

BLG 202F  
Assignment 1

Student Name: Ahmet Furkan Kavrut Student Number: 150190024

Q1)

a) The function is  $f_1(x_0, h) = \sin(x_0 + h) - \sin(x_0)$ .

For deriving  $f_2(x_0, h)$ , since  $f_1$  and  $f_2$  have same values, we can use  $\sin(\phi) - \sin(\psi) = 2 \cos\left(\frac{\phi + \psi}{2}\right) \cdot \sin\left(\frac{\phi - \psi}{2}\right)$ .

Replace  $\phi$  with  $(x_0 + h)$  and  $\psi$  with  $x_0$ :

$$\underbrace{\sin(x_0 + h) - \sin(x_0)}_{f_1(x_0, h)} = 2 \underbrace{\cos\left(\frac{x_0 + h + x_0}{2}\right) \cdot \sin\left(\frac{x_0 + h - x_0}{2}\right)}_{f_2(x_0, h)}$$

$$f_2(x_0, h) = 2 \cos\left(x_0 + \frac{h}{2}\right) \cdot \sin\left(\frac{h}{2}\right)$$

b) The question is about calculating derivation of  $\sin(x)$ .

$$\text{Formula is: } \frac{f(x_0 + h) - f(x_0)}{h} = \frac{\sin(x_0 + h) - \sin(x_0)}{h}$$

If we use this formula, the cancellation errors can occur because "h" is small number and we subtracted two nearby number. Instead of  $\sin(x_0 + h) - \sin(x_0) = f_1(x_0, h)$ , we can replace formula of  $f_2(x_0, h)$ .  $f(x) = \sin(x)$ . The derivation formula can be written as

$$f'(x) = \frac{f_1(x_0, h)}{h} = \frac{f_2(x_0, h)}{h} = \frac{2 \cdot \cos\left(x_0 + \frac{h}{2}\right) \cdot \sin\left(\frac{h}{2}\right)}{h}$$