4.1 Linear Functions

(1) What is a linear function? Determine whether a linear function is increasing, decreasing or constant.

(2) Find the slope of a linear function. Write an equation for a linear function.

(3) Graph linear functions

(4) Determine whether 2 lines are perpendicular or parallel. Write an equation of a line parallel or perpendicular to a given line.

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(1) What is a linear function?

A linear function is a function of the form

$f(x) = mx + b$; where m and b are constants

or $y = mx + b$

E.g. $f(x) = 2x + 5$; $f(x) = -\frac{3}{7}x - \frac{12}{17}$

The graph of a linear function is a line.

Note: When $x = 0$, $y = b$. The point $(0, b)$ is called the y-intercept of f.

m is called the slope of $f(x)$.

Find the R.O.C of $f(x)$ on $[x_1, x_2]$

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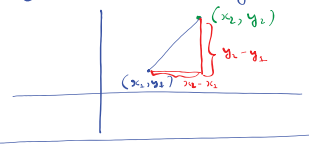
R.O.C. $= \frac{f(x_2) - f(x_1)}{x_2 - x_1} = \frac{mx_2 + b - (mx_1 + b)}{x_2 - x_1}$

$= \frac{mx_2 + b - mx_1 - b}{x_2 - x_1}$

A.R.O.C. of f on $[x_1, x_2] = \frac{mx_2 - mx_1}{x_2 - x_1} = \frac{m(x_2 - x_1)}{x_2 - x_1} = m$

Constant rate of change $= m$.



Increasing / Decreasing / Constant

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$f(x) = mx + b$.

If $m > 0$, then f is increasing.

If $m < 0$, then f is decreasing.

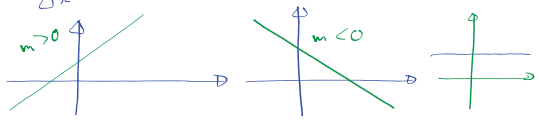
If $m = 0$; then f is constant.

$\left(m = \frac{\Delta y}{\Delta x}, \Delta y = m\Delta x\right)$

$f(x) = 2x + 3$

$f(x) = -\frac{1}{3}x + \frac{5}{7}$

$f(x) = 10$



Note: We only need 2 points to determine a linear function.

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(2) Find the slope and an equation of a linear function given 2 points.

E.g. $f(x)$ is a linear function.

$(2, 3)$ and $(0, 4)$ are points on the line $y = f(x)$.

Find the slope of f. Find an equation for f.

Determine whether f is increasing or decreasing.

Calculate the slope of a linear function given 2 points (x_1, y_1); (x_2, y_2).

$\text{Slope} = \frac{\text{change in } y}{\text{change in } x} = \frac{y_2 - y_1}{x_2 - x_1}$

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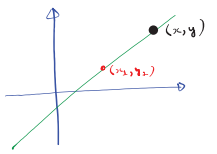
Point - Slope equation of a linear function

$m \rightarrow$ Slope

$(x_1, y_1) \rightarrow$ a point



$\frac{y - y_1}{x - x_1} = m$

$y - y_1 = m(x - x_1)$

$\rightarrow$ isolate y.

Solution to E.g.

$(2, 3)$ and $(0, 4)$.

$\text{Slope} = \frac{4 - 3}{0 - 2} = \frac{1}{-2} = -\frac{1}{2}$.

Point - Slope equation: $y - 3 = -\frac{1}{2}(x - 2)$

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