Grade 12 revision note on unit 11(Social science)

Mathematical Applications in Business

BASIC MATHEMATICAL CONCEPTS IN BUSINESS

1. Ratio

Definition : A ratio is a comparison of two or more quantities expressed in the same unit of measurement.

2. Ratio

Definition : A rate is a comparison of two or more quantities expressed in different units of measurement.

3. Proportion

Definition: A proportion is a statement of equality between two ratios.

Example 10 A secretarial pool (15 secretaries in all) on one floor of a corporate complex has access to 11 telephones. If on a different floor, there are 23 secretaries, approximately what number of telephones should be available?

Solution Let x be the number of telephones available on the other floor. Then we have the proportion $15:11 = 23: x$, that is, $\frac{15}{11} = \frac{23}{x}$.

Hence $x = \frac{11 \times 23}{15} = 16.87$. Therefore, 17 telephones are required.

4. Percentage

Definition: A percentage is the numerator of a fraction whose denominator is 100. The term percent is denoted by % which means "per one hundred".

Note: Percentage = base ×rate

Example 16 If the value added tax (VAT) on sales is 15%, find the VAT on a sale of refrigerator that costs Birr 3,800. What is the total cost of the refrigerator?

Solution The rate is 0.15 and the base is Birr 3,800, hence the percentage would be

Percentage = base $\times$ rate = $3{,}800 \times 0.15$ = Birr 570.

The VAT on the refrigerator is Birr 570.

The total cost of the refrigerator = cost + VAT

= Birr 3,800 + Birr 570

= Birr 4,370.

Compound proportion

Definition: A compound proportion is a situation in which one variable quantity depends on two or more other variable quantities. Specifically, if a variable quantity y is proportional to the product of two or more variable quantities, we say that y is jointly proportional to these variable quantities, or y varies jointly as these variables.

Example 11 If z is proportional to y and to the square of x and $z = 80$ when $x = 2$ and $y = 5$, then find the equation that relates the variables $x, y,$ and z.

Solution We are given that $z \propto yx^2$ which is equivalent to $z = kyx^2$, where k is a constant of proportionality

To determine the constant of proportionality, put the given values of the variable

$80 = k(5)(2^2) = 20k.$

Hence, $k = 4$. Therefore the equation that relates the three variables is $z = 4yx^2$.

Commercial Discount

Discount = r.p

Therefore, the sales price will be given by:

Discount sales price = Original price −Discount =p− r.p = p (1 − r)

Example 17 A wool suit, discounted by 30% for a clearance sale, has a price tag of Birr 399. What was the suit's original price? What is the amount of discount?

Solution Let p be the original price of the suit. The amount of discount is $0.30p$. Hence

$$\text{Sales price} = p - 0.30p = 0.70p \Rightarrow 399 = 0.70\,p \Rightarrow p = \frac{399}{0.70} = Birr\ 570$$

Therefore, the original price p = Birr 570 and the amount of discount is

570 – 399 = Birr 171.

Markup

In order to make a profit, any institution or company must sell its products for more than the product costs the company to make or buy. The difference between a product selling price and its cost is called markup.

Markup = Selling price – Cost price

Example 18 If the price of cement is Birr 250 per quintal and you sell it for Birr 330 per quintal, find the markup per quintal.

Solution: Markup = Selling price – Cost

= Birr 330 per quintal – Birr 250 per quintal = Birr 80 per quintal

Markup is usually expressed in terms of percentage with respect to selling price and cost. Markup with respect to selling price is given by;

$$\text{Markup percent} = \frac{\text{markup}}{\text{selling price}} \times 100\%$$

Similarly markup with respect to cost is given by:

$$\text{Markup percent} = \frac{\text{markup}}{\text{cost}} \times 100\%$$

Example 19 If you buy a gold ring for 498 Birr and sell it for 750 Birr, find the markup percent

a with respect to selling price. **b** with respect to cost.

Solution: Markup = Selling price – Cost price = Birr 750 – Birr 498 = Birr 252.

a The markup percent with respect to the selling price is:

$$\text{Markup percent} = \frac{\text{markup}}{\text{Selling price}} \times 100\% = \frac{252}{750} \times 100\% = 33.6\%.$$

b The markup percent with respect to the cost is:

$$\text{Markup percent} = \frac{\text{markup}}{\text{cost price}} \times 100\% = \frac{252}{498} \times 100\% = 50.6\%.$$

In business, it is often necessary to make conversion between percent markups based on cost and selling price. To convert markup percent based on cost to markup percent based on selling price, use the following relation:

$$\text{Markup percent on selling price} = \frac{\text{markup percent on cost}}{\text{selling price (as percent of cost)}} \times 100\%$$

$$= \frac{\text{markup percent on cost}}{100\% + \text{markup percent on cost}} \times 100\%$$

Similarly, to convert markup percent based on selling price to markup percent based on cost, use the relation:

$$\text{Markup percent on cost} = \frac{\text{markup percent on selling price}}{\text{cost (as percent of selling price)}} \times 100\%$$

$$= \frac{\text{markup percent on cost}}{100\% - \text{markup percent on selling price}} \times 100\%$$

Example22 What is the percent markup on selling price if the markup on cost is 25%?

Solution Since we are given the markup on cost, we use the relation

$$\text{Markup percent on selling price} = \frac{\text{markup percent on cost}}{\text{selling price (as percent of cost)}} \times 100\%$$

$$= \frac{\text{markup percent on cost}}{100\% + \text{markup percent on cost}} \times 100\%$$

$$= \frac{25\%}{100\% + 25\%} \times 100\% = 20\%$$

Compound Interest

Future value of a compound interest:

$$A = P\left(1 + \frac{r}{m}\right)^{mt}$$

where A is amount or future value, P is principal or present value, r is annual or nominal rate, t is time in years, and m is the number of conversion periods per year.

Example

If Birr 100 is deposited in the Commercial Bank ofEthiopia with interest rate of 10% per annum, find the amount if it is compounded annually, semi-annually, quarterly, monthly, and weekly at the end of one year. (No withdrawal or deposit is made in the whole year).

Solution

a. You are given the principal P= Birr 100, the annual interest rate 1.0 = r , for a period of time 1

= t year, and compound period of : mt n = a Annually means 1 = m , so that the amount at the end of the year is

$$A = P\left(1+\frac{r}{m}\right)^{mt} = 100\left(1+\frac{0.1}{1}\right)^{1(1)} = \text{Birr } 110.$$

b. Semi-annually means 2 = m , so that the amount at the end of the year is b Semi-annually means 2 = m , so that the amount at the end of the year is

$$A = P\left(1+\frac{r}{m}\right)^{mt} = 100\left(1+\frac{0.1}{2}\right)^{2(1)} = \text{Birr } 110.25.$$

Ordinary annuity

Many people are not in a position to deposit a large amount of money at a time in an account. Most people save money by depositing relatively small amount at different times. If a depositor makes equal deposits at regular intervals, he/she is contributing to an annuity. The deposits may be made weekly, monthly, yearly, or any other period of time. If we deal with annuities in which the deposits (or payment) are made at the end of each of the deposit (or payment) intervals, which coincides with the compounding period of interest, then this type of annuity is called ordinary annuity.

Depreciation

The decrease in usefulness is a business expense, called depreciation

The depreciation of an asset is caused mainly due to:

A. Physical depreciation:- wear out from use and deterioration from the action of the element

B. Functional depreciation:- inadequacy and obsolescence. Inadequacy results if the capacity does not meet the demand of increased production, while obsolescence

results, if the commodity produced is no longer in demand with respect to quality and cost of production.

$$\text{depreciation} = \frac{\text{cost} - \text{salvage value}}{\text{estimated life in years}}$$

A machine costing Birr 35,000 is estimated to have a useful lifetime of 8 years and a salvage value of Birr 3,000. What is the accumulated depreciation at the end of 5 years? Find the book value of the asset at that time, using the fixed instalment method (where book value = cost – accumulated depreciation)

Solution

We have the cost = Birr 35,000, salvage value = Birr 3,000 and useful life = 8 years. The depreciation charge per year is

$$\text{depreciation} = \frac{\text{cost} - \text{salvage value}}{\text{estimated life in years}} = \frac{35,000 - 3,000}{8} = \text{Birr } 4,000$$

Hence the accumulated depreciation increases by Birr 4,000 every year. The accumulated depreciation at the end of 5 years will be: years × depreciation charge per year = 5 × (4,000) = Birr 20,000. The book value of the asset at the end of 5 years will be: Book value = cost – accumulated depreciation = 35,000 – 20,000 = Birr 15,000.