Econ7115: Structural Models and Numerical Methods in Economics
Assignment W03

Due 13 February 2026

Zi Wang
HKBU
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1. Derive the partial derivatives of the following function at $(2, 1)$ and $(5, 3)$:

$$y = \left[x_1^2 + x_1^2/x_2 - \exp(x_2)\right] \log\left[x_1 + \exp(x_2)\right] \tag{1}$$

   - Please conduct forward/backward/centered differencing.
   - Please conduct automatic differentiation.
   - Compare computational performances and results of the methods above.

2. Let $I = [0, 1] \times [1, 3]$. Compute

$$S = \int_I x^2 + y^2 + 2\frac{x}{y} dx dy \tag{2}$$

   - Please use Newton-Cotes Methods with (i) Trapezoid rule and (ii) Simpson's rule.
   - Please use Monte Carlo integration.
   - Compare computational performances and results of the methods above.