EG02021 Mathematics

Class 2: Differentiation

2.1. Limit and Continuity: Numerically and graphically

$f(x) = 2\text{x} + 3$

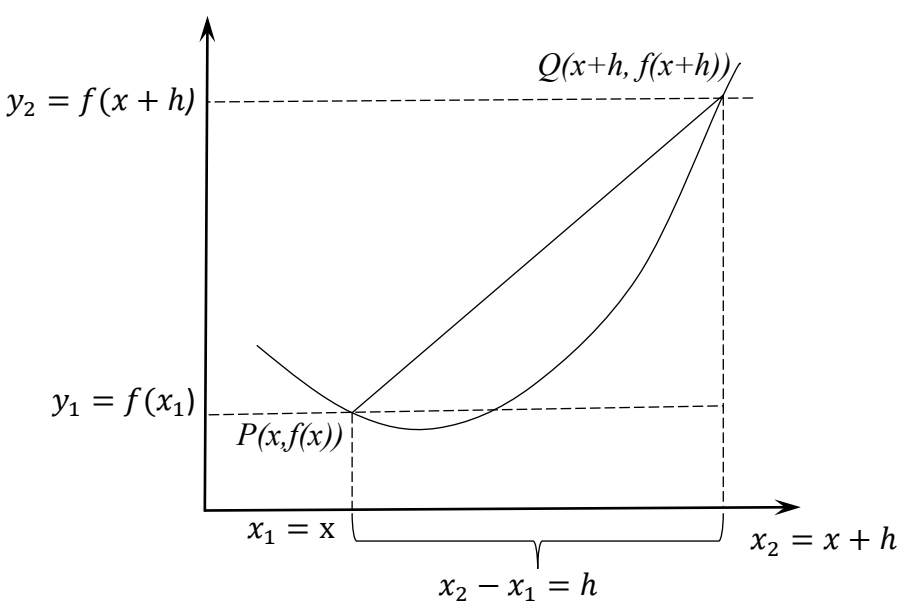
2.2 Limits: Algebraically

1. $\lim_{x\to 2} \sqrt{2x+12}$
2. $\lim_{x\to -3} \frac{x^2-9}{x+3}$
3. $\lim_{x\to 0} \frac{1-cosx}{x}$

2.3.1 Average rate of change

Exercise: Photosynthesis: What was the average number of grams of oxygen had been produced per hour between 9 AM between 11 AM.

2.3.2 Difference Quotients as Average Rate of Change



2.5 Differentiation Techniques

a) Power Rule: $\frac{d}{dx}\sqrt{\text{x}}$

b) Derivative of constant: $\frac{d}{dx}(-1.x^{0.7})$

c) Sum or difference: $\frac{d}{dx}(5x^3 - 3x^2)$

d) Derivative of the Sine and Cosine Functions: $\frac{d}{dx}(4cosx + 3)$

2.6 Instantaneous Rates of Change

I. **Whale Growth**: The growth of a Killer whale (Orcinus Orca) can be modeled by the function:

$$f(t) = 412 + 44.8t + 1.1t^2 - 0.0167t^3$$

Where, $0 \leq t \leq 60$ is the time in months after birth and $f(t)$ is the weight in pounds.

a) Find the rate of change of the weight of whale?
b) Find the weight of the whale at 40 mo?
c) Find the rate of change of the weight of the whale at 40mo?
d) At what time does the whale stop growing?

II. **Population Growth.** The initial population in a bacteria colony is 8000. After *t* hours, the colony has grown to a number *P(t)* given by

$P(t) = 10{,}000\,(1 + 0.86t + t^2)$

a) Find the rate of change of the population *P* with respect to time *t.* This is also known as the growth rate.
b) Find the number of bacteria present after 5 hr. Also, find the growth rate when *t=5*.
c) At what time is the growth rate 200,000 bacteria per hour?