

CALCULUS
GLOBAL GOVERNANCE
A.Y. 2025/26

Recitation IV

Exercise 1 (Hateful agenda versus protests)

Matthew Salwyn, a controversial Italian politician known for his racist and xenophobic views, is planning a series of public speeches across the country. The longer he speaks, the more people become aware of his harmful rhetoric and actively protest against him. However, the opposition response is not linear: while initially the number of protesters increases as Mr. Salwyn speaks, eventually, diminishing returns set in as people grow fatigued by his repetitive speeches.

The percentage of active protesters among the population, $P(t)$, as a function of the total length of Mr. Salwyn speech t (in hours), is modeled by the following function:

$$P(t) := \frac{450 + 90t}{\sqrt{100 + 9t^2}}.$$

- (a) Determine the value of t that maximizes the protest against his hateful agenda and calculate the percentage of active protesters at this time.
- (b) Determine the value of t at which the protest increases most rapidly.
- (c) What should Mr. Salwyn's strategy be in order to minimize the size of the protest?

Exercise 2 (Political elections)

A poll indicates that x months after a particular candidate for the US presidency declares their candidacy, they will have the support of $S(x)$ percent of the voters, where

$$S(x) = \frac{1}{29} (-x^3 + 6x^2 + 63x + 1080) \quad \text{for } 0 \leq x \leq 12.$$

Since the last election held on November 5th 2024, when should Kamala Harris have announced her candidacy to maximize her support? If she had adopted this strategy, would she have won (assuming that she wins if she gets at least 50% of the vote)?

Exercise 3. (Education and Social welfare)

A study indicates that funding m million euros into public education will result in a social welfare score $S(m)$, where S is given by the function

$$S(m) := 4m^2 \sqrt{24 - m^2}.$$

- (a) How much funding should a wise government allocate to maximize the social welfare score? What would the maximum score be?

- (b) At what level of funding is the social welfare score increasing most rapidly?

Exercise 4 (Study productivity)

A GG1 student is preparing for the calculus exam. An efficiency study of students' average performance shows that, if they start studying at 8:00 a.m., their study productivity (measured as the percentage of the material that they manage to assimilate) after x hours is modeled by the function:

$$f(x) = -x^3 + 6x^2 + 15x.$$

However, the study also shows that after a 15-minute break, the student's productivity is described by a different function:

$$g(x) = -\frac{1}{3}x^3 + x^2 + 23x$$

where x denotes the number of hours that have passed since the break. Determine the optimal time between 8:00 a.m. and noon for the student to take the 15-minute coffee break in order to maximize the percentage of assimilated material by 12:15 p.m.