

COMP2208

Math problem sheet 2

1 OVERVIEW

The key points of this problem-sheet are:

- This problem-sheet counts for 5% of this module.
- The questions in this problem-sheet are in multiple-choice format. For each question, select the solution from the choices given.
- The deadline¹ for submission of your solutions: **6th Nov. 2020 by 4pm.**
- Summative feedback will be given within 2 weeks after the deadline.
- Learning Outcome: Test your knowledge on extrema, interpolation, and the Newton-Raphson method.

For submission instructions, please see Section 3 at the end of this document.

2 PROBLEMS

QUESTION 1 (1 point). Consider an algorithm for the generation of bitcoins. Generating more bitcoins becomes increasingly harder and running times to calculate n bitcoins (in hours) follows the law $T(n) = \exp(\alpha n)$ with $\alpha = 0.2$. The electricity cost of running your computer for one hour is £0.1 and you also know that you can sell each bitcoin you calculate for £1. How many bitcoins should you calculate to maximise your profit?

¹Solutions submitted after the deadline will be penalised.

- a 18
- b 20
- c 21
- d 23

QUESTION 2 (1 point). Find the extrema of the function $f(x) = -xe^{-x^2}$ for $x \in (-\infty, \infty)$. Now determine if the extrema are local or global, and maxima or minima.

- a One global minima
- b One local maxima and one global maxima
- c One local minima and one global minima
- d One global minima and one global maxima

QUESTION 3 (1 point). You are given the function $f(x) = x^3$. Knowing the value of $f(x_0)$ where $x_0 = 1$, use linear interpolation to approximate $f(x)$ at $x = 1.01$.

- a 1.07
- b 1.03
- c 0.95
- d 1.01

QUESTION 4 (1 point). Consider the function $f(x) = \sin^2 x$ at $x_0 = 0$. Approximate $f(x)$ at $x = 1$ using the Taylor series up to the fifth order derivative.

- a 0.666
- b 0.654
- c 0.700
- d 0.671

QUESTION 5 (1 point). You use the Newton-Raphson method to estimate the roots of the function $f(x) = x^4$ starting with $x_0 = 1$. How often do you have to iterate to get within 0.01 of the correct solution.

- a 14
- b 12
- c 15
- d 13

Note that the estimated roots are rounded to two decimal places.

3 SUBMISSION INSTRUCTIONS

Submit your work using the ECS electronic hand-in system. The submission is to be made by **4pm** on the due date listed above. Please submit a single file to the ECS electronic hand-in system as detailed below:

- Your submission file must be named as **comp2208-ps2.txt**.
- Your submitted file must be in a **plain ASCII text file format**.
- You can use Notepad (Windows operating system users) or vim, emacs etc. (Linux users) to create the file.
- Each line of the submitted text file should only contain the question number, followed by a single space, and the selected solution for that question.
- Example, if a, b, c, d and a are the solutions you have selected for Questions 1, 2, 3, 4 and 5, respectively, your submitted file should have the following:
1 a
2 b
3 c
4 d
5 a
- So, a problem sheet with five questions will have five lines of text.
- Make sure the questions are answered in ascending order in your text file.
- Failure to follow these instructions will incur a penalty.