Operations Research (4th GITI, year 2019-20)

News:

Operations Research & Analytics: enable organizations to turn complex challenges into substantial opportunities by transforming data into information, and information into insights for making better decisions and improving results.

L. Escudero y M.A. López *SEIO y la historia de la IO en España* Boletín de Estadística e Investigación Operativa 28 (1): 24-55, Feb 2012

The current table reflects in a realistic way the course development during the several sessions. It allows the student to know in advance what is going to happen in each session in order to prepare the subject and to organize its work adequately.

Date	Theory	Readings	Problems	Practice
Sep 3, 19	Extract of the syllabus. Additional bibliography. Hand out of class notes and web page for slides. Survey (motivation, expectations, difficulty, etc.)	J.R. Alonso *Una Universidad nueva* El País 12/01/2009 M. Bolaños *Confidencias de un headhunter* Anales de Mecánica y Electricidad (LXXXII) II: 38-40 Mar-Abr 2005 M.S. Sodhi *What Industry Wants From O.R. Grads* OR/MS Today Aug 2005		
Sep 3, 19	LECTURE NOTES about Optimization mathematical modeling.	*Operations Research Time Line* *Energy Systems Modeling (SADSE)* esión semiplenaria M. Alvar, A. Arranz, A. Ramos, A. Sánchez, J. Villar *Parking pl*	Diet problem.	

Enlaces rápidos

Instituto de Investigación Tecnológica (IIT)

Departamento de Organización Industrial (DOI)

Escuela Técnica Superior de Ingeniería (ICAI)

Universidad Pontificia Comillas

Promoción ICAI 82

Contact

INTRODUCTION TO OPTIMIZATION AND MODELING. OR definition. Historical introduction. Optimization definition. Classification of optimization methods. Model and modeling. Steps in developing a model.

J. Toczek The PuzzlOR

A. Ramos *Some IIT Operations Research Models for Electricity Markets* XIV Latin Ibero-American Congress on Operations Research (CLAIO 2008) Cartagena de Indias, Colombia September 2008 (*Presentation*) S

ace demand and offer assignment IIT-09-019A

A. Ramos, M.T. Peña, A. Fernández, P. Cucala *Mathematical programming approach to underground timetabling problem for maximizing time synchronization* Revista de Dirección, Organización y Administración de Empresas CEPADE 35: 88-95 Junio 2008

S. Cerisola, A. Baillo, J.M. Fernandez-Lopez, A. Ramos, R. Gollmer *Stochastic Power Generation Unit Commitment in Electricity Markets: A Novel Formulation and A Comparison of Solution Methods* Operations Research 57 (1): 32-46 Jan-Feb 2009

S. Lumbreras and A. Ramos *Optimal Design of the Electrical Layout of an Offshore Wind Farm: a Comprehensive and Efficient Approach Applying Decomposition Strategies* IEEE Transactions on Power Systems (accepted)

P. Sánchez-Martín, A. Ramos, J.F. Alonso *Probabilistic mid-term transmission planning in a liberalized market* IEEE

		Transactions on Power Systems 20 (4): 2135-2142 Nov 2005 ROADEF/EURO Challenge 2010: A large-scale energy management problem with varied constraints J.K. Delson and S.M. Shahidehpour *Linear Programming Applications to Power System Economics, Planning and Operations* IEEE Transactions on Power Systems (7) 3: 1155-1163 Aug 1992 A. Meric and M.E. Ceyhan *Operations Research Applications in Electronic Commerce: a Literature Review* J. Board, Ch. Sutcliffe and W.T. Ziemba *Applying Operations Research Techniques to Financial Markets* Interfaces Vol 33. No. 2 pp. 12-24 Mar-Apr 2003 C. Barnhart, P. Belobaba, A.R. Odoni *Applications of Operations Research in the Air Transport Industry* Transportation Science Vol 37. No. 4 pp. 368-391 Nov 2003 H.E. Romeijn et al. *A New Linear Programming Approach to Radiation Therapy Treatment Planning Problems* Operations Research (54) 2: 201-216 Mar-Apr 2006
Sep 10, 19	MODELING WITH LINEAR PROGRAMMING. Transportation problem. Transhipment problem.	Th.A. Grossman *The Spreadsheet Analytic Value Chain* OR/MS Today Aug 2006

Sep 10, 19	Task assignment problem.			
Sep 11, 19	MODELING WITH INTEGER LINEAR PROGRAMMING. Knapsack problem. Set covering problem. Packing problem. Partition problem. Travelling salesman problem (TSP). Fixed cost problem.	TSP Art	Departmental Computer System	
Sep 11, 19			Data Bases. Web server management.	Optimization cases
Sep 17, 19	Disjunctive constraints. Satisfy k of N equations. Selection among N values. Simple implications.		Regional offices.	
Sep 17, 19	Equivalences among logical propositions. Complex logical propositions.			
Sep 18, 19			Selecting a basketball team.	
Sep 18, 19				Team formation. Assignment of optimization practices with GAMS. GAMS Development; Optimization: Energy Systems Modeling (SADSE); OR/MS-today Advertisement, August 2009 Algebraic modeling languages. Transportation problem: mathematical formulation and coding in GAMS.
Sep 24, 19				Execution and analysis of the results. *Good Optimization Modeling Practices*

			Practical session with GAMS. NEOS Server for Optimization
Sep 24, 19			Gymnastics team. Manufacturing microprocessors.
Sep 25, 19			Factory of electronic parts. Staff Selection
Sep 25, 19			
Oct 1, 19	MULTICRITERIA DECISION MAKING. Multicriteria decision analysis. Pareto efficiency.		
Oct 1, 19	Weighted-Sum Method. Epsilon-Constraint Method. Goal Attainment Method.		
Oct 2, 19	MOCK EXAM MIDTERM EXAM year 2014-15 MIDTERM EXAM year 2012-13 MIDTERM EXAM year 2011-12 MIDTERM EXAM year 2010-11 (TOS) MIDTERM EXAM year 2009-10 (TOS) MIDTERM EXAM year 2009-10 (MM) MIDTERM EXAM year 2008-09 (MM) MIDTERM EXAM year 2007-08 (MM)		
Oct 2, 19	LECTURE NOTES about Linear Optimization.	*Mathematical Programming Glossary* *Linear and Discrete Optimization* course from EPFL at coursera.org	

LINEAR PROGRAMMING.

				Un español resuelve un problema matemático de hace medio siglo El Mundo 27/05/2010. Premio Fulkerson 2015 de la Mathematical Optimization Society (MOS) y la American Mathematical Society (AMS) *iMetro: Subway best route calculator*
Oct 8, 19	Hypothesis. Geometry. Properties. Simplex algorithm. Graphical solution. Standard form.	R. Elwes *The algorithm that runs the world* New Scientist (2877) Aug 2012		
Oct 8, 19	Algebraic solution.	*George B. Dantzig*, the father of linear programming R.W. Cottle *George B. Dantzig: A Legendary Life in Mathematical Programming* Mathematical Programming (105) 1: 1-8 Jan 2006 R.W. Cottle *George B. Dantzig: Operations Research Icon* Operations Research (53) 6: 892-898 Nov-Dec 2005 J.C. Nash *The (Dantzig) Simplex Method for Linear Programming* Computing in Science & Engineering (2) 1: 29-31 Jan-Feb 2000 R.E. Bixby *Solving Real-World*	LP Problem Set (1, 2, 3, 4)	

		Linear Programs: a Decade and More of Progress Operations Research (50) 1: 3-15 Jan-Feb 2002		
Oct 9, 19			LP Problem Set (8, 9, 22, 24)	
Oct 9, 19	Multiple optima.			
Oct 15, 19	Degeneracy. Characterizing the solutions. Tabular form.			Practical case report. Hand in of optimization practical cases with GAMS. Comments about the modeling difficulties and GAMS practical case and spent time.
Oct 15, 19	Obtaining an initial basic feasible solution: two-phase method.			
Oct 16, 19	DUALITY. Dual problem. Fundamental properties of duality. Economical interpretation. Graphical interpretation of dual variables and of reduced costs.			Javascript SimpleX PHPSimplex WinQSB, Version 1.0
Oct 16, 19	Sensitivity analysis. Changes in constraint bounds. Change in a coefficient of a non basic variable. Introduction of a new variable. Change in a coefficient of a basic variable. Introduction of a new constraint. Dual simplex method.			
Oct 22, 19	LECTURE NOTES about Mixed integer linear programming.	R.E. Gomory *Early Integer Programming* Operations Research (50) 1: 78-81 Jan-Feb 2002	MIP Problem set (2, 4, 1)	

INTEGER LINEAR PROGRAMMING. Example case. Branch and bound method.

LECTURE NOTES about Nonlinear optimization.

Modeling NLP.
NONLINEAR PROGRAMMING.
Introduction. Problems without constraints: optimality conditions.

Oct 22, 19

H.W. Kuhn *Being in the Right Place at the Right Time*
Operations Research (50) 1: 132-134 Jan-Febr 2002

Entrevista a Mar Hershenson
Anales de Mecánica y Electricidad (LXXXII) II: 3-10 Mar-Abr 2005

Oct 23, 19

Problems with constraints: optimality conditions. Necessary and sufficient Karush-Kuhn-Tucker conditions.

Problem set Inventarios, Función cúbica con hiperplanos, Chequeo de puntos, Objetivo lineal, Problema 2, 3, 4A, 4B, 4C, Triatlón, Función cúbica, Ciencias de la complejidad)

Oct 23, 19

MOCK EXAM
MIDTERM EXAM year 2014-15
MIDTERM EXAM year 2012-13
MIDTERM EXAM year 2011-12
MIDTERM EXAM year 2010-11 (TOS)

	MIDTERM EXAM year 2009-10 (TOS) MIDTERM EXAM year 2009-10 (MM) MIDTERM EXAM year 2008-09 (MM) MIDTERM EXAM year 2007-08 (MM)		
Oct 29, 19	LECTURE NOTES about Decision theory.   DECISION THEORY. Decision criteria. Example.	G.M. Fernández and M.C. Escribano La Teoría de la Decisión: desde sus orígenes hasta comienzos del siglo XIX Boletín de Estadística e Investigación Operativa (30) 3: 292-312, Nov 2014. Leonid Hurwicz, Eric S. Maskin y Roger B. Myerson 2007 Nobel Price in Economic Sciences "for having laid the foundations of mechanism design theory" A. Mas-Colell *Leo Hurwicz, el pionero* El País. 21 Octubre 2007	
Oct 29, 19	Decision trees. Example.		
Oct 30, 19	Bayesian analysis. Example.		
Oct 30, 19			DT Problem set (I+D, Contrato de móvil, Pañuelos, El huerto, El sondeo, Concurso)
Nov 5, 19	LECTURE NOTES about Game theory.	H. Singh *Introduction to Game Theory and Its Application in Electric Power Markets* IEEE Computer Applications in Power (12) 4: 18-22 Oct 1999 M. Shubik *Game Theory and Operations Research: Some Musings 50 Years Later* Operations Research (50) 1: 192-196 Jan-Feb 2002	

GAME THEORY.

P. Horner *Game Theory: A 'Nobel' Pursuit* OR/MS Today (32) 6 Dec 2005

Aumann's Work in Game Theory Leads to von Neumann Prize OR/MS Today (32) 6 Dec 2005

Robert J. Aumann and Thomas C. Schelling 2005 Nobel Price in Economic Sciences "for having enhanced our understanding of conflict and cooperation through game-theory analysis"

John C. Harsanyi, John F. Nash Jr. and Reinhard Selten 1994 Nobel Price in Economic Sciences "for their pioneering analysis of equilibria in the theory of non-cooperative games"

John F. Nash *Non-Cooperative Games* PhD Thesis. Princeton University. May 1950

A. Meca *Génesis y Evolución de la Teoría de Juegos. Sus Orígenes en España* Boletín de Estadística e Investigación Operativa Vol 22 No 1 / Enero 2006

D. Ríos *Varoufakis en los juegos (no) olímpicos* El País 26-jul-2015

Game Theory course from Stanford University at coursera.org

Game Theory courses in Open Education DataBase

Nov 5, 19	Equilibrium on pure and mixed strategies.		GT Problem set (Móviles, Caperucita, Suma nula 3x4, Suma nula 2x4, Suma nula 3x5, Suma nula 4x5)	
Nov 6, 19	Cournot equilibrium. Bertrand equilibrium.			
Nov 6, 19	Cournot equilibrium. Bertrand equilibrium.			
Nov 12, 19	DISCRETE EVENT SIMULATION MODELING Components and Processes. Modeling by Simulation	Simulation Software Survey. OR/MS Today Winter Simulation Conference 2018		J. Banks and R.R. Gibson *The ABCs of Simulation Practice* Analytics Magazine 16-21 Spring 2009
Nov 12, 19	Simulation languages			
Nov 13, 19				Arena Arena Industry Solutions Rockwell Arena simulation 3D - manufacture Rockwell Arena simulation 3D - Bike manufacturer Arena Simulation of Cobequid Blood Clinic
Nov 13, 19				Arena
Nov 19, 19			Problem set Simulation Questions Class	
Nov 19, 19				Case study development
Nov 20, 19				Case study development
Nov 20, 19	SIMULATION OUTPUT ANALYSIS Finite-Horizon Analysis			
Nov 26, 19	Infinite-Horizon Analysis. Comparison of System Designs			Practice OUT. Preview

Nov 26, 19				Practice OUT. Computer lab
Nov 27, 19				Practice OUT. Computer lab
Nov 27, 19	QUEUEING THEORY Poisson processes	C. Moler *The world's largest matrix computation* Matlab News & Notes Oct 2002		
Dec 3, 19	Queueing models		Problem set Local administration, Two processors, Download platforms, Printer, Fair, Bank consultations, Boat engines, Classroom computers	Case study report. Hand in of simulation case study.
Dec 3, 19	LECTURE NOTES about Program Evaluation and Review Technique (PERT).  PROJECT PLANNING AND CONTROL. Critical path.			OpenProject GanttProject Microsoft Project
Dec 4, 19	PERT. Introducing costs. Ending date under risk or uncertainty		Problems 4, 5 and 6	
Dec 4, 19			Problems 4, 5 and 6. Problem set Task sequencing, Training course, Seven activities with acceleration cost, Activities with random duration, Investment with randomness)	
Dec xx, 19			FINAL EXAM year 2014-15 FINAL EXAM year 2012-13 FINAL EXAM year 2011-12 FINAL EXAM year 2010-11	

	(TOS) FINAL EXAM year 2009-10 (TOS) FINAL EXAM year 2008-09 (MM) FINAL EXAM year 2007-08 (MM) FINAL EXAM year 2006-07 (MM)
Jun xx, 20	RESIT EXAM year 2014-15 RESIT EXAM year 2012-13 RESIT EXAM year 2011-12 RESIT EXAM year 2010-11 (TOS) RESIT EXAM year 2009-10 (TOS) RESIT EXAM year 2008-09 (MM) RESIT EXAM year 2007-08 (MM) RESIT EXAM year 2006-07 (MM)