Australian National University

Venue ____________________

Student Number |__|__|__|__|__|__|__|__|

Research School of Economics

EXAMINATION

Semester 1 - In-Class & Online, 2024

ECON2125/ECON6012_Semester 2 Optimisation for Economics and Financial Economics

This paper is for ANU and ANU students.

Examination Duration: 60 minutes
Reading Time: 15 minutes
Exam Conditions:
(No electronic aids are permitted e.g. laptops, phones)
Materials Permitted In The Exam Venue: No materials permitted
Materials To Be Supplied To Students: 1 x 20 page
Instructions To Students: See next page

INSTRUCTIONS TO STUDENTS

- Read the questions carefully.
- Questions are worth different amount of marks given in parenthesis. Sub-questions in each questions are of equal value.
- To maximize your marks, explain all the steps in your arguments.
- If any part of the question seems missing or ambiguous, state clearly the way you interpret it, and carry on with your answer.
- In solving the questions, you can use any fact from the lecture materials without proof, unless specifically asked to give details. In either case, you should clearly state the relevant fact.
- You do not need to do the questions in order, as long as you clearly mark in your answer sheets which question you are addressing.

QUESTIONS

Question 1. (*10 marks*)

Find an example of a nonlinear function $f\colon D \subset \mathbb{R}^2 \to \mathbb{R}$ that has has neither a maximizer nor a minimizer on D. Remember to define both the function and its domain. Explain why the function has this property.

Question 2. (*10 marks*)

Make a sketch of the graph of correspondence $\gamma\colon \mathbb{R} \to 2^{\mathbb{R}}$ given by

$$\gamma(x) = \left\{ y \in \mathbb{R}\colon |y| \leq \sqrt{|x|} \right\}$$

Question 3. (*20 marks*)

Characterize the set of maximizers of the following function on its domain.

$$f\colon \mathbb{R}^2 \ni (x, y) \mapsto e - \frac{e^{x^2+y^2}}{x^2+y^2} \in \mathbb{R}$$

Question 4. (*20 marks*)

Find the gradient of the composite function $h = f \circ g$ using the chain rule. Then compute its stationary points, i.e. the points where the gradient is equal to the null vector.

$$f\colon \mathbb{R}^2 \ni (x, y) \mapsto x^5 - 5x^3 - 15x^2y + 5y^3 \in \mathbb{R}$$
$$g\colon \mathbb{R}^2 \ni (x, y) \mapsto \begin{pmatrix} \ln(x) \\ \ln(-y) \end{pmatrix} \in \mathbb{R}^2$$

END OF EXAMINATION