

# Course diary - Calculus (module B)

## B.A. in Global Governance, Fall 2025

Prof. Rafael Leon Greenblatt

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- **Lecture #1, 30/09/25:** Introduction to the Wolfram Mathematica computer algebra system; examples of graphs of functions and relationship to limits.
- **Lecture #2, 7/10/25:** Word problems involving derivatives and monotonicity. Relationship to graphs.
- **Lecture #3, 14/10/25:** Techniques for finding global and local extrema, examples
- **Lecture #4, 21/10/25:** Examples of word problems involving global extrema
- **First midterm – 29/10/25**
- **Lecture #5, 1/12/25:** Functions of several variables. Sketching graphs in  $2D$  and  $3D$ . Level curves. Reference: Section 7.1 in [1].
- **Lecture #6, 2/12/25:** Partial derivatives: definition and example. Definition of the gradient. Visualization of the gradient, relationship to level curves. Reference: Section 7.2 in [1].
- **Lecture #7, 3/12/25:** Local approximations (Taylor formula) for functions of one and two variables. The tangent plane.
- **Lecture #8, 9/12/25:** Chain rule and total derivatives for functions of two variables. Critical points for functions of two variables. Second order partial derivatives. Reference: Sections 7.1 and 7.2 in [1].
- **Lecture #9, 10/12/25:** Equality of mixed partial derivatives. Second derivative test for local extrema of two-variable functions, with illustrations from quadratic forms. Examples. Reference: Section 7.3 in [1].
- **Lecture #10, 11/12/25:** Further examples of the second derivative test for critical points of functions of two variables Reference: Section 7.3 in [1].
- **Lecture #11, 15/12/25:** Graphical representation of critical points in  $2D$ . Relationship to global extrema.

- **Lecture #12, 16/12/25:** Constrained optimization with 2 variables. Lagrange multiplier method. Comparison with direct solutions. Graphical explanation for the method. Examples. Reference: Section 7.5 in [1].
- **Lecture #13, 17/12/25:** Review of functions of two variables
- **Lecture #14, 7/1/26:** Review of first order differential equations
- **Second midterm – 12/1/26**

## 1 References

### References

- [1] L. Hoffmann et al. *Applied Calculus for Business, Economics and the Social and Life Sciences, 11th Expanded Edition*. McGraw-Hill Education, 2011.