

**Exercise 1. (Derivatives of  $e^x$  and  $\ln x$ )**Compute  $f'(x)$  where:

(a)  $f(x) = (\sin x)^{x^2}$

(b)  $f(x) = \ln(\tan x + e^{-2x})$

(c)  $f(x) = (x^2 - 1)^{\ln x}$

(d)  $f(x) = \ln((\cos x)^{2x^3})$

**Exercise 2. (Linear approximations)**

Use linear approximations to approximate the following values:

(a)  $\ln(e^3 + \frac{1}{100})$

(b)  $\sin 1$  (*Hint:  $\pi/3 \approx 1$* )

(c)  $\sqrt{99}$

(d)  $\ln(\frac{3}{\pi})$  (*Hint:  $\pi/3 \approx 1$* )

**Exercise 3. (Minima and Maxima)**Find the local minima and maxima of  $f(x)$  on the given interval:

(a)  $f(x) = x + \sin x$  over  $[0, 2\pi]$

(b)  $f(x) = \frac{x}{1+x^2}$  over  $[0, 10]$

(c)  $f(x) = 3x\sqrt{1-x^2}$  over  $[0, 1]$

(d)  $f(x) = x^2 + \frac{4}{x}$  over  $[1, 4]$

**Exercise 4. (Mean Value Theorem)**Use the mean value theorem and find all  $1 < c < 2$  such that  $f(2) - f(1) = f'(c)(2 - 1)$ :

(a)  $f(x) = x^3$

(b)  $f(x) = \sin(\pi x)$

(c)  $f(x) = 1 + x + x^2 + x^3$