$x = Se^{pn}, where\ S\ is\ a\ constant$

2. $\dot{x} + px = q\ for\ all\ values\ of\ n,$

$$x = Se^{-pn} + \frac{q}{p}, where\ S\ is\ a\ constant$$

3. $\dot{x} + px = qx^2\ for\ all\ values\ of\ n,$

$$x = \frac{p}{q - Se^{pn}}\ where\ S\ is\ a\ constant$$

Chapter 10 Rate of Interest and Values

Repayment of Mortgage

Let us look at a sample question which would sound like, A person has taken a mortgage for € A that he will pay over t installments at the rate of r% compounded annually. How much will he pay per installment?

From the previous section, Let p be the amount for each installment so

$$\frac{p}{r} \times 100 \left[1 - \frac{1}{(1 + \frac{r}{100})^n}\right] = A$$

Example: Let us use the example of the next door neighbor who has taken a mortgage of € 100000 that he will pay over 4 installments at the rate of 20% compounded annually. How much will he pay per installment?

$$\frac{p}{20} \times 100 \left[1 - \frac{1}{\left(1 + \frac{20}{100}\right)^4}\right] = 100000$$

$$p \times 5 \left[1 - \frac{1}{(1.20)^4}\right] = 100000$$

$$p = \frac{100000}{5} \times 0.5177$$

$$p = 10354$$

Now to find the amount per installment or p we can just use:

$$p = \frac{rA}{1 - (1 + r)^{-n}}$$

To find the number of periods required to pay back the loan at given amount per installment we can use:

$$n = \frac{lnp - \ln(p - rA)}{\ln(1 + r)}$$

Understanding Internal Rate of Return:

Just remember the following formula where Initial investment is A, and the returns per period is $p_1, p_2 \dots\dots\dots p_n$ for n periods, The rate of return be r

$$A = \frac{p_1}{(1 + r)^1} + \frac{p_2}{(1 + r)^2} + \cdots \dots + \frac{p_n}{(1 + r)^n}$$

To make the calculation easier assum$(1 + r)^{-1} = x$, therefore rewrite the formula

$A = p_1x + p_2x^2 + \cdots \ldots + p_nx^n$
Then first solve for x and substitute $(1+r)^{-1} = x$, to find the value of r

Chapter 11 Multi Variables and their Functions

Understanding Surfaces and Distance

For a 3 dimensional figure, the general equation for a plane in space is given by:
$px + qy + rz = s$
Now let us see its economical use,
We can consider each plane or axis to represent a product, then the space is called budget plane, where p, q and r are cost of goods/unit and s is the total value.
Now for a 3D space, we can find the distance between any 2 points on the space,
The formula is given for two point (p_1, q_1, r_1) and (p_2, q_2, r_2)
The distance is given by $distance = \sqrt{(p_1, -p_2)^2 + (q_1 - q_2)^2 + (r_1 - r_2)^2}$
Now the equation for a sphere is given for a center (u, v, w) and radius r
$(x-u)^2 + (y-v)^2 + (z-w)^2 = r^2$

Chapter 12 Comparative Statistics

A peek into General Cases:

For partial derivatives when we know $z = f(x,y)$ and c is a constant
$F(x,y,z) = c \Rightarrow z'_x = -\frac{F'_x}{F'_z}, \quad z'_y = -\frac{F'_y}{F'_z} \; for \; F'_z \neq 0$
Now for a more general case,
$F(x_1, x_2, \ldots \ldots, x_n, z) = \frac{\delta F/\delta x_i}{\delta F/\delta z}$, $where \; i = 1,2, \ldots .., n$

Understanding Linear Approximation

The Linear approximation to f(x) about (x_o, y_o) is given by the formula
$f(x,y) \approx f(x_o, y_o) + f'_1(x_o, y_o)(x - x_o) + f'_2(x_o, y_o)(y - y_o)$
Where, $f'_1(x_o, y_o)$, stands for first derivative of (x_o, y_o) in terms of x and $f'_2(x_o, y_o)$ stands for the first derivative of (x_o, y_o), in terms of y.
Now one can generalize the above equation to re-write it for functions of several variables
Linear approximation to $z = f(\mathbf{x}) = f(x_1, \ldots \ldots x_n)$ $about$ $\mathbf{x}^0 = (x_1^0, \ldots \ldots, x_n^0)$
$f(\mathbf{x}) \approx f(\mathbf{x}^0) + f'_1(\mathbf{x}^0)(x - x^0) + \ldots \ldots \ldots . + f'_n(\mathbf{x}^0)(x_n - x_n^0)$
Again $f'_n(x^0)$ stands for the first derivative in terms of the nth variable in the equation