



PONTIFICAL CATHOLIC UNIVERSITY OF RIO DE JANEIRO  
CENTRE OF SCIENCE AND TECHNOLOGY  
DEPARTAMENT OF INDUSTRIAL ENGINEERING

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## IND 2621      OPTIMIZATION UNDER UNCERTAINTY

TOTAL HOURS: 45

CREDITS: 3/CRITERIA 12

REQUIREMENTS(S): LINEAR PROGRAMMING, PROBABILITY AND STATISTICS

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<b>GOALS</b>	Introduce concepts and methods for handling optimization problems with uncertain coefficients. State-of-the-art techniques are presented through practical applications of theoretical developments and computational tools.
<b>SYLLABUS</b>	Introduction to optimization under uncertainty; two-stage stochastic programming; multistage stochastic programming; risk averse optimization; probabilistic constraints; robust optimization; adjustable robust optimization; distributional robust optimization.
<b>PROGRAM</b>	<p>Introduction to optimization under uncertainty</p> <ul style="list-style-type: none"><li>- Farmer and newsvendor problems</li><li>- Value of stochastic solution and value of information</li></ul> <p>Two-stage-stochastic programming</p> <ul style="list-style-type: none"><li>- Sample average approximation</li><li>- Benders decomposition</li><li>- Partition refinement methods</li></ul> <p>Multistage stochastic programming</p> <ul style="list-style-type: none"><li>- Scenario tree representation</li><li>- Filtration interpretation of non-anticipation constraints</li><li>- Stochastic Dual Dynamic Programming</li></ul> <p>Risk averse optimization</p> <ul style="list-style-type: none"><li>- Mean-risk models</li><li>- Coherent and convex risk measures in optimization models</li><li>- Dynamic risk measures and time consistency</li><li>- Probabilistic constraint</li></ul> <p>Robust optimization</p> <ul style="list-style-type: none"><li>- Definition of uncertainty sets</li><li>- Dual reformulation and oracle-based algorithms</li><li>- Adjustable robust optimization</li></ul> <p>Distributional robust optimization</p>

- BIBLIOGRAPHY** SHAPIRO, A.; DENTCHEVA, D.; RUSZCZYNSKI, A. Lectures on Stochastic Programming: Modeling and Theory (Second Edition), MOS-SIAM Series on Optimization, 2014.
- BEN-TAL, A.; EL-GHAOU, L.; NEMIROVSKI, A. Robust Optimization, Princeton University Press, 2009.
- BIRGE, J.R.; LOUVEAUX, F. Introduction to Stochastic Programming (Second Edition), Springer Series in Operations Research and Financial Engineering, 2011.
- ADDITIONAL REFERENCES** RUSZCZYNSKI, A.; SHAPIRO, A. Stochastic Programming Models, Handbooks in Operations Research and Management Science, Elsevier, Volume 10, 2003.
- PETER, K.; MAYER, J. Stochastic Linear Programming: Models, Theory, and Computation. Springer, 2005.