Forest Management definitions

Forest Management is the conduction of a forest, either large or small, taking in account its natural constraints (such as climate, the state of the stand, etc.), budget (economic constraints) objectives of the landlord/s, stakeholders, public, government (such as laws and pertinent national needs), as well as ethics, nature preservation/recovery, biodiversity and sustainability. Also, a comprehensive plan must be elaborated for the long term and its instructions and goals assessed, so to engage alternative paths to the ultimate goal if necessary, being these alternatives present (ideally) in the plan from the beginning. Serra R. 2016

"A plan of using natural resources "short –long "in accordance with data collected, constrains and decision maker tendency and considering legal aspects to maximize the outcomes and create sustainability." Motaz, 2016

Forest Management is a practice, involving planning, which aims at regulating in details forestland use in order to meet different interests (economic, ecological, social, etc.) Marcon M., 2016

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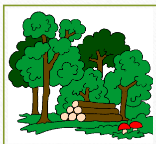

Forest as capital?

- A forest is a store of wealth or capital. In this sense forest is like a certificate of deposit or a stock you buy in the hope that over time it will return more money that you paid for it.
- In a financial sense, if you consider trees and land as capital , two of the most important inputs into forestry are capital and time.
- How can we allocate these in a way that maximizes satisfaction to society?
- Let's now see how investors can use standard tools of financial analysis to evaluate forestry decisions.
  - To decide how much to pay for forest properties and management practices,
  - Measure how profitable forest investments are.

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Why we should learn Financial Analysis?

- Forest management alternatives provide different returns at different times. How can you compare them financially?
- How do you determine the value of forest land that is used to grow timber?
- Forests are valuable assets. If foresters don't understand financial analysis, forests will be managed by people who do - accountants and business majors.
- Financial analysis will be useful to you in managing your own personal finances: loans, mortgages, retirement, and investments

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- Basic Definitions
- *Discounting* is the process of converting future values to present values.
- *Compounding* is the reverse process: converting present values to future values.
- A *present value* is a value that is expressed in terms of euros received immediately.
- A *future value* is a value that is expressed in terms of euros received at some future time.

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- *Discounting* is the process of converting a value that is expressed in terms of euros received at one point in time to an equivalent value expressed in terms of euros received at an earlier point in time.

- *Compounding* is the process of converting a value that is expressed in terms of euros received at one point in time to an equivalent value expressed in terms of euros received at a later point in time.

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- *Interest* is the money that you pay to borrow money.

- *Interest* is the money that your investments earn when you lend money.

- The *interest rate* is the percentage of the amount borrowed that is paid in interest after one unit of time – usually a year.

- Interest can also be viewed as an *exchange rate* between euros today and euros one year from now.

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Using the Interest Rate to Convert Values Earned One Year Apart

- Let
  - V_0 = the amount in the account today.
  - V_1 = the amount in the account in one year.
  - i = the interest rate earned on the account in one period.
- Now, if you make no further deposits or withdrawals, the amount you will have in the account in one year is a function of the current amount in the account and the interest rate:
  - $V_1 = V_0 + i{*}V_0$ = principal + interest

  or:
  - $V_1 = V_0(1 + i)$

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Using the Interest Rate to Convert Values Earned n Years Apart

- Let
  - V_2 = the amount in the account in 2 years.
- Now, we know that:
  - $V_1 = (1 + i)\ V_0$

  and
  - $V_2 = (1 + i)\ V_1$
- So, combining these equations gives:
  - $V_2 = (1 + i)\ (1 + i)\ V_0 = (1 + i)^2\ V_0$
- Generalizing this argument gives:
  - $\boxed{V_n = (1 + i)^n\ V_0}$ → Formula for future values for a single value

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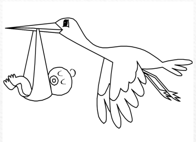
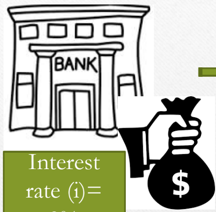
Using the Interest Rate to Convert Values Earned n Years Apart





Interest rate (i)= 3%

Initial Capital : 5000 €

??? Value in 2034 = 18 years from now ???

$$V_n = V_0 (1 + i)^n$$

$$V_{18} = 5000 (1 + 0.03)^{18}$$

$$V_{18} = 8512.16 \text{ €}$$

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If we know the future value and want to have the present value?

- Gives the present value (V_0) of a value that occurs in year n (V_n), given the interest rate i:

$$V_n = V_0 (1 + i)^n$$

$$V_0 = {}^{V_n}/_{(1+i)^n}$$

How to get the interest rate if you know Vn and Vo?

$$i = \left[\sqrt[n]{{}^{V_n}/_{V_0}}\right] - 1 = \left[{}^{V_n}/_{V_0}\right]^{1/n} - 1$$

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Some conventions:

- Interest rates will be yearly percentage rates of change.
- Monthly or daily interest rate, are the annual interest rate divided by 12 or by 365.
- For any investment, costs and revenues are assumed to occur at the same time of year
- Term Present value, "present" means now.
- Year 0 means now.
- Rates such as interest, inflation growth rates or taxes are expressed in the formulas as decimals.
- Interest for now, are assumed to be fixed all over planning horizon or time lime

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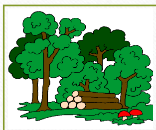

Examples

A forestry firm asks for credit to install an eucalyptus tree plantation. Plantation costs (V_0) are 36€/ha and interest rate i= 6%. The value of debt 4 years from now will be:

$$V_4 = V_0\,(1+i)^4 = 36\,(1+0.06)^4 = 45.4\ €/ha$$

A forestry firm estimates that the revenue from its first coppice harvest in a eucalyptus plantation will be 47.2 € / ha, 8 years from now. The present equivalent income will be:

$$V_0 = V_8 / (1+i)^8 = 47.2 / (1+0.06)^8 = 29.6\ €/ha$$

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Discounting and compounding payment series

- Payments must be equal.
- Payments must occur at regular intervals called "periods".
- No payment occurs at year 0.
- The first payment occurs at the end of the first period.
- Payments must be all of the same sign, positive or negative

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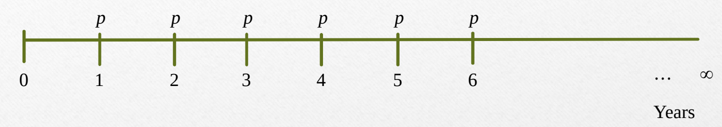
Perpetual annual series

- The time below diagrams a perpetual annual series of payments at €p each.



Present value

$$V_o = \frac{p}{i}$$

Future Value

$$V_n = \infty$$

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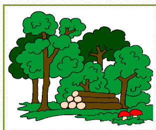


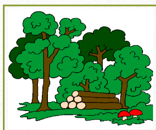
Examples

Suppose a firm is commited to perpetual timber management and wishes to compute the present value of annual hunting lease income at 3€ per ha in perpetuity, the first payment due at the end of the first year. i=5%

$$V_o = \frac{p}{i} = \frac{3}{0.05} = 60€/ha$$

This formula makes sense think of leaving if you this of leaving 60€ in the bank forever. The 60€ is our present value and at 5% interest rate, you can withdraw an income of 3€ /year in perpetuity.

$$p = i \times V_o = 0.05 \times 60 = 3€$$



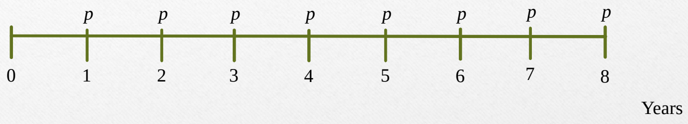
Examples

A forestry firm pays annual and constant administrative cork oak forest management costs of 0.8 € / ha. Compute the value of this perpetual series (i = 6%).

$$V_o = \frac{p}{i} = \frac{0.8}{0.06} = 13.4\ €/ha$$

Terminating annual series

- Equal annual payments that stop at some date are terminating annual series as shown below for n= 8 years



Present value

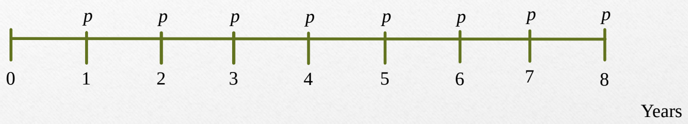
$$V_0 = p\left[\frac{1-(1+i)^{-n}}{i}\right]$$

Future Value

$$V_n = p\left[\frac{(1+i)^n - 1}{i}\right]$$

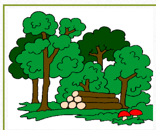
Terminating annual series

- Equal annual payments that stop at some date are terminating annual series as shown below for n= 8 years



Capital recovery

$$p = V_0\left[\frac{i}{1-(1+i)^{-n}}\right]$$

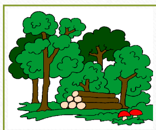


Examples

You own a land that a hunting club wishes to lease for 50€ per ha per year for 15 years. If your minimum acceptable rate (interest rate) is 7%, what is the present value of this lease to you?

$$V_0 = p\left[\frac{1-(1+i)^{-n}}{i}\right] = 50\left[\frac{1-(1+0.07)^{-15}}{0.07}\right]$$

$$= 455.42\ €/ha$$



Examples

In the lease example above, if you put each 50€ lease payment in the bank at 7% interest, what would the accumulated value be in 15 years?

$$V_n = p\left[\frac{(1+i)^n - 1}{i}\right] = 50\left[\frac{(1+0.07)^{15} - 1}{0.07}\right]$$

$$= 1256.5\ €/ha$$

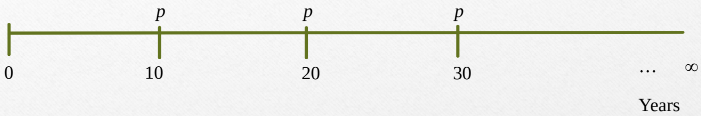
You can check it by compounding the present value computed previously for 15 years:

$$V_{15} = V_0 \times (1+i)^{15} = 455.43.\times (1+0.07)^{15}$$

$$= 1256.5\ €/ha$$

Perpetual Periodic Series

- Perpetual regular payments more than one year apart are called a perpetual periodic series, as shown below for the case where period is t= 10 years



Present value

$$V_0 = \left[\frac{p}{(1+i)^t - 1}\right]$$

Future Value

$$V_n = \infty$$

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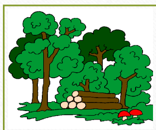
Examples

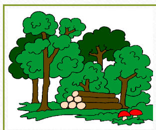


At 6% interest, what is the present value 3000€ Christmas tree harvest income occurring in 10 years thereafter, in perpetuity?

$$V_0 = \left[\frac{p}{(1+i)^t - 1}\right] = \left[\frac{3000}{(1+0.06)^{10} - 1}\right] = 3793\ €$$

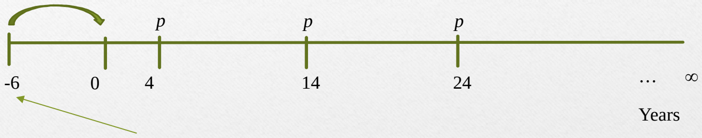
3793€ should be the maximum willingness to pay if you want to earn 6%

If you put 3793€ in the bank at 6%, you could withdraw 3000€ every 10 years, forever without adding any more funds.



Examples

Suppose, for the same harvest income series, the 1st harvest occurs in 4 years, so that the trees are now 6 years old. What is the present value in year 0 at 6% interest?

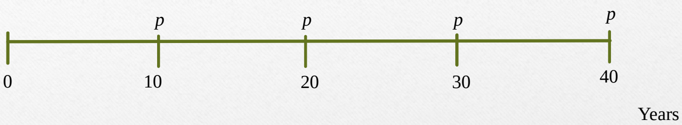


$$V_{-6} = \left[\frac{p}{(1+i)^t - 1}\right] = \left[\frac{3000}{(1+0.06)^{10} - 1}\right] = 3793\ €$$

$$V_0 = V_{-6}(1+i)^n = 3793 \times (1+0.06)^6 = 5380{,}44€$$

Terminating Periodic Series

- Terminating regular payments more than one year apart are called a terminating periodic series, as shown below for the case where period is t= 10 years and n=40



Present value

$$V_0 = p\left[\frac{1-(1+i)^{-n}}{(1+i)^t - 1}\right]$$

Future Value

$$V_n = p\left[\frac{(1+i)^n - 1}{(1+i)^t - 1}\right]$$

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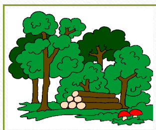
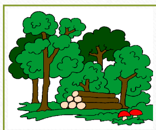


Examples

Suppose, a Christmas tree farmer plants to grow four crops of small trees on a 5 year rotation. If each harvest brings 1000€ and the first is due in 5 years, what is the present value of these yields to a farmer whose interest is 8% ?

$$V_0 = p\left[\frac{1-(1+i)^{-n}}{(1+i)^{t}-1}\right] = 1000\left[\frac{1-(1+0.08)^{-20}}{(1+0.08)^{5}}\right]$$

$$V_0 = 1673.57\ €$$

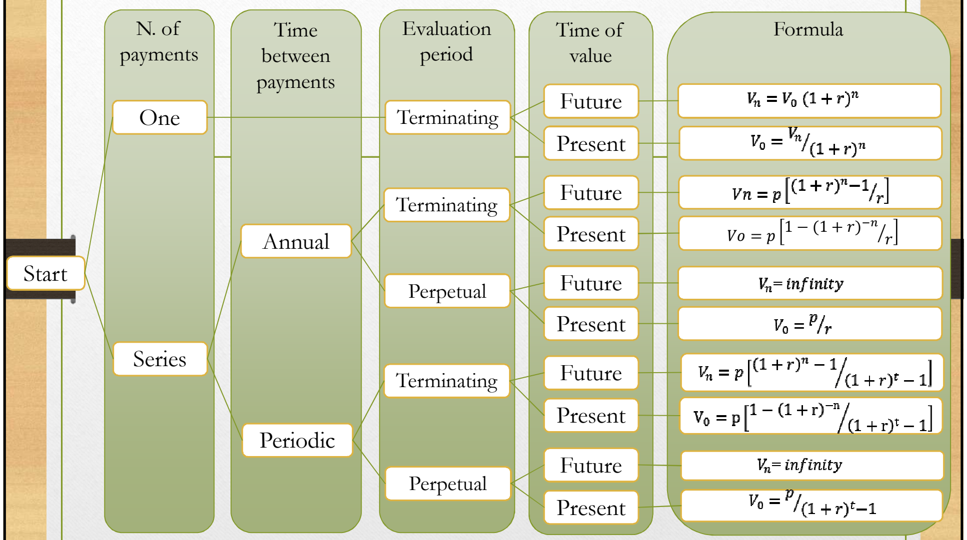


Examples

In the above example, what would be the future value of the harvest incomes in year 20, if they were invested at 8% interest?

$$V_n = p\left[\frac{(1+i)^{n}-1}{(1+i)^{t}-1}\right] = 1000\left[\frac{(1+0.08)^{20}-1}{(1+0.08)^{5}-1}\right]$$

$$V_{20} = 7800.42\ €$$



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Net Present Value

- Is the present value of revenues minus present value of costs. You can compare present values of negative flows (costs) as well as positive ones.

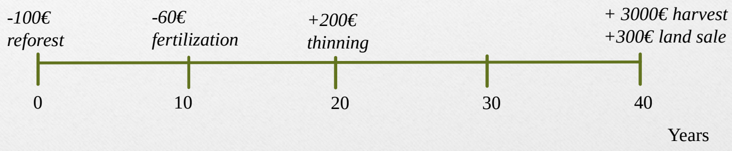
$$NPV = R_0 + \frac{R_1}{(1+r)^1} + \frac{R_2}{(1+r)^2} + \ldots + \frac{R_n}{(1+r)^n}$$
$$- C_0 - \frac{C_1}{(1+r)^1} - \frac{C_2}{(1+r)^2} - \ldots - \frac{C_n}{(1+r)^n}$$

- In general terms:

$$NPV = \sum_{y=0}^{n} \left[\frac{R_y}{(1+r)^y} - \frac{C_y}{(1+r)^y}\right]$$

Net Present Value

- NPV defines an investor's willingness to pay for an asset based on estimated benefits, costs, and the desired rate of return.
- Thus, NPV is a powerful tool in valuing forest properties.
- Example:



i=6%

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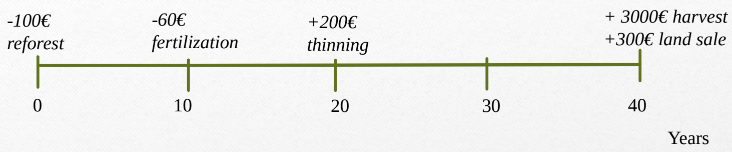
Net Present Value



$$NPV = \frac{200}{(1+0.06)^{20}} + \frac{3000+300}{(1+0.06)^{40}} - \frac{60}{(1+0.06)^{10}} - 100$$

$$NPV = \frac{200}{3.207} + \frac{3300}{10.286} - \frac{60}{1.791} - 100$$

$$NPV = \ 249.69\ €/ha$$

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Key points

- Forests are capital assets. From an efficient view, they should yield at least as much satisfaction (rate of return) as the same capital value could yield in other uses.
- Over time, productive capital will yield satisfactions that exceed the original cost. Thus, future value of capital benefits exceeds the present value. Conversely, the present value must be less than the future value.
- The further in the future a value occurs, the lower its present value. Discounting formulas can give present values of single future payments or regular series of future payments (revenues or costs).Compounding formulas give the future values if payments are not perpetual.
- A buyer's maximum willingness to pay for an asset is the net present value of the asset's yields, using the buyers discount rate.

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Key points

- A buyer's maximum willingness to pay for an asset is the net present value of the asset's yields, using the buyers discount rate.
- Capital is allocated efficiently if the last unit invested yields the same rate of return in all pursuits- the equi-marginal principle.
- The discount rate may seem to make the needs of future generations appear minuscule today. On other hand, the power of compound interest let us make major contributions to future citizens by investing fairly small amounts now.

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