Taloustieteen matemaattiset menetelmät
31C01100
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Problem Set 0: Solutions

1. **Solution**

$$f(x) = \begin{cases} 2 & \text{if } x = 0, 1 \\ 0 & \text{otherwise} \end{cases}$$

2. **Solution**

   1. $f(x) = x^a$, $f'(x) = ax^{a-1}$
   2. $f(x) = e^{ax}$, $f'(x) = ae^{ax}$
   3. $f(x) = (3x+2)^3$, $f'(x) = 3(3x+2)^2 \times 3 = 9(3x+2)^2$
   4. $f(x) = \frac{3x}{x^2+1}$, $f'(x) = 3 \times \frac{1}{x^2+1} + 3x \times \frac{-1}{(x^2+1)^2} \times 2x = \frac{3}{x^2+1} - \frac{6x^2}{(x^2+1)^2} = \frac{-3(x^2-1)}{(x^2+1)}$
   5. $f(x) = 4e^{-3x}$, $f'(x) = -12e^{-3x}$
   6. $f(x) = x \ln x$, $f'(x) = \ln x + 1$

3. **Solution**

   1. Local maximum: $f(x) = \frac{2}{3\sqrt{3}}$ at $x = \frac{1}{\sqrt{3}}$
   2. Local minimum: $f(x) = -\frac{2}{3\sqrt{3}}$ at $x = -\frac{1}{\sqrt{3}}$.
   3. No global maximum
   4. No global minimum

4. **Solution**

   1. Convex
   2. Convex
   3. Both concave and convex
   4. Concave. If -f(x) is convex, then f(x) is concave
   5. Concave
   6. Concave for $x \leq 0$, and convex for $x \geq 0$