Simple and Compound Interest

NCS Mathematics DVD Series

Nelson Mandela Metropolitan University
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GOVAN MBEKI
MATHEMATICS DEVELOPMENT UNIT
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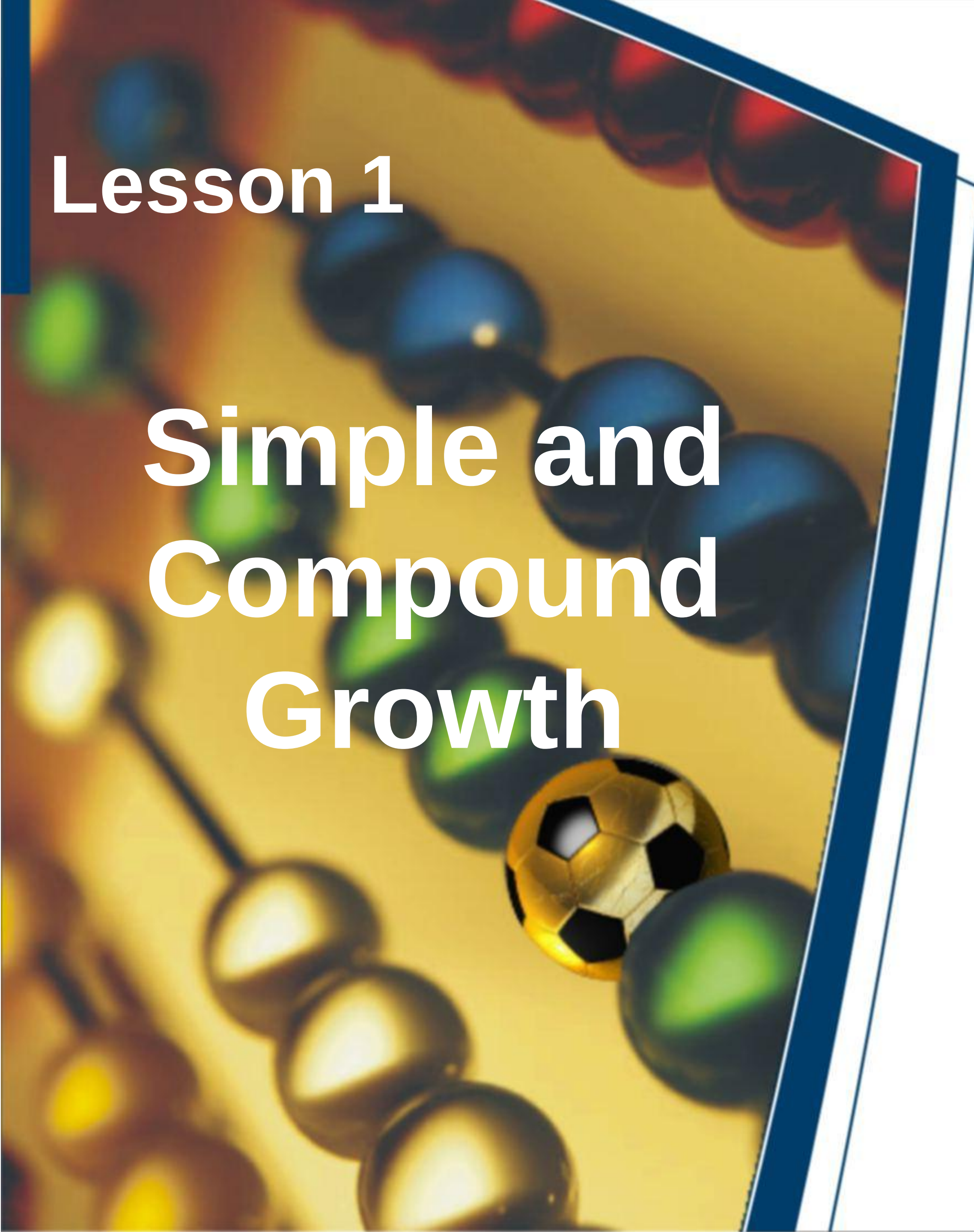
Outcomes for this DVD

In this DVD you will:

- Revise simple and compound growth LESSON 1.
- Work with problems involving simple and compound decay LESSON 2.
- Work with nominal and effective rates LESSON 3.



Lesson 1

Simple and Compound Growth

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Appreciation (Growth)

A description of Appreciation (or growth)

- When something appreciates, its value increases.
- Two types of growth will be considered:
  - Simple
  - Compound
- Growth can be calculated by means of available formulae.

What is Simple Growth (interest)?

- Simple interest is a fixed percentage of the amount invested or borrowed and is calculated on the original amount.

- When simple interest is applied to an investment, the value of the investment increases by an agreed fixed percentage at specific regular time intervals.

- Simple interest entails adding a constant amount to the principal amount at regular intervals.

Formula to Calculate Simple Growth

Assume that:

P is the amount borrowed or invested, called the **principal**.

r is the **interest rate** or growth rate.

n is the number of investment (growth) periods.

Simple Growth formula:

$$A = P + \frac{P \times n \times r}{100} = P\left(1 + \frac{n \times r}{100}\right) = P(1 + ni)$$

where $i = \frac{r}{100}$.

A is the **accrued** or final **amount**.

Interest earned:

$$I = P \bullet i \bullet n$$

Graphical Interpretation of Simple Growth

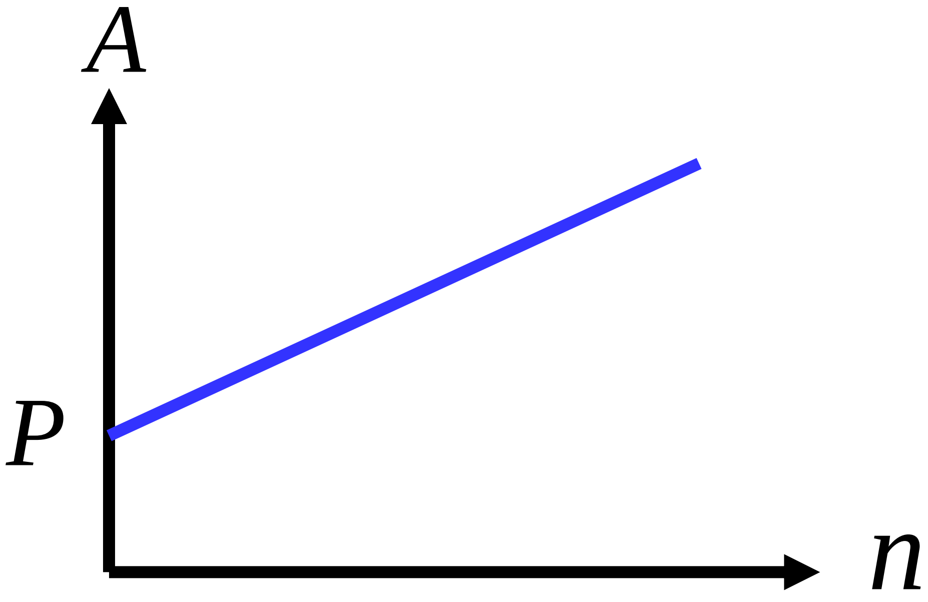
$$A = P(1 + ni)$$

$$\therefore A = P + (Pi)n$$

Linear relationship with:

(1) A a function of n

(2) $c = P$ and $m = Pi;\ m > 0$



Calculate Simple Growth

Example 1: An amount of R1 050 is invested at a simple interest rate of $4\frac{3}{4}\%$ p.a. for a period of 9 months. Calculate:

(a) The simple interest (growth) earned on the investment;

(b) Final value of the investment (accrued value).

Know that:

$P = 1\ 050$

$r = 4\frac{3}{4}\% = 4,75\%$

$n = 9$ months

$= \frac{9}{12}$ years

$= 0,75$ years

$i = \frac{r}{100}$

$= \frac{4,75}{100}$

$= 0,0475$

(a) Amount of growth (Interest earned):

$I = P \times i \times n = 1\ 050 \times 0,0475 \times 0,75 = R37,41$

(b) Final value of investment:

$A = P + I = R1\ 050 + R37,41 = R1\ 087,41$

Alternatively, calculate directly by means of the formula $A = P(1 + ni)$.

Calculate Accrual and Interest

Mrs B invested R4 000 at 8,75% p.a. in a fixed deposit account.

If simple interest is paid at the end of 4 years, calculate:

(a) How much money will she receive?

(b) How much interest will she earn?

$$P = 4\ 000$$

$$i = 0,0875$$

$$n = 4$$

$$(a)\quad A = 4\ 000(1 + 0,0875 \times 4)$$

$$= \text{R}5\ 400$$

$$A = P(1 + i \cdot n)$$

$$I = A - P \text{ or } I = P \cdot i \cdot n$$

$$(b)\quad I = 5\ 400 - 4\ 000 = \text{R}1\ 400$$

$$\text{or } I = 4\ 000 \times 0,0875 \times 4 = \text{R}1\ 400$$

Calculate the Principal

How much money should you invest in a fixed deposit account paying 9% p.a. simple interest if you would like to receive R8 000 at the end of 5 years?

$$A = 8\ 000$$
$$i = 0,09$$
$$n = 5$$
$$P = ?$$

$$A = P\left(1 + i \bullet n\right) \Rightarrow P = \frac{A}{1 + i \bullet n}$$

$$P = \frac{8\ 000}{1 + 0,09 \times 5} = \text{R}5\ 517,24$$

Tutorial 1: Simple Growth

1) A student borrows R15 000 for 3 years at simple interest to pay for his studies. If he has to pay back R20 625 at the end of the three years, what rate of (simple) interest per annum is he paying?

2) If I invest R15 000 in a fixed deposit account at 10% p.a. simple interest, how long will it take before I will have R30 000?

PAUSE DVD

- Do Tutorial 1
- Then View Solutions

Tutorial 1 Problem 1: Suggested Solution

1) A student borrows R15 000 for 3 years at simple interest to pay for his studies. If he has to pay back R20 625 at the end of the three years, what rate of (simple) interest per annum is he paying?

Possible Method:

- Use formula $A = P(1 + i \bullet n)$
- Substitute in given values
- Make i subject of formula

$P = 15\ 000$

$n = 3$

$A = 20\ 625$

$i = ?$

$$20\ 625 = 15\ 000(1 + i \times 3)$$

$$\therefore 3i + 1 = \frac{20\ 625}{15\ 000}$$

$$\therefore i = \frac{1}{3}\left(\frac{20\ 625}{15\ 000} - 1\right) = 0{,}125 = 12{,}5\%$$

Tutorial 1 Problem 2: Suggested Solution

2) If I invest R15 000 in a fixed deposit account at 10% p.a. simple interest, how long will it take before I will have R30 000?

$$A = P(1 + i \bullet n)$$

$$\Rightarrow A = P + P \bullet i \bullet n$$

$$\Rightarrow P \bullet i \bullet n = A - P$$

$$\Rightarrow n = \frac{A - P}{P \bullet i}$$

$$n = \frac{30\ 000 - 15\ 000}{15\ 000 \times 0{,}1}$$

$$= \mathbf{10\ years}$$

Recalculate A by means of $A = P(1 + i \bullet n)$ to check!

What is Compound Growth (interest)?

- Simple interest is calculated on the original amount borrowed or invested.
- When calculating compound interest the interest charged or earned in each period is added to the principal.
- This means that the principal increases (grows).
- Interest earned or charged for the next period is calculated on the increased principal amount.

Formula to Calculate Compound Growth

Assume that :

P is the amount borrowed or invested, called the **principal**.

r is the **interest** rate or growth **rate**.

n is the **number** of investment or **growth periods**.

Compound Growth Formula :

$$A = P\left(1 + \frac{r}{100}\right)^n = P(1+i)^n \quad \text{where} \quad i = \frac{r}{100}$$

A is the **accrued** or final **amount**.

Graphical Interpretation of Compound Growth

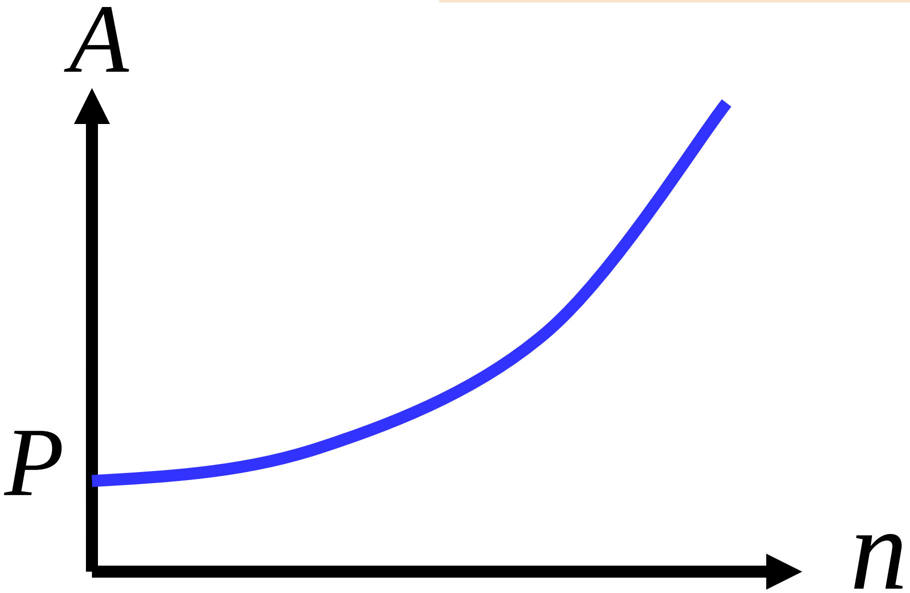
$$A = P(1+i)^n$$

Exponential Growth relationship with:

(1) A a function of n

(2) Vertical intercept at P

(3) Base $(1+i) > 1$



Interest Compounded Quarterly

Mrs Save deposits R5 000 in a fixed account for 7 years at an interest rate of 9,25% p.a. compounded **quarterly**.

What amount of money will be available after 7 years?

$$A = P\left(1+\frac{i}{4}\right)^{4n}$$

$$P = 5\ 000$$

$$n = 7$$

$$i = 0,0925$$

$$= 5\ 000\left(1+\frac{0,0925}{4}\right)^{4\times 7}$$

$$= \text{R}9\ 483.61$$

Interest Compounded Monthly

Mrs Save deposits R5 000 in a fixed account for 7 years at an interest rate of 9,25% p.a. compounded **monthly**.

What amount of money will be available after 7 years?

$$A = P\left(1+\frac{i}{12}\right)^{12n}$$

$$P = 5\ 000$$
$$n = 7$$
$$i = 0{,}0925$$

$$= 5\ 000\left(1+\frac{0{,}0925}{12}\right)^{12\times 7} = \text{R}9\ 530{,}10$$

Tutorial 2: Compound Growth

1) What is the annual rate of interest being charged by Africa Bank on a loan of R25 000 if R30 000 is to be repaid in 3 years time in full settlement if interest is compounded **quarterly**?

2) If an amount of R3 000 is invested at 12% p.a. compounded **quarterly**, how long will it take to reach R8 694,83?

PAUSE DVD

- **Do Tutorial 2**
- **Then View Solutions**

Tutorial 2 Problem 1: Suggested Solution

1) What is the annual rate of interest being charged by Africa Bank on a loan of R25 000 if R30 000 is to be repaid in 3 years time in full settlement if interest is compounded **quarterly**?

$$\frac{i}{4} = \left(\frac{30\ 000}{25\ 000}\right)^{\frac{1}{12}} - 1$$

$$\frac{i}{4} = \left(\frac{A}{P}\right)^{\frac{1}{4n}} - 1$$

$$\therefore \frac{i}{4} = 0,01531$$

$$\Rightarrow i = 0,06124 = 6,124\%$$

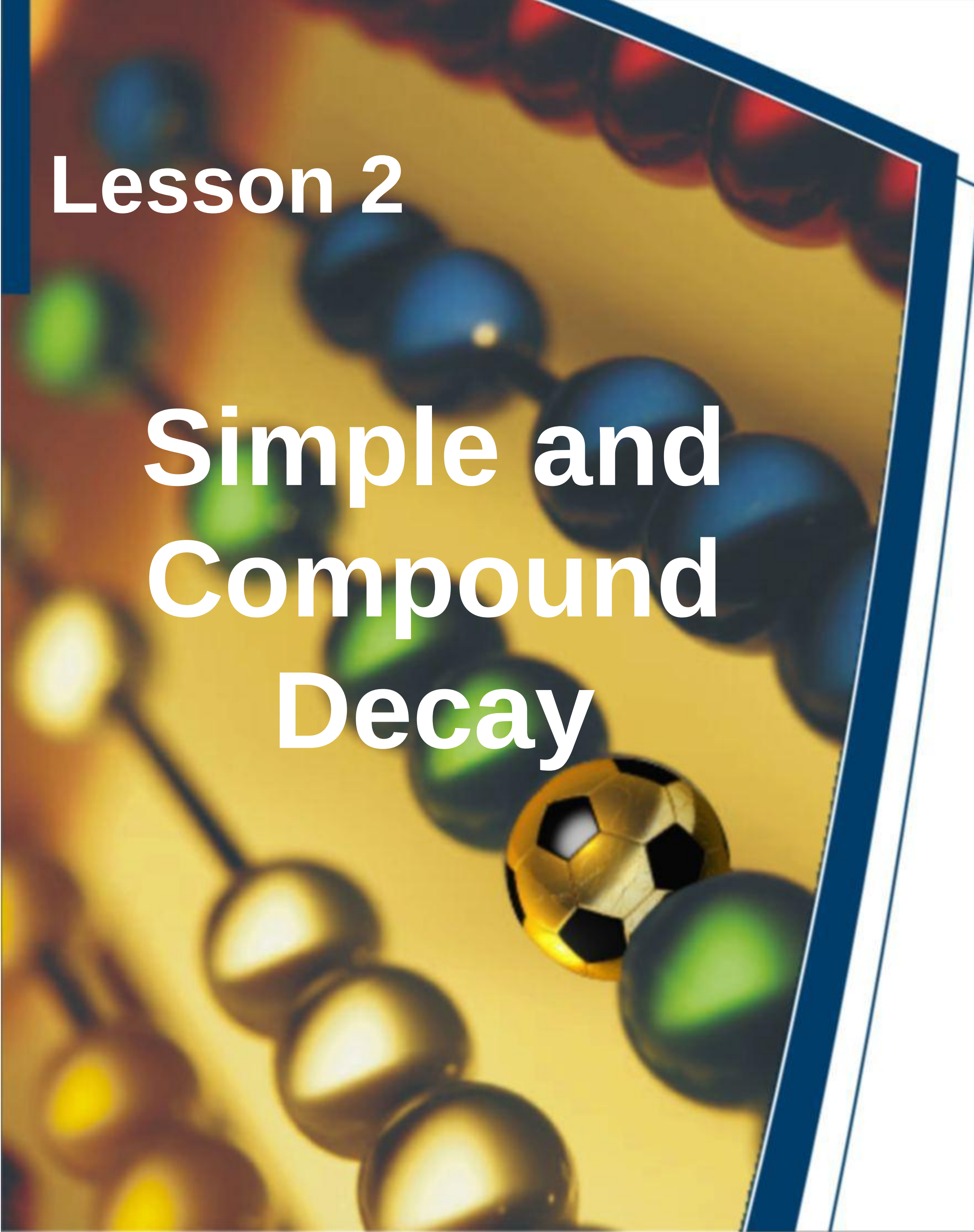
Tutorial 2 Problem 2: Suggested Solution

2) If an amount of R3 000 is invested at 12% p.a. compounded **quarterly**, how long will it take to reach R8 694,83?

$$4n = \frac{\log \frac{8\ 694,83}{3\ 000}}{\log\left(\frac{0,12}{4}+1\right)}$$

$$n = \frac{\log\left(\frac{A}{P}\right)}{\log(i+1)} \Rightarrow 4n = \frac{\log\left(\frac{A}{P}\right)}{\log\left(\frac{i}{4}+1\right)}$$

$$\therefore 4n = 36 \text{ quarters} \Rightarrow n = 9 \text{ years}$$



Lesson 2

Simple and Compound Decay

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Depreciation (decay)

- Business people need to keep track of the current value of items used in their business.

- The value of an item of equipment used in a company is an important factor in determining whether the company is profitable or not.

- For example, if the owner of a print shop purchases a photocopier costing R500 000 and it lasts only 5 years, then the **income generated** by the photocopier needs to exceed the **replacement value** of the photocopier before the business can be considered to be profitable.

Flat-Rate Depreciation (decay)

Most equipment will decrease in value over time.

It is said to depreciate in value.

Flat-rate (straight-line) depreciation

- This occurs when the value of the item is reduced by the same amount per year while it is in use.
- It is the opposite of simple interest, where the value of the investment increases by a constant amount each year.
- Depreciation rate is *Pi.*

Flat-rate Depreciation of Computer System

Example:

The purchase price of a computer system was R10 000.

Its value decreases annually by R1 250.

Draw a table to find its book value after 5 years.

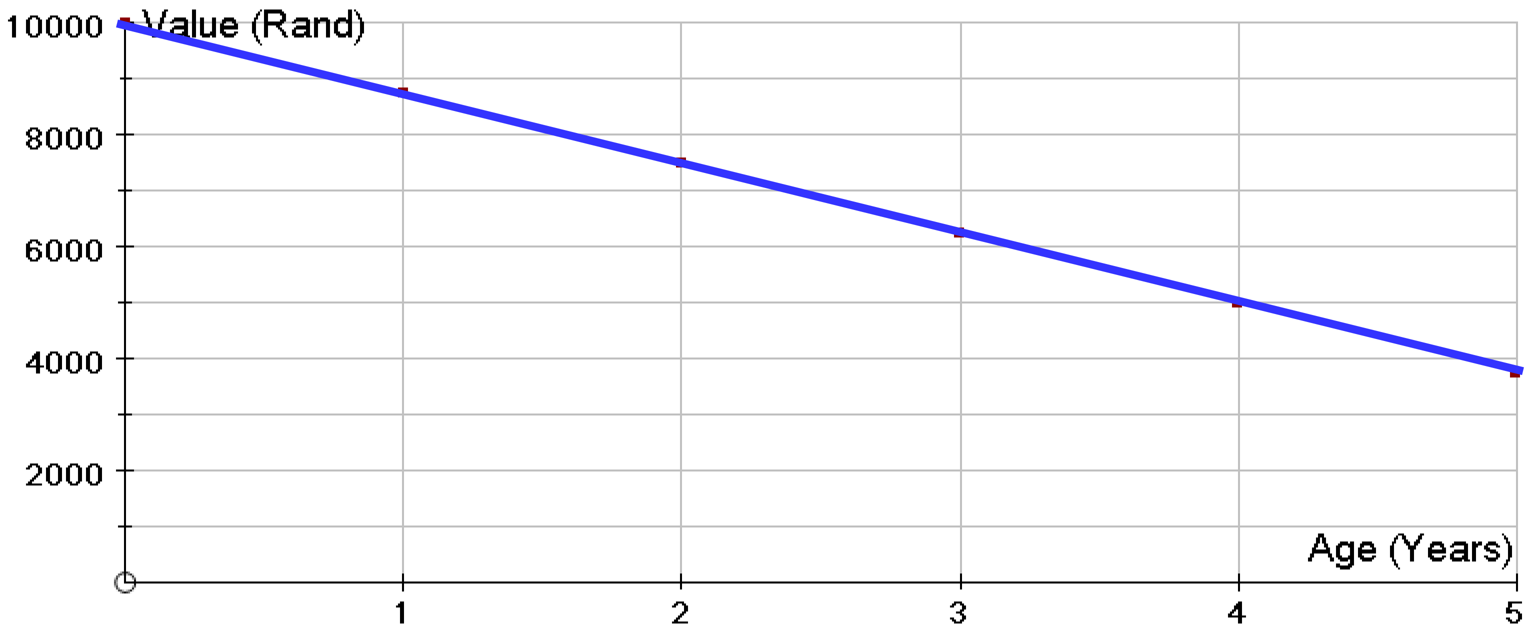
Age (years)	Book value (rand)
0	10 000
1	8 750
2	7 500
3	6 250
4	5 000
5	3 750

Straight-line Depreciation of Computer System

We have seen that the computer system purchased for R10 000 and depreciating annually by R1 250 will be worth R3750 after 5 years.

This depreciation can also be illustrated graphically.

Age (Years)	0	1	2	3	4	5
Value (Rand)	10 000	8 750	7 500	6 250	5 000	3 750



Flat-rate Depreciation of Furniture

Example:

A company purchased office furniture to the value of R20000.

The value of the furniture decreases by 10% per year.

$10\% \text{ of } R20\ 000$
$= R2\ 000$

Determine its book value after 6 years.

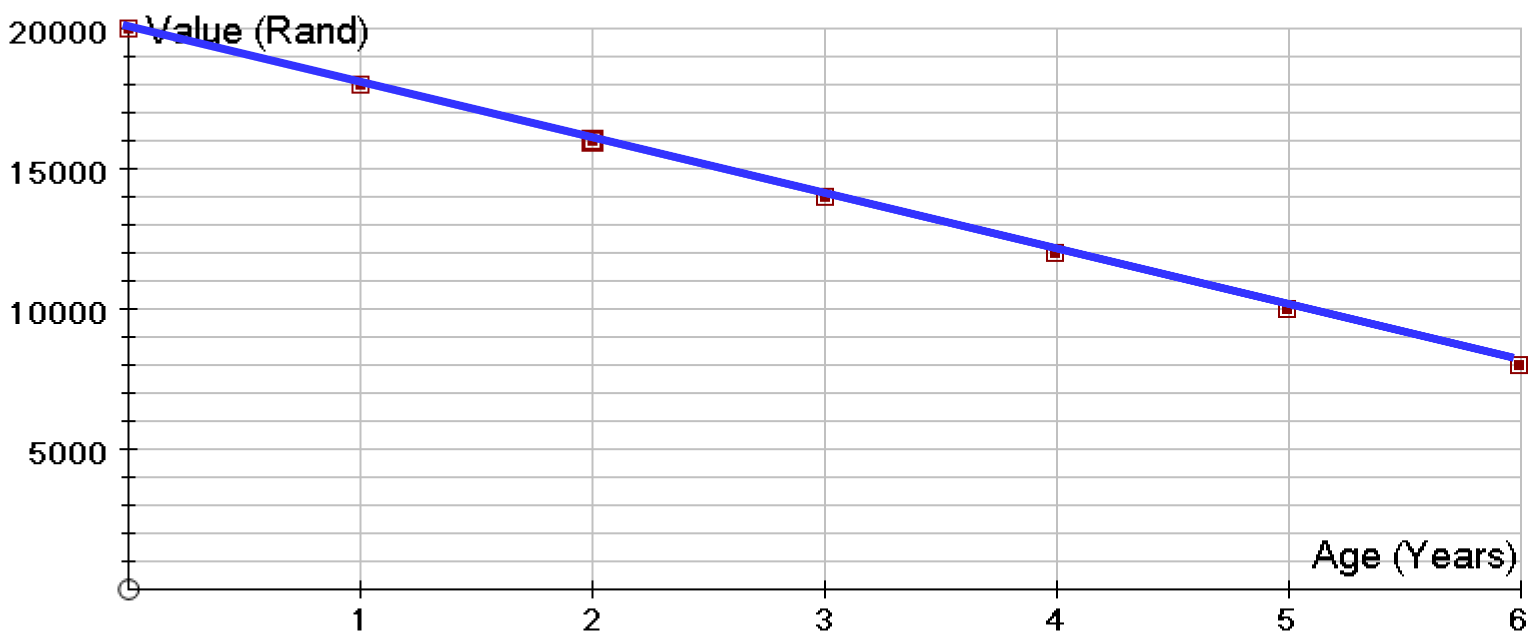
Age (years)	Book value (Rand)
0	20 000
1	18 000
2	16 000
3	14 000
4	12 000
5	10 000
6	8 000

Straight-line Depreciation of Furniture

We have seen that furniture purchased for R20 000 and depreciating annually by R2 000 will be worth R8 000 after 6 years.

Age (Years)	0	1	2	3	4	5	6
Value (Rand)	20 000	18 000	16 000	14 000	12 000	10 000	8 000

This depreciation can also be illustrated graphically.



Formula to Calculate Flat-rate Depreciation

Flat-rate book value after n years

$$= \text{Purchase price} - \text{Annual depreciation} \times n$$

Assume that:

A: Book value after n years

P: Purchase price

r: Depreciation rate per year

n: Time in years

$$A = P - \frac{P \times r}{100} \times n$$

$$= P - P \times i \times n$$

$$= P(1 - i \times n)$$

Calculate Flat-rate Depreciation of Furniture by means of the Formula

Example (Revisited):

A company purchased office furniture to the value of R20000.The value of the furniture decreases by 10% per year. Determine, by means of the relevant formula, its book value after 6 years.

<u>Given:</u>

$$P = 20\ 000$$

$$i = \frac{r}{100} = 0{,}1$$

$$n = 6$$

$$A = P(1 - i \times n)$$

$$= 20\ 000(1 - 0{,}1 \times 6)$$

$$= \text{R}8\ 000$$

Tutorial 3: Flat-rate Depreciation

1. A sewing machine originally cost R750 and was traded in for R150 after 12 years. Calculate the flat-rate of depreciation per year.

2. A computer, purchased for R7 500, depreciates at a flat-rate of 20% per annum.
   (a) What is its value after 3 years?
   (b) After how long will the computer be written off as scrap if the scrap value is zero?

PAUSE DVD

- **Do Tutorial 3**
- **Then View Solutions**

Tutorial 3 Problem 1: Suggested Solution

1. **A sewing machine originally cost R750 and was traded in for R150 after 12 years. Calculate the flat-rate of depreciation per year.**

$$A = P(1 - i \times n)$$

$$\therefore 150 = 750(1 - 12i)$$

$$\therefore 150 = 750 - 9\ 000i$$

$$\therefore i = \frac{150 - 750}{-9\ 000} = 0,0\overline{6}$$

$$i = \frac{r}{100} \Rightarrow r = 100i \Rightarrow r = 0.0666\cdots \times 100 = 6\frac{2}{3}\%$$

<u>Given</u>

$P = 750$

$A = 150$

$n = 12$

<u>Wanted</u>

$r = ?$

Tutorial 3 Problem 2: Suggested Solution

2. A computer, purchased for R7 500, depreciates at a flat-rate of 20% per annum.
   (a) What is its value after 3 years?
   (b) After how long will the computer be written off as scrap if the scrap value is zero?

$$2(a)\quad A = P\left(1 - i\times n\right) \Rightarrow A = 7\ 500\left(1 - 0,2\times 3\right)$$

$$= 7\ 500\times 0,4$$

$$= \text{R}3\ 000$$

$$2(b)\quad A = 0$$

$$\Rightarrow P\left(1 - i\times n\right) = 0$$

$$\Rightarrow n = \frac{1}{i} \Rightarrow n = \frac{1}{0,2} = \frac{1}{1/5} = 5 \text{ years}$$

Reducing Balance Depreciation

- Value of item is reduced by a constant percentage for each year it is in use.
- Opposite to compound interest.
- Relationship not linear but exponential (later!).

Example of Reducing Balance Depreciation

Example: A computer system costs R10 000 and decreases in value by 20% per year by means of the reducing balance method. Find its book value after 4 years.

Age (Years)	Book Value (Rand)	Calculation of new book value
0	10 000	
1	8 000	$10\ 000 - 0{,}2 \times 10\ 000 = 8\ 000$
2	6 400	$0{,}8 \times 8\ 000$
3	5 120	$0{,}8 \times 6\ 400$
4	4 096	$0{,}8 \times 5\ 120$

Exponential Depreciation (Decay)

Example (revisited): A computer system costs R10 000 and decreases in value by 20% per year. Find its book value after 4 years.

Age (Years)	Book Value (Rand)	Ratio between two consecutive book value
0	10 000	
1	8 000	$\frac{8\,000}{10\,000} = 0{,}8$
2	6 400	$\frac{6\,400}{8\,000} = 0{,}8$
3	5 120	$\frac{5\,120}{6\,400} = 0{,}8$
4	4 096	$\frac{4\,096}{5\,120} = 0{,}8$

$\therefore$ Relationship between age and current book value is an example of exponential decay.

Relationship is given by:

$$A = 10^4 \times 0{,}8^n$$

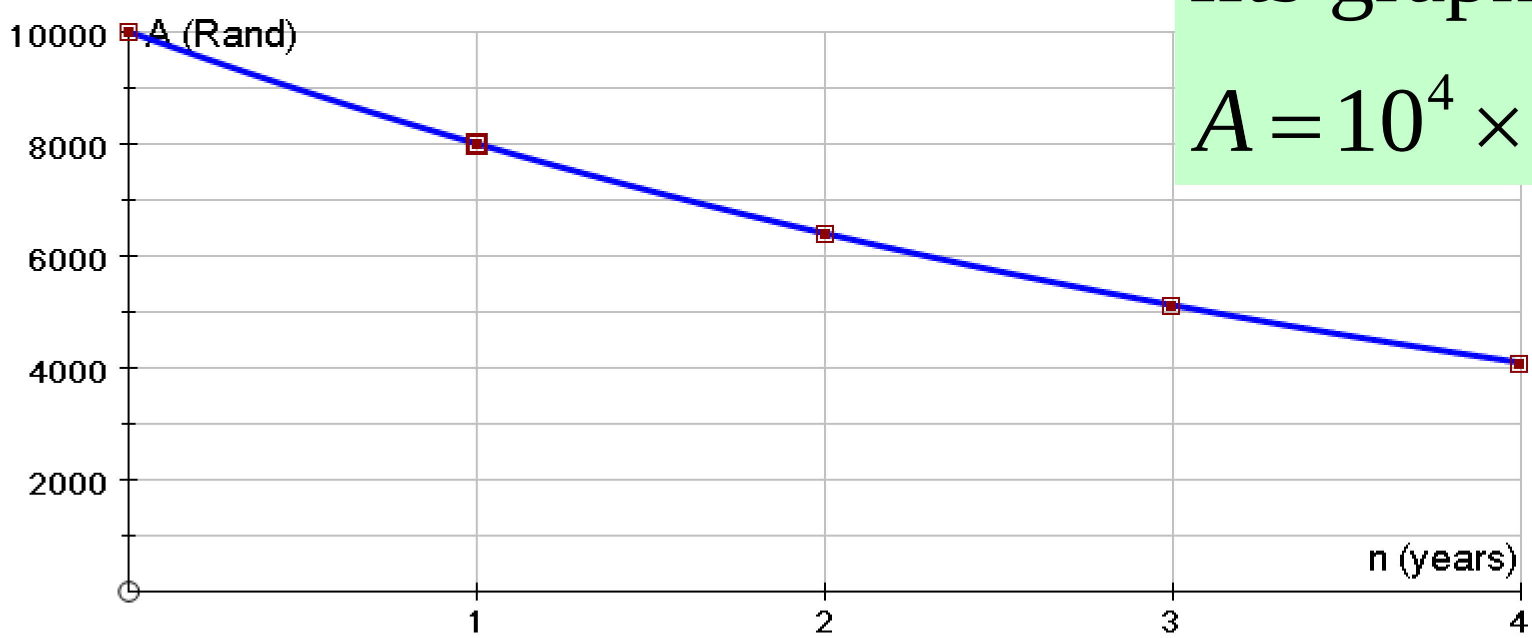
Exponential Nature of Reducing Balance Depreciation

Example (revisited): A computer system costs R10 000 and decreases in value by 20% per year. Find and illustrate graphically its book value for each of the next four years.

Age (Years)	0	1	2	3	4
Book value (Rand)	10 000	8 000	6 400	5 120	4 096

Data perfectly fits graph of

$$A = 10^4 \times 0,8^n$$



Formula to Calculate Reducing Balance Depreciation

Reducing balance depreciation

is opposite to

compound interest growth

Assume that:

A: Book value after n years

P: Purchase price

r: Depreciation rate per year

n: Time in years

Formula for compound interest growth:

$$A = P\left(1 + \frac{r}{100}\right)^n = P(1+i)^n$$

$\therefore$ Formula for reducing balance depreciation is:

$$A = P\left(1 - \frac{r}{100}\right)^n = P(1-i)^n$$

Application of Reducing Balance Depreciation Method: Example 1

<u>Example</u>

A car depreciates at a reducing balance rate of 18% per year. What will its value be after 5 years if its purchase price was R145 000?

Suggested solution:

$$A = P(1-i)^n$$

$$= 145\ 000 \times 0{,}82^5$$

$$= R53\ 757{,}28$$

<u>Given and wanted:</u>

$$P = 145\ 000$$

$$i = \frac{r}{100} = \frac{18}{100} = 0{,}18$$

$$n = 5$$

$$A = ?$$

Application of Reducing Balance Depreciation Method: Example 2

Example

A washing machine purchased for R5 000 depreciates at 15% per year. After how many years will its value be approximately R1 250?

Given and wanted:

$P = 5\ 000$

$A = 1\ 250$

$i = \frac{r}{100} = \frac{15}{100} = 0{,}15$

$n = ?$

Suggested solution:

$$A = P(1 - i)^n$$

$$1\ 250 = 5\ 000 \times 0{,}85^n$$

$$0{,}85^n = 0{,}25$$

Guess and Check:

n	7	8	9	10
$0{,}85^n$	0,32	0,27	0,23	0,197

$$\Rightarrow n \approx 9$$

Application of Reducing Balance Depreciation Method: Example 3

Example

A washing machine purchased for R5 000 depreciates at 15% per year. After how many years will its value be approximately R1 250?

Given and wanted:

$$P = 5\ 000$$

$$A = 1\ 250$$

$$i = \frac{r}{100} = \frac{15}{100} = 0{,}15$$

$$n = ?$$

Suggested solution:

$$A = P(1 - i)^n$$

$$1\ 250 = 5\ 000 \times 0{,}85^n$$

$$n \log 0{,}85 = \log \frac{1\ 250}{5\ 000}$$

$$\Rightarrow n = \frac{\log 0{,}25}{\log 0{,}85} = 8{,}53$$

$$\Rightarrow n \approx 9$$

Tutorial 4: Reducing balance depreciation

1. A radio purchased for R1 500 incurs a 15% per annum reducing balance depreciation.
   (a) Find the book value after 6 years.
   (b) What is the total depreciation after 6 years?
   (c) If the radio has a scrap value of R200, in which year will this value be reached?

2. What reducing balance rate will cause a stove to drop from R8000 to R6500 in 3 years?

3. The population of a certain species of whale is currently estimated at 2500 and this species is decreasing by 6 % per year.
   (a) How many of this species will there be in 7 years time?
   (b) If it is known that the whales will become extinct when the numbers fall below 300, how many more years can the species be expected to survive?

PAUSE DVD

- Do Tutorial 4
- Then View Solutions

Tutorial 4 Problem 1: Suggested Solution

1. A radio purchased for R1 500 incurs a 15% per annum reducing balance depreciation.
   (a) Find the book value after 6 years.
   (b) What is the total depreciation after 6 years?
   (c) If the radio has a scrap value of R200, in which year will this value be reached?

$$1(a)\quad A = P(1-i)^n = 1500 \times (1-0{,}15)^6 = R565{,}72$$

$$1(b)\quad \text{Total Depreciation } = R1\,500 - R565{,}72 = R934{,}27$$

$$1(c)\quad 200 = 1500 \times (1-0{,}15)^n \Rightarrow 0{,}85^n = \frac{200}{1\,500}$$

$$\Rightarrow n \log 0{,}85 = \log 200 - \log 1\,500$$

$$\Rightarrow n = \frac{\log 200 - \log 1\,500}{\log 0{,}85} \approx 12{,}397$$

$\therefore$ Scrap value in 13^{th} year

Tutorial 4 Problem 2: Suggested Solution

2. What reducing balance rate will cause a stove to drop from R8000 to R6500 in 3 years?

$$2. \quad A = P\left(1 - i\right)^{n}$$

$$\therefore 6\ 500 = 8\ 000\left(1 - i\right)^{3}$$

$$\Rightarrow \left(1 - i\right)^{3} = \frac{6\ 500}{8\ 000} = 0{,}8125$$

$$\Rightarrow 1 - i = \sqrt[3]{0{,}8125} \Rightarrow 1 - i = 0{,}933$$

$$\therefore i = 0{,}067 \Rightarrow \text{Reducing balance rate} = 6{,}7\%$$

Tutorial 4 Problem 3: Suggested Solution

3. The population of a certain species of whale is currently estimated at 2500 and this species is decreasing by 6 % per year.
(a) How many of this species will there be in 7 years time?
(b) If it is known that the whales will become extinct when the numbers fall below 300, how many more years can the species be expected to survive?

$$3(a) \quad A = 2500(1-0,06)^7 = 1\,621 \text{ will be left}$$

$$3(b) \quad 300 = 2\,500 \times 0,94^n$$

$$\Rightarrow 0,94^n = 0,12$$

n	33	34	35
$0,94^n$	0,1298	0,1219	0,1147

Try different values for n
OR Use logs

$\Rightarrow$ Species will become extinct after 34 years

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Lesson 3

Nominal and Effective Rates

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Nominal and Effective Rates

- The rate that is usually given in problems involving compound increase or decrease is the rate applied once a year, which we call the **nominal rate**.
- When the appreciation or depreciation is applied more often than once a year, the **effective rate** is higher or lower than the nominal rate.
- Relationship between effective and nominal rates is illustrated by means of the following example in the next slide:

Nominal rate of 12% per annum compounded monthly is equivalent to effective rate of 12,68% per year.

Comparing Nominal and Effective Rates

Show that:

Nominal rate of 12% per annum compounded monthly is equivalent to effective rate of 12,68% per year.

Nominal rate:

$r = 12\% \text{ p.a.} = 1\% \text{ per month}$

$n = 1 \text{ year} = 12 \text{ months}$

Assume:

$P = 100 \text{ (Why?)}$

$$A = P\left(1+i\right)^{n}$$

$$\Rightarrow A = 100\left(1+0,01\right)^{12}$$

$$\Rightarrow A = 112,68 \text{ rand}$$

Thus the interest on $R100$ is $R12,68$

$\therefore$ Effective rate is 12,68%

Compound Growth (Appreciation) (Comparing Effective and Nominal Rates)

1. R100 at 12% p.a. compounded bi-annually.

$A = 100 \times 1,06^2 = R112,36 \Rightarrow$ Effective Rate is 12,36%

2. R100 at 12% p.a. compounded quarterly.

$A = 100 \times 1,03^4 = R112,55 \Rightarrow$ Effective Rate is 12,55%

3. R100 at 12% p.a. compounded monthly.

$A = 100 \times 1,01^{12} = R112,68 \Rightarrow$ Effective Rate is 12,68%

$\therefore$ **In the case of compound growth :**

The more often interest is compounded during a year the higher the effective rate.

Compound Depreciation (Decay) (Comparing Effective and Nominal Rates)

1. R100 depreciates at 12% p.a. bi-annually.

$A = 100 \times 0,94^2 = R88,36 \Rightarrow$ Effective Rate is 11,64%

2. R100 depreciates at 12% p.a. quarterly.

$A = 100 \times 0,97^4 = R88,53 \Rightarrow$ Effective Rate is 11,47%

3. R100 depreciates at 12% p.a. monthly.

$A = 100 \times 0,99^{12} = R88,63 \Rightarrow$ Effective Rate is 11,36%

$\therefore$ **In the case of compound decay :**

The more often interest is compounded during a year the lower the effective rate.

Relationship between Nominal and Effective Interest Rates

Assume that $n=1$ and interest is compounded during m equal time intervals annually.

Then $A=P(1\pm i \bullet n)$ and $A=P\left(1\pm\frac{i}{m}\right)^{m\times n}$

$$\Rightarrow P(1\pm E)=P\left(1\pm\frac{N}{m}\right)^{m}$$

$$\Rightarrow (1\pm E)=\left(1\pm\frac{N}{m}\right)^{m}$$

From Nominal Growth Rate to Effective Growth Rate

Calculate the effective growth rate per annum if the nominal growth rate of 18% p.a. is compounded quarterly.

$$1+E=\left(1+\frac{0,18}{4}\right)^4$$

$$\Rightarrow E=\left(1+\frac{0,18}{4}\right)^4-1$$

$$\therefore E=0,1925=19,25\%$$

From Nominal Depreciation Rate to Effective Depreciation Rate

Calculate the effective depreciation rate per annum if the nominal decay (depreciation) rate of 18% p.a. is compounded monthly.

$$1-E=\left(1-\frac{0{,}18}{12}\right)^{12} \Rightarrow E=1-\left(1-\frac{0{,}18}{12}\right)^{12}$$

$$\therefore E=1-\left(1-\frac{0{,}18}{12}\right)^{12}=0{,}1659=16{,}59\%$$

From Effective to Nominal Rate

Calculate the nominal growth rate per annum compounded quarterly if the effective growth rate is 9% per annum.

$$1 + 0,09 = \left(1 + \frac{N}{4}\right)^4$$

$$\therefore 1 + \frac{N}{4} = \sqrt[4]{1,09}$$

$$\Rightarrow N = 4\left(\sqrt[4]{1,09} - 1\right)$$

$$\Rightarrow N = 0,087 = 8,7\%$$

Tutorial 5: Effective and Nominal Rates

1) Calculate the effective rate of depreciation per annum if the nominal rate of depreciation of 18% p.a. is compounded quarterly.

2) Calculate the nominal growth rate per annum compounded monthly if the effective growth rate is 13% per annum.

PAUSE DVD

- Do Tutorial 5
- Then View Solutions

Tutorial 5 Problem 1: Suggested Solution

1) Calculate the effective rate of depreciation per annum if the nominal rate of depreciation of 18% p.a. is compounded quarterly.

$$1-E=\left(1-\frac{0,18}{4}\right)^4 \quad \Rightarrow E=1-\left(1-\frac{0,18}{4}\right)^4$$

$$\therefore E=1-\left(1-\frac{0,18}{4}\right)^4=0,1682=16,82\%$$

Tutorial 5 Problem 2: Suggested Solution

2) Calculate the nominal growth rate per annum compounded monthly if the effective growth rate is 13% per annum.

$$1+0,13=\left(1+\frac{N}{12}\right)^{12}$$

$$\therefore 1+\frac{N}{12}=\sqrt[12]{1,13} \Rightarrow N=12\left(\sqrt[12]{1,13}-1\right)$$

$$\Rightarrow N=0,1228=12,28\%$$

End of the DVD on Simple and Compound Interest

REMEMBER!

- Consult text-books for additional examples.
- Attempt as many as possible other similar examples on your own.
- Compare your methods with those that were discussed in the DVD.
- Repeat this procedure until you are confident.
- Do not forget:

Practice makes perfect!