Test your maths and programming skills

These exercises are designed to make sure you remember some of the basic maths and programming skills, which you will need for this course. Please do the exercises carefully, and refer to the given resources if you have difficulties solving them.

1. Find the *derivatives* of each of the following:
   (a) $\ln(\sin x)$
   (b) $\sin(\ln x)$
   (c) $e^{(1+x^2)}$
   (d) $(\cos x) \cdot e^{1-2x^2}$

   If you have trouble finding the derivatives, please read and study this document[1].

2. Find the *integrals* of each of the following (using a suitable substitution):
   (a) $\int_0^1 (x+5)^4 \, dx$
   (b) $\int \sin(7x-3) \, dx$
   (c) $\int x \cdot \sin(2x^2) \, dx$
   (d) $\int e^{\cos x} \, \sin x \, dx$

   If you find that you have difficulties with applying the substitution rule, please read and study this online resource[2].

3. Find the *eigenvalues* of these matrices:
   (a) $\begin{pmatrix} 2 & 1 \\ 2 & 3 \end{pmatrix}$
   (b) $\begin{pmatrix} -1 & 2 \\ -4 & 3 \end{pmatrix}$
   (c) $\begin{pmatrix} 2 & 0 & 0 \\ -1 & 2 & 1 \\ -4 & 1 & 2 \end{pmatrix}$

   If you can't remember how to calculate eigenvalues using the characteristic polynomial, please recap here[3].

4. Program a function in Python that takes an integer as an argument and returns a list containing the first n Fibonacci numbers, where n is the integer given in the argument.

We will discuss the problems Thursday, April 6, 2023.

[1] `https://mathcentre.ac.uk/resources/uploaded/mc-ty-chain-2009-1.pdf`
[2] `https://mathcentre.ac.uk/resources/uploaded/mc-ty-intbysub-2009-1.pdf`
[3] `https://lpsa.swarthmore.edu/MtrxVibe/EigMat/MatrixEigen.html`