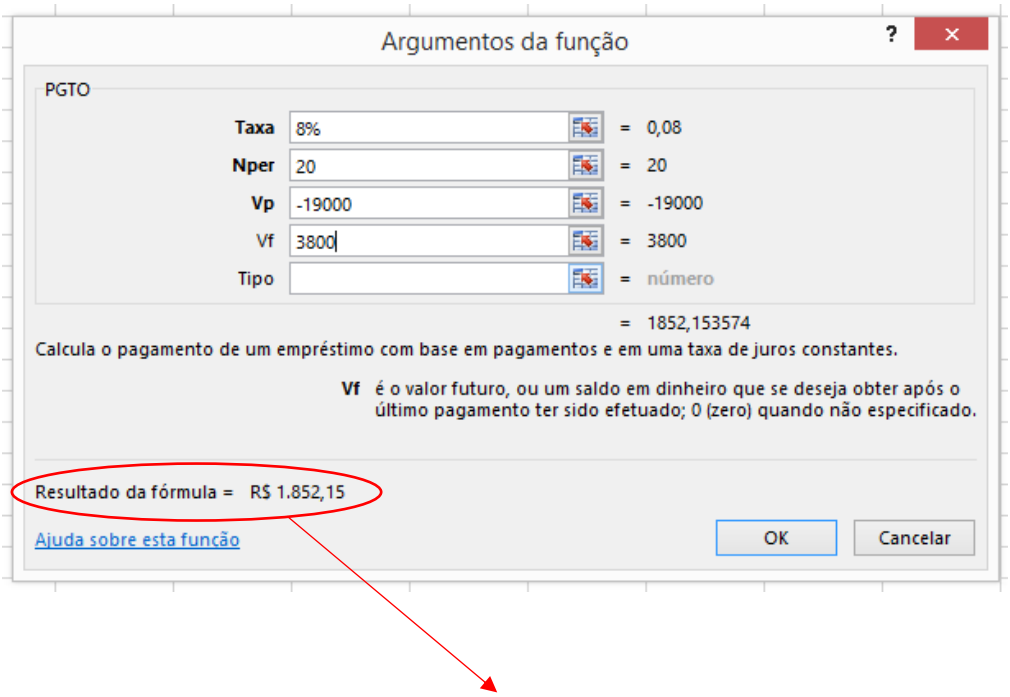
$$j = PGTO - D \quad (5)$$

And the PGTO calculation will be given by Eq. (6):

$$PGTO = VP * \left[\frac{(1+i)^n * i}{(1+i)^n - 1}\right] - VF * \left[\frac{i}{(1+i)^n - 1}\right] \quad (6)$$

Example of the PGTO calculation

Using MS Excel, you can calculate the PGTO from the PGTO function available in the software itself. Thus, using the example of purchasing a machine by R$ 19,000.00 [VP], which has a Final Value [FV] of R$3,800.00 at the end of its useful life, and assuming the equipment will be used for 20 years [n], and that the interest rate [i] for the period will be 8%. In MS-Excel it will be:



Thus, the PGTO = D + j will be R$ 1,852.15 (already provided in the argument window of MS Excel function), where the PGTO represents the cost of capital at a given interest rate (8%). By having this value, it is possible to calculate the annual interest, considering a linear depreciation as calculated in the “Depreciation” section which was R$760,00. Thus, according to the relationship described in eq. (7), we have:

$$j = PGTO - D \quad (7)$$

$$j = 1.852{,}15 - 760 = 1.092{,}15$$

EBITDA or LAJIDA

EBITDA is an important financial indicator that aims to show the performance of the project analyzed, measuring productivity and efficiency, leading the student to evaluate the profitability of the project under discussion.

The term EBITDA stands for "Earning Before Interests, Taxes, Depreciation and Amortization", which in Portuguese is [LAJIDA]. The EBITDA calculation model can be seen in Table 4.

Table 4. EBITDA Calculation

(+)	Total Revenue
(-)	Deductions and Taxes
(=)	Net Receipts
(-)	Total Cost
(=)	Gross profit
(-)	Fixed Costs
(+)	Other Operating Revenues
(=)	EBITDA

EBITDA can be viewed as a component that indicates a project's operational cash-generating capacity, showing whether the project generates profit or loss from its operating activities, not considering tax and financial effects. Thus, EBITDA enables the analysis of the evolution of the valuation process of the project.

Structuring a cash flow

In order to build cash flow, the components described above should be considered in line with the needs of the project in question. Table 5 is an example of how cash flow can be structured, taking into consideration all the components described above.

Table 5. Adequate structuring of a cash flow

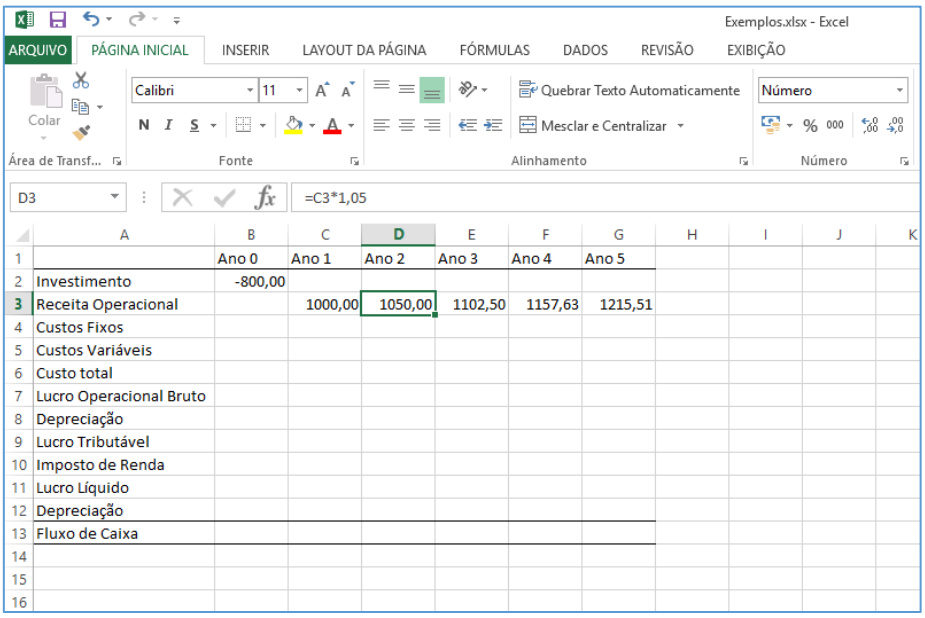
Period	0	1	2	3	4	5	6	7	8	…	N
(-) Investments											
- facilities											
- machinery											
- ...											
(+) Total Revenue											
Fixed Costs											
- Rent											
- IPTU											
- telephone											
- Insurance											
-											
Variable Costs											
- raw material											
- packages											
-											
(-) Total Cost (Payments)											
(=) Gross Profit (Net Cash Balance)											
(-) Depreciation											
(=) Taxable profit											
(-) Income tax											
(=) Net profit											
(+) Depreciation											
(=) Cash flow											

It is also possible to calculate the accumulated cash flow, which is obtained by summing the periods prior to the value of the period considered. In this regard, it is important to note that the cash flow used for the calculation of project feasibility and profitability indicators to be addressed in the “Example of a Cash Flow Preparation” are presented above, ie the current values and not the accumulated cash flow. The application of the economic feasibility index formulas to the accumulated values generates values that have no analytical interest.

Example of a cash flow reparation

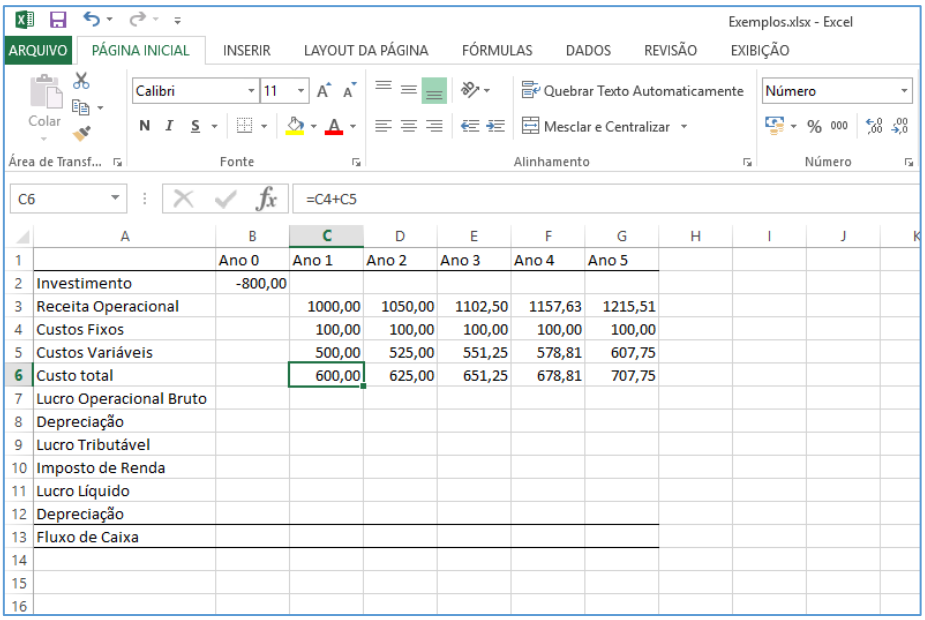
A company whose unit of its product is sold by R$1.00 estimates to sell 1,000 units in the first year of activity, with projected growth of 5% per year over a period of 5 years. The initial investment required for the activity is R$ 800.00 and the fixed cost is R$100.00. The estimated cost per unit produced is R$ 0.50. Considering that the estimated depreciation costs are 5% of the initial investment value each year and the income tax charged is 27.5%, how should the cash flow be set up?

Following the sequence of information presented in this section, the investment is first accounted for in year 0 (zero). In the sequence, revenue for the first year calculated and revenue for subsequent years is projected from the projected growth rate. This means that in the first year the revenue will be R$ 1,000.00; in the second year R$ 1,050.00; In the third year the same growth rate should be applied over the previous period, which results in an estimated revenue of R$ 1,102.05 and so on until the year 5 (five). The inclusion and calculation of these values are illustrated in an MS Excel spreadsheet below:



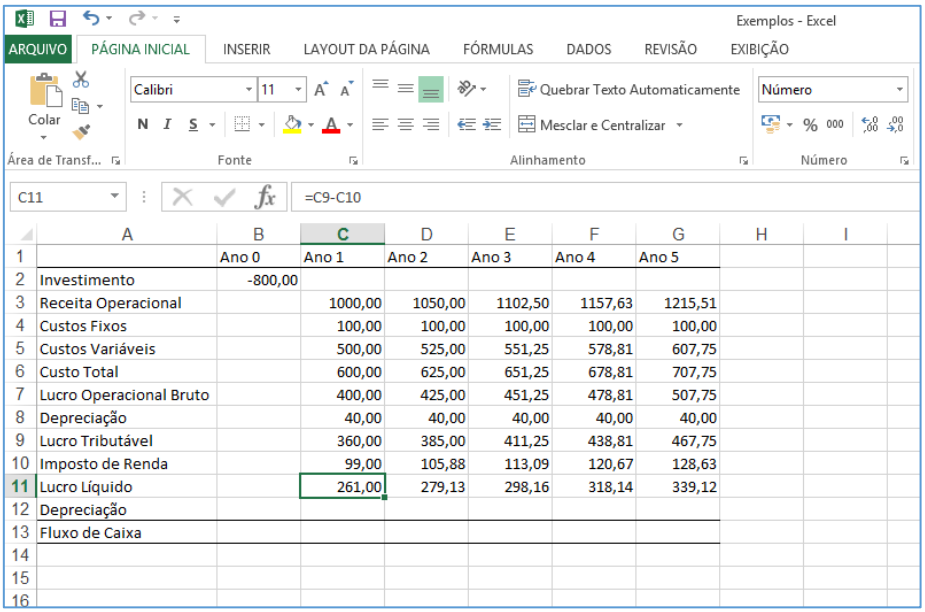
	A	B	C	D	E	F	G
1		Ano 0	Ano 1	Ano 2	Ano 3	Ano 4	Ano 5
2	Investimento	-800,00					
3	Receita Operacional		1000,00	1050,00	1102,50	1157,63	1215,51
4	Custos Fixos						
5	Custos Variáveis						
6	Custo total						
7	Lucro Operacional Bruto						
8	Depreciação						
9	Lucro Tributável						
10	Imposto de Renda						
11	Lucro Líquido						
12	Depreciação						
13	Fluxo de Caixa						
14							
15							
16							

In the sequence, the costs are calculated. Fixed costs are R$100 every year. Variable costs should also grow 5%, representing the estimated sales increase also considered in revenue. The sum of both will offer us total cost, as shown in the figure below.



	A	B	C	D	E	F	G
1		Ano 0	Ano 1	Ano 2	Ano 3	Ano 4	Ano 5
2	Investimento	-800,00					
3	Receita Operacional		1000,00	1050,00	1102,50	1157,63	1215,51
4	Custos Fixos		100,00	100,00	100,00	100,00	100,00
5	Custos Variáveis		500,00	525,00	551,25	578,81	607,75
6	Custo total		600,00	625,00	651,25	678,81	707,75
7	Lucro Operacional Bruto						
8	Depreciação						
9	Lucro Tributável						
10	Imposto de Renda						
11	Lucro Líquido						
12	Depreciação						
13	Fluxo de Caixa						
14							
15							
16							

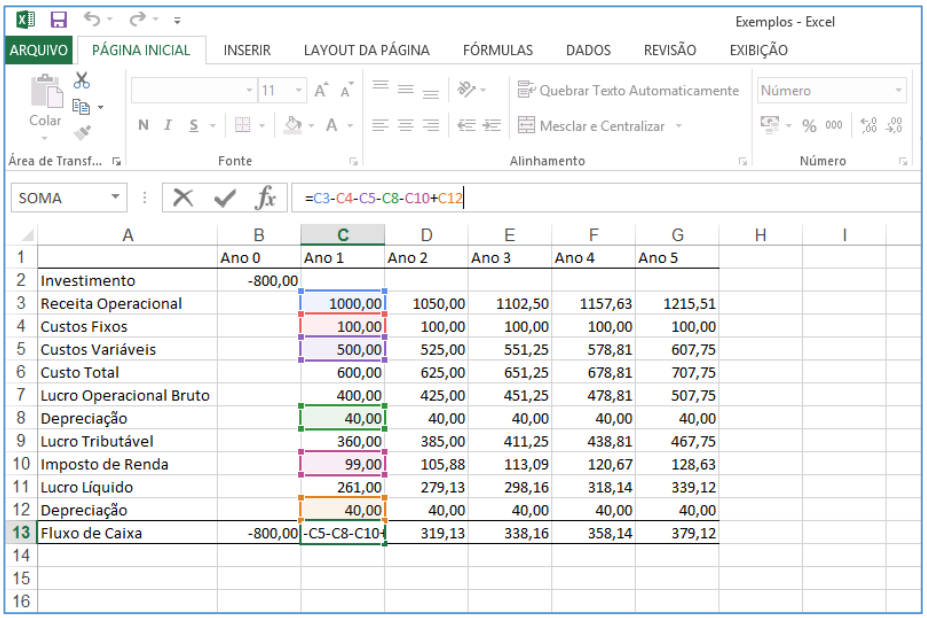
Subtracting operating revenue by total cost gives us gross operating income. This, discounted by the estimated depreciation, offers us the taxable profit. As the initial investment was R$ 800.00 and the depreciation rate considered was 5% of this amount, the estimated depreciation amount is R$ 40.00. The income tax rate is 27.5%. Thus, for the first year, we will have a gross operating profit of R$400.00, a taxable profit of R$360.00. Net income, in its turn, will be the result of subtracting taxable income by income tax; in this case, it will be R$ 261.00.



	A	B	C	D	E	F	G
1		Ano 0	Ano 1	Ano 2	Ano 3	Ano 4	Ano 5
2	Investimento	-800,00					
3	Receita Operacional		1000,00	1050,00	1102,50	1157,63	1215,51
4	Custos Fixos		100,00	100,00	100,00	100,00	100,00
5	Custos Variáveis		500,00	525,00	551,25	578,81	607,75
6	Custo Total		600,00	625,00	651,25	678,81	707,75
7	Lucro Operacional Bruto		400,00	425,00	451,25	478,81	507,75
8	Depreciação		40,00	40,00	40,00	40,00	40,00
9	Lucro Tributável		360,00	385,00	411,25	438,81	467,75
10	Imposto de Renda		99,00	105,88	113,09	120,67	128,63
11	Lucro Líquido		261,00	279,13	298,16	318,14	339,12
12	Depreciação						
13	Fluxo de Caixa						
14							
15							
16							

Finally, the amount of depreciation withdrawn for calculating taxable income should be reconsidered for calculating the cash flow balance for that year. This is

because the value is taken only for the calculation of taxes, not representing an expenditure made by the firm. Thus, the sum of net income and depreciation gives us the balance for that year. For the first year, the balance is R$ 301.00. The calculation in the MS Excel spreadsheet is illustrated below.



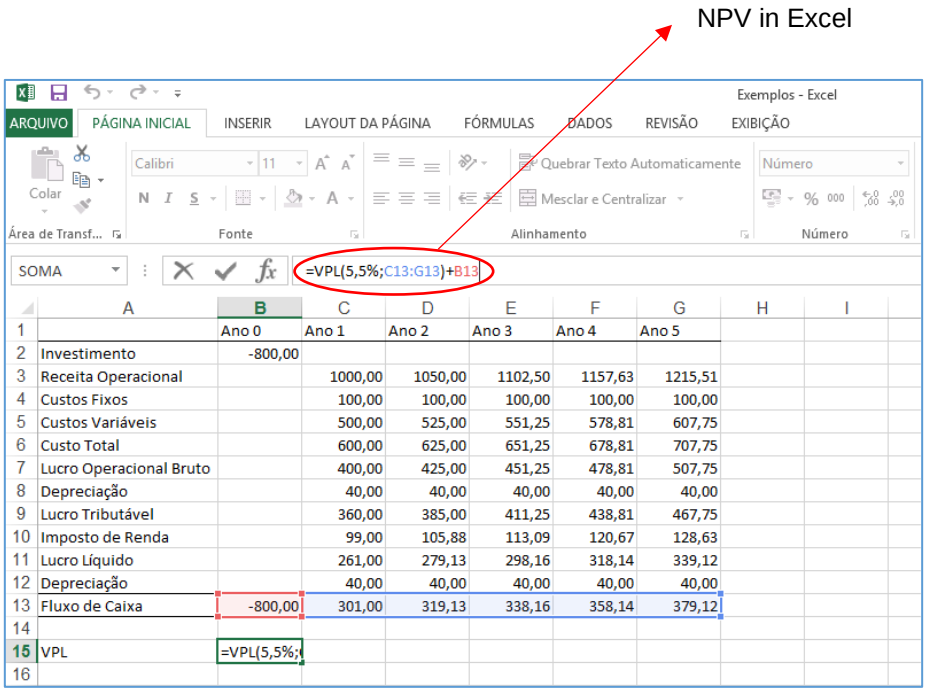
	A	B	C	D	E	F	G
1		Ano 0	Ano 1	Ano 2	Ano 3	Ano 4	Ano 5
2	Investimento	-800,00					
3	Receita Operacional		1000,00	1050,00	1102,50	1157,63	1215,51
4	Custos Fixos		100,00	100,00	100,00	100,00	100,00
5	Custos Variáveis		500,00	525,00	551,25	578,81	607,75
6	Custo Total		600,00	625,00	651,25	678,81	707,75
7	Lucro Operacional Bruto		400,00	425,00	451,25	478,81	507,75
8	Depreciação		40,00	40,00	40,00	40,00	40,00
9	Lucro Tributável		360,00	385,00	411,25	438,81	467,75
10	Imposto de Renda		99,00	105,88	113,09	120,67	128,63
11	Lucro Líquido		261,00	279,13	298,16	318,14	339,12
12	Depreciação		40,00	40,00	40,00	40,00	40,00
13	Fluxo de Caixa	-800,00	-C5-C8-C10+	319,13	338,16	358,14	379,12
14							
15							
16							

Feasibility indicators

With cash flow organized in the manner discussed and exemplified above, the next step is to calculate project feasibility indicators. There are three main feasibility indicators: Net Present Value [NPV], Internal Rate of Return [IRR], and Payback, which is subdivided between Simple Payback and Discounted Payback.

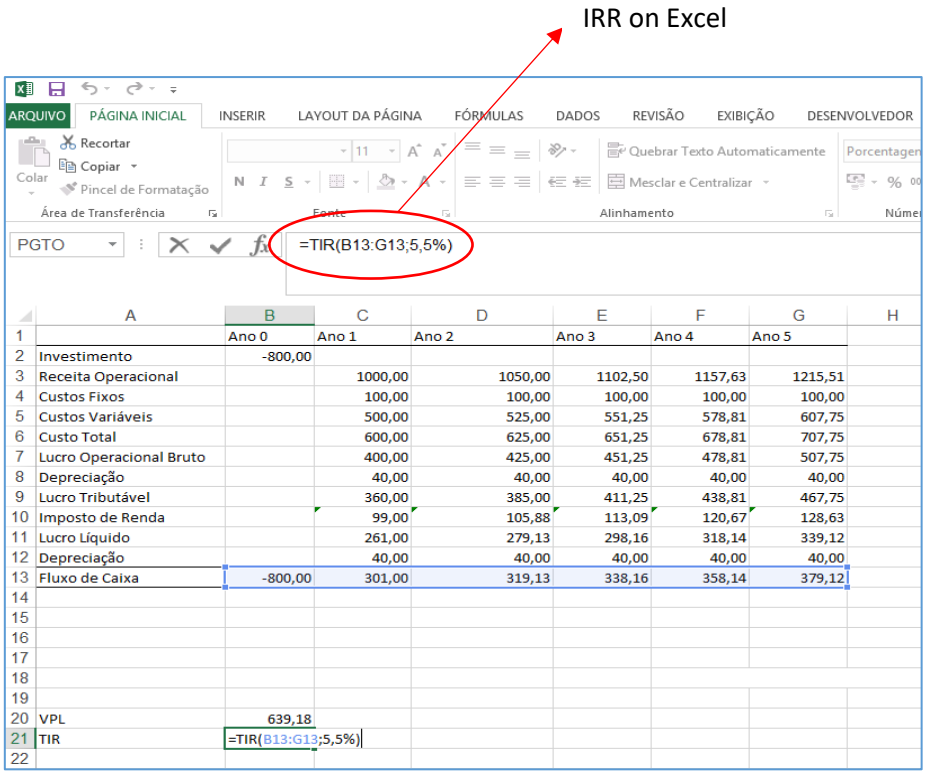
The NPV is the comparison of the inputs and outputs of all periods brought to present value. That is, it is the sum of the results of each year brought with reference to year zero. To bring this value to the present one must consider using a rate that represents the minimum that is sought with that project. This rate is the minimum acceptable rate of return [MARR]. Usually, MARR is the real rate of return on a risk-free investment, which can be represented by the purchase of government bonds. In order to obtain the MARR, one may consider either a real rate of return or a nominal rate of return discounted by inflation. The relationship between these rates, and the correct way to discount the nominal rate by inflation, are dealt with in the section "Interest and nominal and real interest rates" Considering a 5.5% rate for the above example, project NPV is R$639.18 as shown in the illustration of MS Excel spreadsheet below used to carry this calculation. MS Excel performs this calculation using the "NPV" command (circled in red

in the figure below) where you enter the chosen MARR (5.5%) and the period cash flow values, adding the investment value externally.



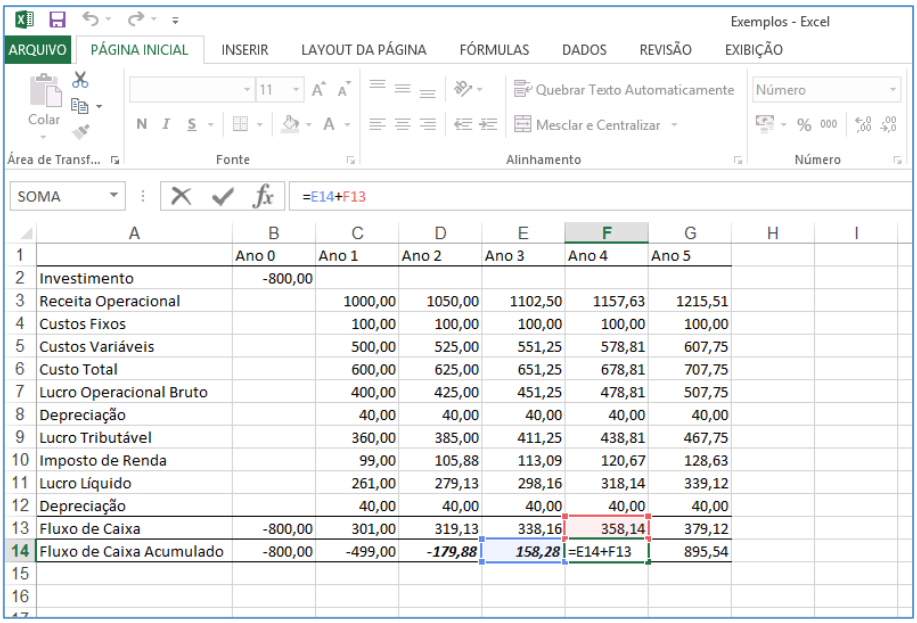
IRR is the rate that would make this cash flow zero. Note that the 5.5% MARR choice resulted in a positive value, which indicates that the IRR will be higher than this value. By calculating the IRR in the MS Excel spreadsheet we obtain a value of 30.11%. MS Excel performs this calculation using the “IRR” command (circled in red in the figure below) where you enter the cash flow values for the entire period considering the investment amount, and an estimated value for the IRR (which does not affect the result obtained). The student should be aware of the application of IRR in cases where cash flow fluctuates positive and negative values over time in the project[1]. In these cases, the project may present several values for IRR, negative or positive, even no solution, which means that the IRR found has no economic meaning and should be disregarded.

[1]Projects typically start with negative values, which represent the investment. In subsequent periods, resource entries are often observed. This caveat when calculating the IRR refers to cases where, after the project has already presented a positive balance in at least one year, it presents negative balances again.



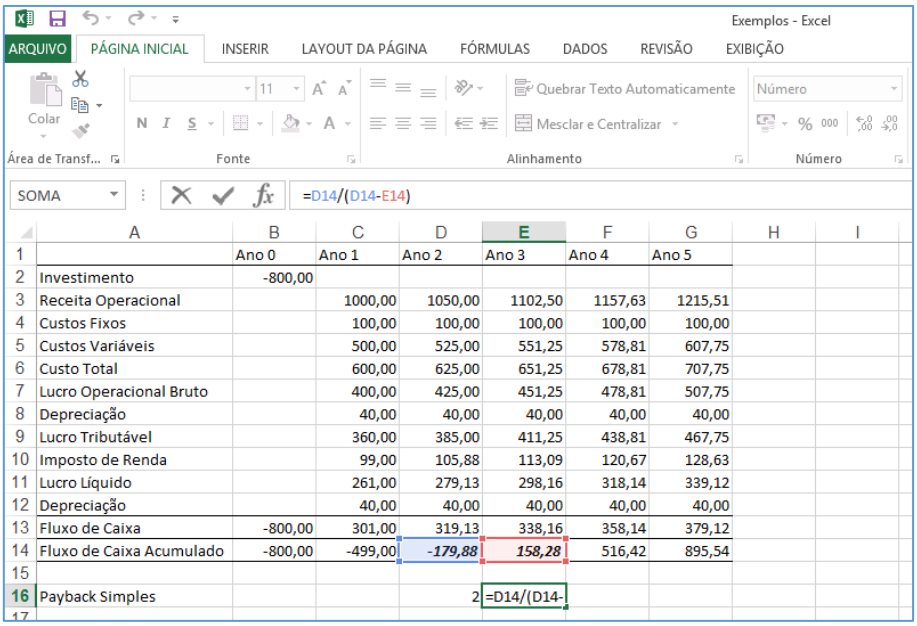
Payback is the period in which the initial investment is recovered through cash inflows in subsequent periods. In order to facilitate Payback calculation, it is recommended to calculate accumulated cash flow, which is done by summing each cash flow balance with the amounts from previous periods. This cash flow can be calculated in two ways: not bringing the values of future periods to the present or bringing the values of future periods for this present (of course, it is recommended to use the TMA to carry this operation). In the first case, we have simple Payback; in the second case, we have the discounted Payback.

The spreadsheet presented below illustrates how to calculate the accumulated cash flow. Note that the values highlighted in bold and italics indicate that the accumulated cash flow was positive between years 2 and 3.



	A	B	C	D	E	F	G
1		Ano 0	Ano 1	Ano 2	Ano 3	Ano 4	Ano 5
2	Investimento	-800,00					
3	Receita Operacional		1000,00	1050,00	1102,50	1157,63	1215,51
4	Custos Fixos		100,00	100,00	100,00	100,00	100,00
5	Custos Variáveis		500,00	525,00	551,25	578,81	607,75
6	Custo Total		600,00	625,00	651,25	678,81	707,75
7	Lucro Operacional Bruto		400,00	425,00	451,25	478,81	507,75
8	Depreciação		40,00	40,00	40,00	40,00	40,00
9	Lucro Tributável		360,00	385,00	411,25	438,81	467,75
10	Imposto de Renda		99,00	105,88	113,09	120,67	128,63
11	Lucro Líquido		261,00	279,13	298,16	318,14	339,12
12	Depreciação		40,00	40,00	40,00	40,00	40,00
13	Fluxo de Caixa	-800,00	301,00	319,13	338,16	358,14	379,12
14	Fluxo de Caixa Acumulado	-800,00	-499,00	*-179,88*	*158,28*	=E14+F13	895,54
15							
16							

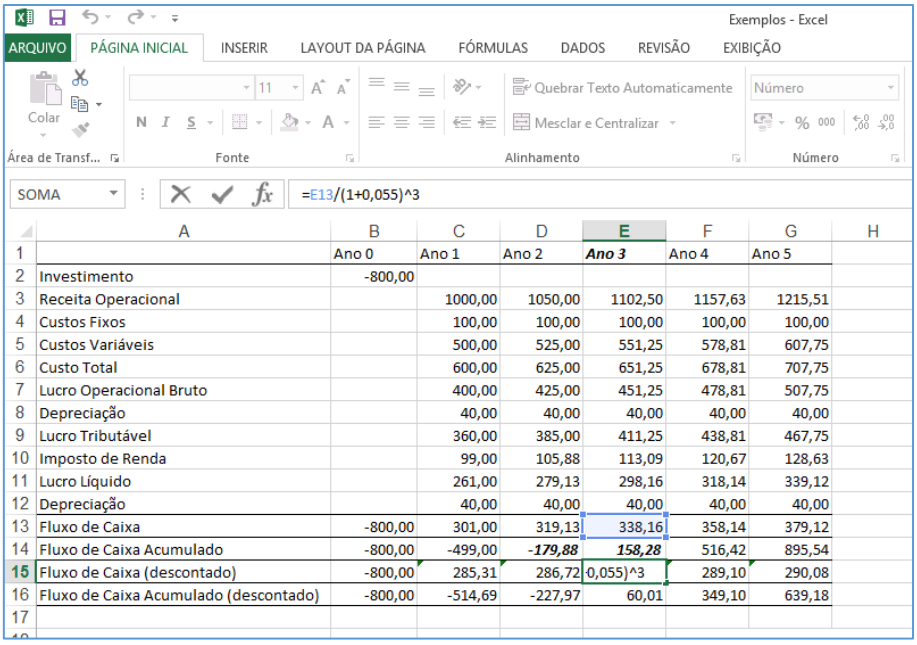
We then start from this information and divide the second-period balance by the difference between the second-period balance and the third-period balance to specify the time at which the initial investment was recovered. In this case, simple Payback is 2.53.



	A	B	C	D	E	F	G
1		Ano 0	Ano 1	Ano 2	Ano 3	Ano 4	Ano 5
2	Investimento	-800,00					
3	Receita Operacional		1000,00	1050,00	1102,50	1157,63	1215,51
4	Custos Fixos		100,00	100,00	100,00	100,00	100,00
5	Custos Variáveis		500,00	525,00	551,25	578,81	607,75
6	Custo Total		600,00	625,00	651,25	678,81	707,75
7	Lucro Operacional Bruto		400,00	425,00	451,25	478,81	507,75
8	Depreciação		40,00	40,00	40,00	40,00	40,00
9	Lucro Tributável		360,00	385,00	411,25	438,81	467,75
10	Imposto de Renda		99,00	105,88	113,09	120,67	128,63
11	Lucro Líquido		261,00	279,13	298,16	318,14	339,12
12	Depreciação		40,00	40,00	40,00	40,00	40,00
13	Fluxo de Caixa	-800,00	301,00	319,13	338,16	358,14	379,12
14	Fluxo de Caixa Acumulado	-800,00	-499,00	*-179,88*	*158,28*	516,42	895,54
15							
16	Payback Simples			2	=D14/(D14-		

In the case of discounted Payback, the same procedure is performed for discounted accumulated cash flow. In order to obtain discount cash flow, the MARR must be discounted from the values for subsequent years. For the first year, the value should be divided by (1+MARR); for the second period by (1+MARR)^2; for the period n (1+TMA)^n. This should be done because it is a compound interest rate. The discounted

cash flow calculation is illustrated below (highlighting the third-period balance calculation).



	A	B	C	D	E	F	G	H
1		Ano 0	Ano 1	Ano 2	***Ano 3***	Ano 4	Ano 5	
2	Investimento	-800,00						
3	Receita Operacional		1000,00	1050,00	1102,50	1157,63	1215,51	
4	Custos Fixos		100,00	100,00	100,00	100,00	100,00	
5	Custos Variáveis		500,00	525,00	551,25	578,81	607,75	
6	Custo Total		600,00	625,00	651,25	678,81	707,75	
7	Lucro Operacional Bruto		400,00	425,00	451,25	478,81	507,75	
8	Depreciação		40,00	40,00	40,00	40,00	40,00	
9	Lucro Tributável		360,00	385,00	411,25	438,81	467,75	
10	Imposto de Renda		99,00	105,88	113,09	120,67	128,63	
11	Lucro Líquido		261,00	279,13	298,16	318,14	339,12	
12	Depreciação		40,00	40,00	40,00	40,00	40,00	
13	Fluxo de Caixa	-800,00	301,00	319,13	338,16	358,14	379,12	
14	Fluxo de Caixa Acumulado	-800,00	-499,00	***-179,88***	***158,28***	516,42	895,54	
15	Fluxo de Caixa (descontado)	-800,00	285,31	286,72	0,055)^3	289,10	290,08	
16	Fluxo de Caixa Acumulado (descontado)	-800,00	-514,69	-227,97	60,01	349,10	639,18	
17								

Note that after the discounted cash flow has been calculated, the accumulated discounted cash flow is calculated, which is used to calculate the discounted payback. Note that the discounted Payback is expected to be higher than the simple Payback, as in the case of discounted Payback future revenues are discounted by the MARR, resulting in lower amounts being added to the discounted cash flow, which postpones that the initial investment is offset by cash inflows.

Nominal and real values - deflating data series

This section aims to assist the student in the procedure of deflating series used in cash flow. The importance of this procedure is the fact that it is necessary to use real variables, that is, variables that have been extracted from the action of inflation. This should be done, as a cash flow considers a period – be it monthly or annual, so there will be the effect of inflation in the period.

Based on Sartoris (2003), we can observe the deflation of a series of data, which can be understood from an example. Based on Table 6, the wages of a group of workers, and the respective inflation for the period are presented.

Table 6. Nominal wages and inflation in each period

Month	Current price wages (nominal wages)	Inflation of the period (%)
January	$ 100	3
February	$ 110	3.2
March	$ 120	3.4
April	$ 130	3.6
May	$ 140	4
June	$ 150	4.1
July	$ 160	4.3

From Table 6, it is observed the need to obtain the real wages of workers. Wages represent a constant value that, based on it, it can identify these workers' purchasing power. This means extracting the effect of the devaluation of inflation on nominal wages, known as deflation of a range of data.

This procedure is performed from a simple cross-multiplication. Thus, it is possible to find the value of the respective month at June prices:

January real wage (July price) = (100x4.3) / 3 = $ 143.33
Real February wage (July price) = (110x4.3)/3.2 = $ 147.81
Real March wage (July price) = (120x4.3)/3.4 = $ 151.76
April real wage (July price) = (130x4.3) / 3.6 = $ 155.28
May real wage (July price) = (140x4.3)/4 = $ 150.50
June real wage (July price) = (150x4.3) / 4.1 = $ 157.32
July real wage (July price) = (160x4,3)/4,3 = $ 160

Thus, it is possible to complete Table 6 with Table 7, as follows:

Table 7. Nominal and real wages and inflation in each period

Month	Current price wages (nominal wages)	Inflation of the period (%)	Real wages (wages at constant prices)
January	$ 100	3	$ 143.33
February	$ 110	3.2	$ 147.81
March	$ 120	3.4	$ 151.76
April	$ 130	3.6	$ 155.28
May	$ 140	4	150.28
June	$ 150	4.1	$ 157.32
July	$ 160	4.3	$ 160

Based on Table 7, it is observed that there was a fall in workers' purchasing power during May, and there was an increase in the other months.

Interest and nominal and real interest rates

For Assaf Neto and Lima (2014), interest represents the amount that the lender charges for lending someone money. Also, it can be understood as the expected value when an individual conduct an investment operation (Assaf Neto and Lima, 2014).

The nominal interest rate corresponds to the amount (in %) provided by financial institutions which focus on investment loans as well as consumer and credit cards. When an individual makes a loan or has a credit card debt, it is the nominal rates that will incur over their outstanding balance, not considering the effect of inflation on the debt period.

On the other hand, there is the real interest rate which consists of the nominal interest rate, discounted to inflation. A practical example would be an individual who has an amount invested, the bank informs him that his investment had an annual yield of 12% (nominal interest), while inflation in the period was 6% per annum. Based on this information, it is possible to calculate the real interest rate consisting of interest received after discounting inflation. This calculation is given by Eq. (7):

$$\text{Real interest} = \frac{(1+\text{Nominal Interest})}{(1+\text{Inflation})} - 1 \qquad (7)$$

$$\text{Real interest} = \frac{(1 + 0.12)}{(1 + 0.06)} - 1$$

$$\text{Real interest} = \frac{(1.12)}{(1.06)} - 1 = 0.0566$$

Multiplying 0.0566 by 100:

$$\text{Real interest} = 5.66\%$$

The student should pay attention because, although the value is given as a percentage (%) for both the nominal interest rate and the inflation rate, when applying (2) these values must be in decimal numbers (0.12 for the nominal interest rate, and 0.06 for the inflation rate). As a result, the real interest rate will also be a decimal value (0.0566), which must be multiplied by 100 so the percentage value (5.66%) can be obtained.

The importance of making this calculation is that the real interest rate discounting the effect of inflation in the period providing the real gain of investment in the corresponding period, ie, according to Assaf Neto and Lima (2014) it will indicate the incident real portion of interest (excluding inflation) either in investment or in the cost of capital. It is important to consider the impact of real variables, given that an investment has a time horizon within the project. Thus, when considering interest rates in investment within cash flow, it is necessary to use the real interest rate.

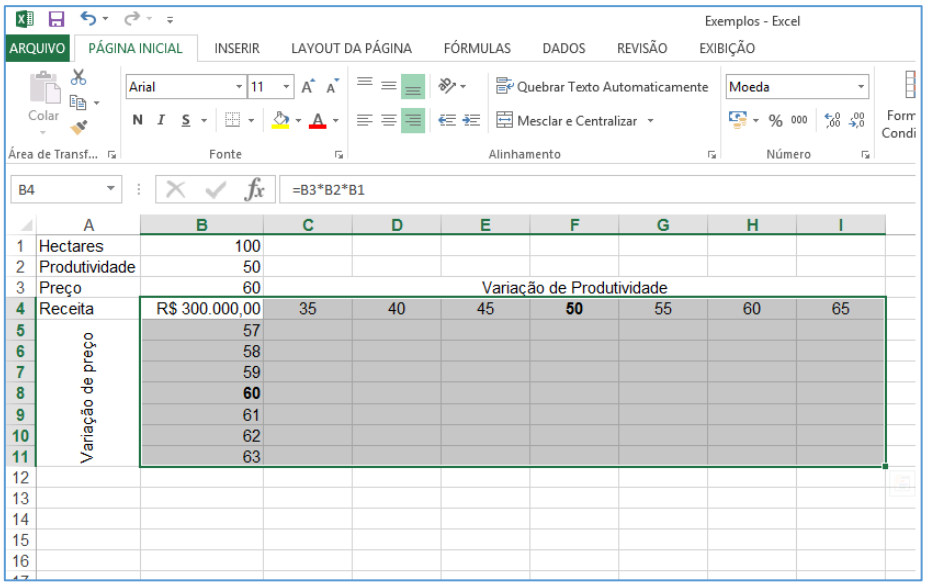
Considering what has been presented in this section and in the previous section, it can be noted that there are two alternative ways to consider cash flow and the rate of inflation. The first is to consider all cash flow in nominal terms, ie projecting cash flow and including an expectation of inflation, and to consider a nominal interest rate. On the other hand, it is also possible to consider cash flow in real terms, ie without incorporating an expectation of inflation, and to use a real interest rate to calculate the present value. A relatively common mistake is to consider nominal values and discount them at a nominal rate, so that inflation is not considered; on the other hand, there are cases, although less frequent, of students who deflate the grade and bring the projected values to the present at a real rate, which implies considering the discount of the inflation rate in a double way.

Scenario and sensitivity analysis

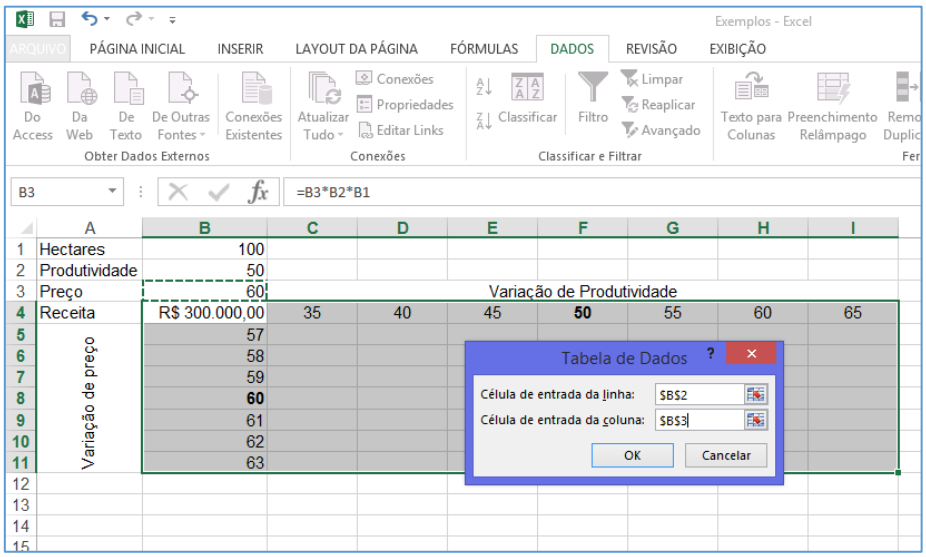
There is a possibility of errors in cash flow projections, both in terms of cost and revenue. Costs are usually more easily predicted than revenues, as they are more closely related to the designer's decisions, while revenues vary with demand, which in turn is determined by external factors, which are most often not possible to control. In the case of agricultural enterprises, for example, there is also the possibility of numerous productivity variations, often associated with climatic factors such as drought, excessive rainfall, among others.

For each specific type of project, you need to assess which risks are the most prevalent and consider them in different scenarios. It is then possible to make the sensitivity analysis of the projects, which is nothing more than to calculate how different scenarios may affect the profitability indicators. For example, you might consider a pessimistic scenario, where sales are down 25% from the projected base scenario, and an optimistic scenario, where sales are up 25% over the projected base scenario. By calculating the feasibility indicators of each scenario, it is possible to verify if the project is viable even considering adverse situations. This is also true when considering a crop failure that affects yield which is common in crop feasibility analysis, for example.

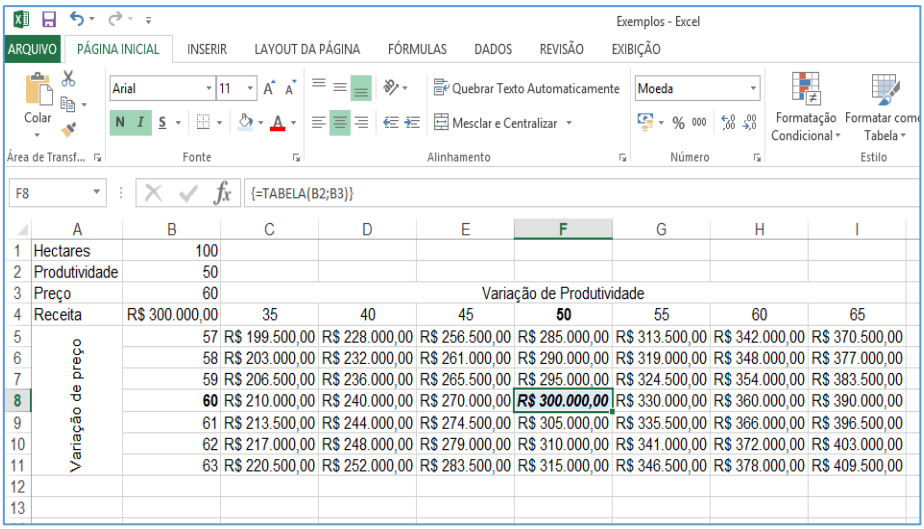
One tool that can be very useful in this type of analysis is the MS Excel data table. Through it, it is possible to verify the impact of changes on two variables simultaneously. Imagine, for example, that a feasibility project aims to grow soybeans on an area of 100 hectares. The base scenario considered assumes productivity of 50 bags per hectare, at a bag price of R$ 60.00. Thus, the estimated revenue for the project is R$ 300,000.00. What is sought in this sensitivity analysis is what the impact on revenue of changes in productivity and price is. From the base scenario, we consider reductions and additions of 5 units in productivity and 1 unit in prices, so that we can assemble the table illustrated below.



When selecting the row that composes this table, as illustrated in the previous figure, you must select “data - hypothesis test - data table”. The window that demands row and column input rows will appear, which in this example are productivity and price respectively. You must then include this information as illustrated below.



By including this information, the software will automatically calculate how revenue varies with price and productivity changes. The results obtained through this operation are illustrated below. Note that the basic scenario revenue value, as well as productivity and bag price, are highlighted in the figure. Note also that this highlighted revenue of R$ 300,000.00 corresponds to the calculated revenue for the base scenario, which considers this same productivity and this same price of the highlighted row and column.



	A	B	C	D	E	F	G	H	I
1	Hectares	100							
2	Produtividade	50							
3	Preço	60	Variação de Produtividade						
4	Receita	R$ 300.000,00	35	40	45	**50**	55	60	65
5	Variação de preço	57	R$ 199.500,00	R$ 228.000,00	R$ 256.500,00	R$ 285.000,00	R$ 313.500,00	R$ 342.000,00	R$ 370.500,00
6		58	R$ 203.000,00	R$ 232.000,00	R$ 261.000,00	R$ 290.000,00	R$ 319.000,00	R$ 348.000,00	R$ 377.000,00
7		59	R$ 206.500,00	R$ 236.000,00	R$ 265.500,00	R$ 295.000,00	R$ 324.500,00	R$ 354.000,00	R$ 383.500,00
8		**60**	R$ 210.000,00	R$ 240.000,00	R$ 270.000,00	***R$ 300.000,00***	R$ 330.000,00	R$ 360.000,00	R$ 390.000,00
9		61	R$ 213.500,00	R$ 244.000,00	R$ 274.500,00	R$ 305.000,00	R$ 335.500,00	R$ 366.000,00	R$ 396.500,00
10		62	R$ 217.000,00	R$ 248.000,00	R$ 279.000,00	R$ 310.000,00	R$ 341.000,00	R$ 372.000,00	R$ 403.000,00
11		63	R$ 220.500,00	R$ 252.000,00	R$ 283.500,00	R$ 315.000,00	R$ 346.500,00	R$ 378.000,00	R$ 409.500,00
12									
13									

Finally, it is also possible to weight the returns obtained in each scenario by the estimated probability that it will occur. Again, the way in which project sensitivity is analyzed must meet the characteristics of the project, always aiming to make it as close to reality as possible, or at least to provide a realistic description of what one expects to observe.

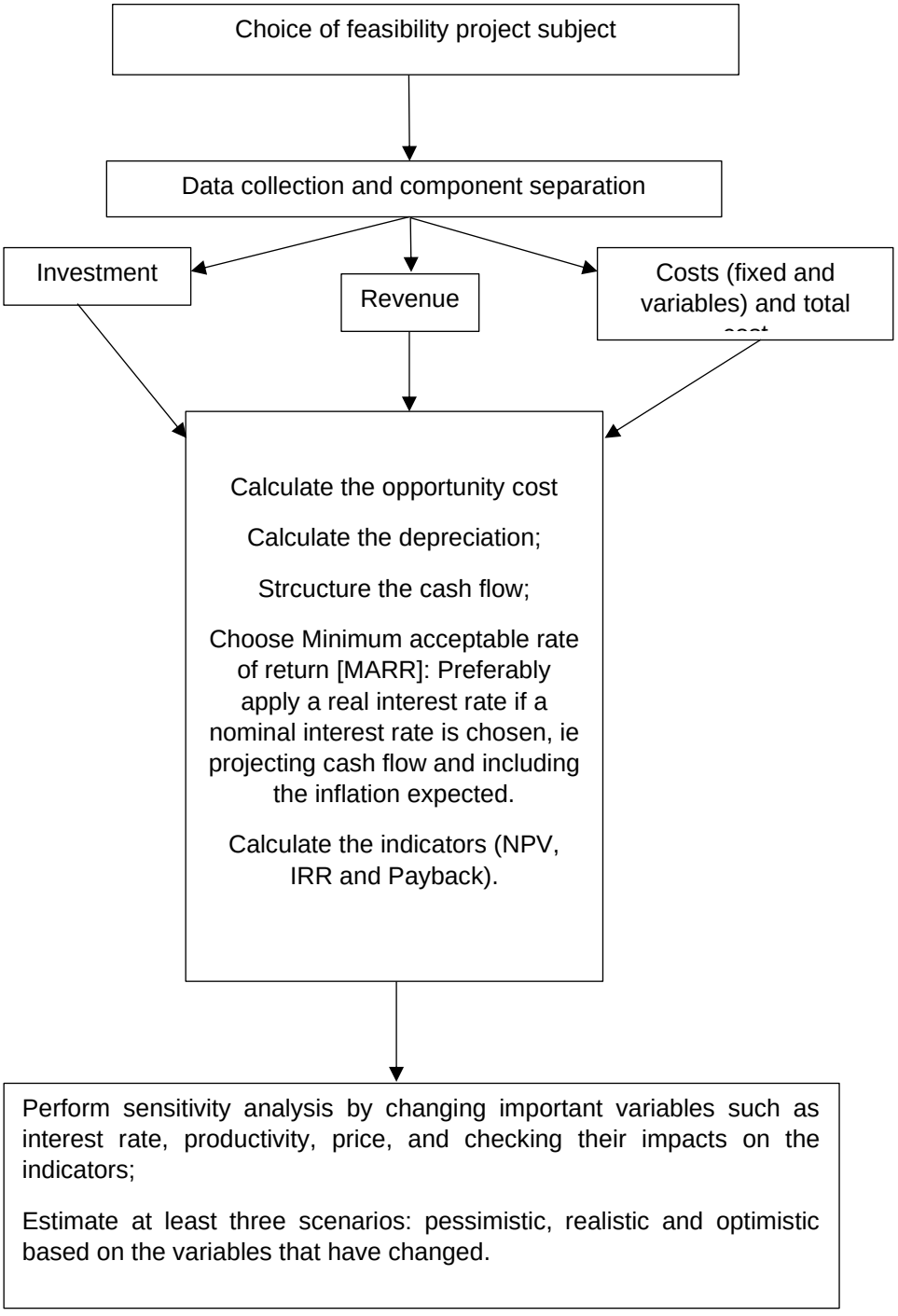
Performing a checklist (steps required for cash flow)

Finally, in order to facilitate the construction of a well-structured and organized cash flow, the student must follow a checklist containing six necessary steps that must be followed to perform reality-adherent feasibility analysis, namely:

1. Separate and discriminate the Investment (remembering that it always starts at cash flow time zero), revenues and costs, following the criteria presented in the sections “Investment”, “Revenues”, “Fixed and variable costs and the total cost”;
2. After making the correct separation, the proper structuring of the for the cash flow in a spreadsheet must be done, following the model presented in Table 5 of the section “Structuring a cash flow”;
3. Calculate the depreciation levied on the necessary equipment that must be purchased for the implementation of the project in question. The depreciation rate should be chosen according to the criteria of the Department of Federal Revenue of Brazil [SRFB], which provides a depreciation table;

4. Correctly use the feasibility indicator calculation formulas available in MS Excel, first by following the example of the “Structuring a Cash Flow” section, and then by using the indicator examples for the “Feasibility Indicators” section. ;
5. Pay due attention to the correct use and calculation of deflated variables and real and nominal interest rates, making the correct combination of their use according to the items “Nominal and real values - Deflating Data Series” and “Interest and nominal and real interest rates”, avoiding considering the discount of the inflation rate in a double way;
6. Estimate different scenarios for revenues and interest rates, confirming the behavior of indicators such as NPV, IRR, and Payback. At least three scenarios are recommended: one pessimistic, one realistic, and one optimistic as explained in the “Scenario and Sensitivity Analysis” section.

Flowchart for the preparation of cash flow



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