FOUNDATIONS OF DIFFERENTIAL CALCULUS AND PROBABILITY

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Learning objectives
By the end of this course, students will be able to understand and apply the fundamentals of differential calculus and optimization techniques to solve multivariable problems. They will also gain a solid foundation in probability theory, including the ability to work with both univariate and multivariate distributions, and apply these concepts to real-world scenarios.

Prerequisites
Students should have a basic understanding of single-variable calculus, including derivatives and integrals.

Course Syllabus

1. Review of Differential Calculus and Optimization

    - Basic definitions: functions, limits, and continuity.
    - Taylor series.
    - Multivariable functions.
    - Partial derivatives and gradient of a function.
    - Applications of Taylor expansion in multiple variables.
    - Optimization: critical points, maxima, minima, and saddle points, Hessian matrix test for classifying critical points.

2. Review of Probability

    - Events and probability spaces.
    - Cumulative distribution function (CDF) and probability density function (PDF).
    - Moments and moment generating function.
    - Notable distributions and their properties. Gaussian distribution, Lognormal distribution, Chi-square distribution, Exponential distribution, Gamma distribution, Poisson distribution.

Grading
The final grade will be based on a 2h open book exam at the end of the course, containing exercises similar to those assigned during the lectures: students are allowed to consult the material provided by the instructor and the notes they took during the lectures.