# Mathematics for Political Science

Lecture 4: Calculus II

Exercises

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1. For each of the functions:

$$f(x) = 3x^2 - 7x + 2 \qquad g(x) = 8x^3 - 46x^2 + 73x - 35$$

   1. Sketch a plot the function on the interval $[0, 5]$ (calculate f(x) for integer values of x to get a general idea of the shape of the function).
   2. Identify the values of x that generate local maxima or minima (ignoring endpoints).
   3. Show mathematically whether these are maxima or minima.

2. Find the value of x that maximizes the function $\ell(x) = 2\ln(x) - x - \ln(2x + 1)$ using the following approach.

   1. Take the derivative of $\ell(x)$ and set it equal to 0.
   2. Manipulate the expression to remove fractions and express it as a quadratic.
   3. Solve for x.

3. Find the partial derivatives of the function $(eR(\frac{f}{f+g}))^h$ with respect to $e$ and $f$.

4. (Gill 5.13 [adapted]) Calculate the following indefinite integrals:

   a. $\int 4y^3 dy$ b. $\int (x^2 - x^{-\frac{1}{2}}) dx$ c. $\int 360t^6 dt$

5. (Gill 5.10 [adapted]) Solve the following definite integrals using the antiderivative method:

   a. $\int_6^8 x^3 dx$ b. $\int_1^9 2y^5 dy$ c. $\int_{-1}^0 (3x^2 - 1) dx$

   d. $\int_{-1}^1 (14 + x^2) dx$ e. $\int_2^4 e^y dy$ f. $\int_2^4 \sqrt{t} dt$

6. (Gill 5.11) Calculate the area of the following function that lies above the x-axis and over the domain $[-10, 10]$:

$$f(x) = 4x^2 + 12x - 18$$