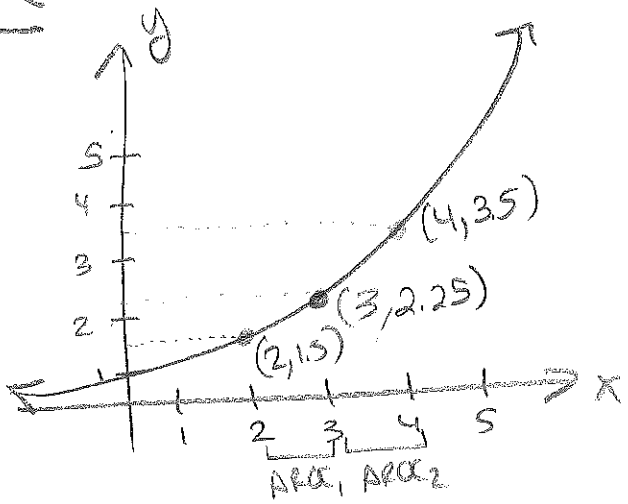
# How do we approximate instantaneous roc (iroc)?

IROC is used to find the roc on a nonlinear graph/fxn/table at a given point.

IROC is the average of two AROCs, one aroc below the point and one aroc above the point.

$$\text{Approx IROC} = \frac{\text{AROC}_1 + \text{AROC}_2}{2}$$

## Graph




approx. IROC @ x = 3

1. find aroc on [2,3]
2. find aroc on [3,4]
3. $\frac{\text{AROC}_1 + \text{AROC}_2}{2}$

$(2, 1.5), (3, 2.25)$ ($x_1, y_1$ $x_2, y_2$) $\Rightarrow \text{AROC}_1 = \frac{2.25 - 1.5}{3 - 2} = .75$

$(3, 2.25), (4, 3.5)$ ($x_1, y_1$ $x_2, y_2$) $\Rightarrow \text{AROC}_2 = \frac{3.5 - 2.25}{4 - 3} = 1.25$

$$\text{IROC} = \frac{\text{AROC}_1 + \text{AROC}_2}{2} = \frac{.75 + 1.25}{2} = \boxed{1}$$

## Function

Given $f(x) = \frac{1}{2}x^3 - 1$, approx. IROC @ $x = 3$ (given)

$[2, 3]$ ($x_1, x_2$)

$f(2) = \frac{1}{2}(2)^3 - 1 = 3$ "$y_1$"

$f(3) = \frac{1}{2}(3)^3 - 1 = 12.5$ "$y_2$"

$$AROC_1 = \frac{12.5 - 3}{3 - 2} = \frac{9.5}{1} = 9.5$$

$[3, 4]$ ($x_1, x_2$)

$f(3) = 12.5$ "$y_1$"

$f(4) = \frac{1}{2}(4)^3 - 1 = 31$ "$y_2$"

$$AROC_2 = \frac{31 - 12.5}{4 - 3} = 18.5$$

$$IROC = \frac{AROC_1 + AROC_2}{2} = \frac{9.5 + 18.5}{2} = \frac{28}{2} = \boxed{14}$$

## Table

| | | | | | |
|---|---|---|---|---|---|
| \$ | 10,508 | 11,750 | 20,433 | 19,576 | 17,112 |
| yr | 2012 | 2013 | 2014 | 2015 | 2016 |

$AROC_1$ spans 2014 → 2015; $AROC_2$ spans 2015 → 2016

Approx. IROC in 2015

$$AROC_1 = \frac{19570 - 20433}{2015 - 2014} = -\$863/yr$$

$$AROC_2 = \frac{17,112 - 19,570}{2016 - 2015} = -\$2458/yr$$

$$IROC = \frac{AROC_1 + AROC_2}{2} = \frac{-863 + (-2458)}{2} = -\$1,660.50/yr$$