



Está usted en: Inicio > Centros > Escuela Técnica Superior de Ingeniería (ICAI) > Instituto de Investigación Tecnológica > Andrés Ramos
 [Principal] [Résumé/CV] [Material docente] [Operations Management] [Mathematical Methods] [Operations Research] [Técnicas de Optimización de Sistemas] [Modelado y Simulación de Sistemas] [Applied Optimization] [Statistics II] [Quantitative Decision Methods] [Optimization Techniques] [Deterministic Optimization] [Stochastic Optimization] [Investigación] [Open Models] [openSDUC] [openTEPES] [TEPES] [ROM] [StarNet] [FLOP] [iMetro]

Operations Research (4th GITI+ADE, year 2020-21)



Enlaces rápidos

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 10, 20	<p>Extract of the syllabus. Additional bibliography. Hand out of class notes and web page for slides. Survey (motivation, expectations, difficulty, etc.)</p>	<p>J.R. Alonso Una Universidad nueva El País 12/01/2009</p> <p>FAQs About O.R. & Analytics</p>		
Sep 10, 20	<p>LECTURE NOTES about Optimization mathematical modeling.</p>   <p>INTRODUCTION TO OPTIMIZATION AND MODELING. OR definition. Historical introduction. Optimization definition. Classification of optimization methods. Model and modeling. Steps in developing a model.</p>	<p>Operations Research Time Line</p> <p>Energy Systems Modeling (SADSE)</p> <p>J. Toczek The PUZZLOR</p> <p>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) Sesión semiplenaria</p> <p>M. Alvar, A. Arranz, A. Ramos, A. Sánchez, J. Villar Parking place demand and offer assignment IIT-09-019A</p> <p>A. Ramos, M.T. Peña, A. Fernández,</p>	Diet problem.	

- 
Instituto de Investigación Tecnológica (IIT)
- 
Departamento de Organización Industrial (DOI)
- 
Escuela Técnica Superior de Ingeniería (ICAI)
- 
Universidad Pontificia Comillas
- Promoción ICAI 82



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

<p>Sep 11, 20</p>	<p>MODELING WITH LINEAR PROGRAMMING. Transportation problem. Transshipment problem.</p>	<p>Th.A. Grossman The Spreadsheet Analytic Value Chain OR/MS Today Aug 2006</p>	<p>Team formation.</p>
-------------------	---	---	------------------------

Sep 11, 20 Task assignment problem.

Sep 17, 20 [MODELING WITH INTEGER LINEAR PROGRAMMING.](#) Knapsack problem. Set covering problem. Packing problem. Partition problem.

Sep 17, 20	Travelling salesman problem (TSP). Fixed cost problem.	TSP Art	Optimization cases
Sep 18, 20		Three products. Charter flights.	
Sep 18, 20	Disjunctive constraints. Satisfy k of N equations. Selection among N values.		
Sep 24, 20	Logical propositions. Absolute value. Maximum, minimum.		
Sep 24, 20		Selecting a basketball team.	
Sep 25, 20		Bakery. Job shop.	
Sep 25, 20		Paper roll cut.	
Oct 1, 20		Car renting. Two pipelines	
Oct 1, 20	MULTICRITERIA DECISION MAKING. Multicriteria decision analysis. Pareto efficiency. Weighted-Sum Method. Compromise Programming. Goal Programming.	Factory of electronic parts. Staff selection. Swimming pools. Sequencing tasks. Exams. Data base.	Preliminary mathematical formulation of the optimization case study
Oct 2, 20			Assignment of optimization case studies 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 .
Oct 2, 20			Execution and analysis of the results. Good Optimization Modeling Practices

Practical session
with GAMS. [NEOS
Server for
Optimization](#)

Oct 8,
20

[MIDTERM EXAM
year 2019-20](#)
[MOCKUP 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 \(MM\).](#)

[LECTURE NOTES
about Linear
Optimization.](#)



[Mathematical
Programming
Glossary](#)

[Linear and Discrete
Optimization course
from EPFL at
coursera.org](#)

Oct 8,
20

[LINEAR
PROGRAMMING.](#)
Hypothesis.
Geometry.
Properties.

[Un español
resuelve un
problema
matemático de
hace medio siglo](#)
El Mundo
27/05/2010.

Oct 9,
20

Simplex algorithm.
Graphical solution.
Standard form.

R. Elwes [The
algorithm that runs
the world](#) New
Scientist (2877)
Aug 2012

[Premio Fulkerson
2015](#) de la
Mathematical
Optimization
Society (MOS) y la
American
Mathematical
Society (AMS)

[iMetro: Subway
best route
calculator](#)

Oct 9,
20

Algebraic solution.
Multiple optima.
Degeneracy.
Characterizing the
solutions. Obtaining

[George B. Dantzig](#) ,
the father of linear
programming
R.W. Cottle [George](#)

[Javascript SimpleX
PHPSimplex
WinQSB, Version
1.0](#)

an initial basic
feasible solution:
two-phase method. [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 Linear
Programs: a
Decade and More of
Progress](#)
Operations
Research (50) 1: 3-
15 Jan-Feb 2002

Oct 15,
20 [LP Problem Set](#)

Oct 15,
20 LP Problem Set

Oct 16,
20 LP Problem Set

Oct 16,
20 LP Problem Set

Oct 22,
20 LP Problem Set

Oct 22,
20 DUALITY. Dual
problem.
Fundamental
properties of
duality. Economical
interpretation.
Graphical
interpretation of
dual variables and
of reduced costs.
Sensitivity analysis.
Changes in
constraint bounds.

Oct 23,
20 [LECTURE NOTES
about Mixed integer
linear
programming.](#) R.E. Gomory [Early
Integer
Programming](#)
Operations
Research (50) 1:



78-81 Jan-Feb
2002



[INTEGER LINEAR PROGRAMMING.](#)

Example case.

Oct 23, 20
Example case.
Branch and bound method.

[MIP Problem set](#)

[LECTURE NOTES about Nonlinear optimization.](#)



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



Oct 29, 20
Modeling NLP.
[NONLINEAR PROGRAMMING.](#)
Introduction.
Problems without constraints:
optimality conditions.

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

Oct 29, 20
Problems with constraints:
optimality conditions.
Necessary and sufficient Karush-Kuhn-Tucker conditions.

[Practical case report.](#)
Hand in of optimization practical cases with GAMS.

Oct 30, 20

[Problem set NLP](#)

Comments about the modeling difficulties and GAMS practical case and spent time.

Oct 30, 20

Problem set NLP

Nov 6, 20
[LECTURE NOTES about Decision theory.](#)

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.

DECISION THEORY.

Decision criteria.
Example.

[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

Nov 6, Decision trees.
20 Example. [Problem set DT](#)

Nov 12, Bayesian analysis.
20 Example. Problem set DT

Nov 12, [LECTURE NOTES](#)
20 [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

GAME THEORY.

M. Shubik [Game Theory and Operations Research: Some Musings 50 Years Later](#) Operations Research (50) 1: 192-196 Jan-Feb 2002

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 19,
20 Equilibrium on pure
and mixed
strategies.

[Problem set GT](#)

Nov 19,
20 Cournot
equilibrium.
Bertrand
equilibrium.

Problem set GT

Nov 20,
20 [DISCRETE EVENT](#)
[SIMULATION](#)
[MODELING](#)
Components and
Processes. Modeling
by Simulation.
Simulation
languages

[Simulation](#)
[Software Survey.](#)
OR/MS Today
[Winter Simulation](#)
[Conference 2019](#)

J. Banks and R.R.
Gibson [The ABCs](#)
[of Simulation](#)
[Practice](#) Analytics
Magazine 16-21
Spring 2009

Nov 20,
20

[Introduction to](#)
[ARENA](#)

[Arena](#)

		Arena Industry Solutions: Rockwell Arena simulation 3D - manufacture Rockwell Arena simulation 3D - Bike manufacturer Arena Simulation of Cobequid Blood Clinic
Nov 26, 20	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)	
Nov 26, 20	SIMULATION OUTPUT ANALYSIS Finite-Horizon Analysis. Infinite-Horizon Analysis.	
Nov 27, 20		Problem set Quiz on Simulation Quiz on Output Analysis
Nov 27, 20		Introduction to ARENA
Dec 3, 20		ASSESSMENT: Case study development
Dec 3, 20		ASSESSMENT: Case study development
Dec 4, 20	QUEUEING THEORY Poisson processes	C. Moler The world's largest matrix computation Matlab News & Notes Oct 2002
Dec 4, 20	Birth-Death process	
Dec 10, 20		Problem set QT
Dec 10, 20		Problem set QT
Dec 11, 20	LECTURE NOTES about Program Evaluation and	OpenProject GanttProject Microsoft Project

[Review Technique \(PERT\).](#)



[PROJECT PLANNING AND CONTROL.](#)

Critical path.

<p>Dec 11, 20</p> <p>PERT. Introducing costs. Ending date under risk or uncertainty</p>	<p>Problems 4, 5 and 6. Problem set Task sequencing, Training course, Seven activities with acceleration cost, Activities with random duration, Investment with randomness)</p>
<p>Dec xx, 20</p>	<p>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)</p>
<p>Jun xx, 21</p>	<p>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)</p>