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Financial Mathematics



Lesson 1: Saving for future studies

$$x = \frac{Fi}{[(1+i)^n - 1]}$$

$$= \frac{10000 \times \left(\frac{0,095}{12}\right)}{\left[\left(1 + \frac{0,095}{12}\right)^{10} - 1\right]}$$

$$= R964,89$$

Lesson 2: Evaluating loan options

$$1. \quad P = \frac{x[(1 - (1+i)^{-n})]}{i}$$

$$= \frac{800\left[1 - \left(1 + \frac{0,085}{12}\right)^{-24}\right]}{\frac{0,085}{12}}$$

$$= R17599,56$$

This is the present value in 4 years time. We assume he makes no payments while studying to calculate the present value of this NSFAS loan by using the compound interest formula:

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

$$= 17\,599,56$$

$$(1 + 0,085 \div 12)^{48}$$

$$= R\,12541,87$$

2. Total payment = $R800 \times 24 = R19200$
 Loan amount = $R12541,87$
 Total Interest = $R6657,13$

3. The total payment is the same $R19200$.
 However, he will only get $R10\,876,41$ from the bank and pay $R8323,59$ in interest whereas for a NSFAS loan he will pay only $R6657,13$ in interest. The NSFAS loan is clearly better. However, both loans may be subject to a change in interest rates and this needs to be considered carefully.

Lesson 3: Housing loans

$$1. \quad x = \frac{P.i}{[1 - (1+i)^{-n}]}$$

$$= \frac{R400000 \cdot \left(\frac{0,12}{12}\right)}{\left[1 - \left(1 + \frac{0,12}{12}\right)^{-240}\right]}$$

$$= \frac{R4000}{[1 - 0,0918058365]}$$

$$= R4000,91$$

$$2. \quad x = \frac{P.i}{[1 - (1+i)^{-n}]}$$

$$= \frac{R400000 \cdot \left(\frac{0,125}{12}\right)}{\left[1 - \left(1 + \frac{0,125}{12}\right)^{-240}\right]}$$

$$= \frac{R4166,666666666666}{[1 - 0,083153341]}$$

$$= R4544,56$$

New re-payment is $R4544.56$ per month

Total cost of loan at 12%
 $= R4000,91 \times 240 = R960218,40$

Total cost of loan at 12,5%
 $= R4544,56 \times 240 = R1090694,40$

The difference in interest is $R130\,476$

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Lesson 4: A sinking fund

Depreciation

$$F_v = P_v(1-i)^n$$

$$F_v = R100000(1-0,1)^4$$

$$= R 65610$$

Increase due to Inflation

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

$$F_v = R100\ 000(1+0,07)^4$$

$$= R 131\ 079,60$$

$$\text{Difference} = R131\ 079,60 - R 65610$$

$$= R 65\ 469,60$$

Sinking fund Future value = R 65 469,60

Assume interest rate for annuity: 11,5%

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

$$= \frac{R65469,60 \times \left(\frac{0,115}{12} \right)}{\left[\left(1 + \frac{0,115}{12} \right)^{48} - 1 \right]}$$

$$= R1080,62$$

Phil needs to invest R1080,62 in an annuity each month for 4 years to be able to replace his machinery.