



Faculty of Business Economics

UPCT



# Course unit description:

## Operations Research

**Degree/s:** Degree in Business Administration and Management

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## 1. Subject data

<b>Name</b>	Operations Research			
<b>Subject area</b>	Mathematics			
<b>Module</b>	Quantitative Methods for Business			
<b>Code</b>	510109010			
<b>Degree programme</b>	Degree in Business Administration and Management			
<b>Curriculum</b>	2016			
<b>Centre</b>	Faculty of Business Economics			
<b>Type</b>	Optional			
<b>Length of subject</b>	Termly	Term	2	Course 3 <sup>rd</sup>
<b>Language</b>	English			
<b>ECTS</b>	4.5	<b>Hours / ECTS</b>	25	<b>Total workload (hours)</b>
				112.5

## 2. Lecturer data

<b>Lecturer in charge</b>	Roberto J. Cañavate Bernal		
<b>Department</b>	Quantitative and Computer Methods		
<b>Knowledge area</b>	Quantitative Methods for Business		
<b>Office location</b>	Faculty of Business Sciences - Third floor, office 325		
<b>Telephone</b>	968 325783	<b>Fax</b>	968 325745
<b>email</b>	<a href="mailto:r.canavate@upct.es">r.canavate@upct.es</a>		
<b>URL / WEB</b>	<a href="http://metodos.upct.es">http://metodos.upct.es</a>		
<b>Office hours</b>	Published on 'Aula Virtual' and on bulletin board		
<b>Location</b>	Office 325		

<b>Qualification/Degree</b>	Degree in Mathematics
<b>Academic rank at UPCT</b>	College Lecturer (Profesor Titular de Escuela Universitaria)
<b>Year of admission in UPCT</b>	2000
<b>Number of five-year periods (<i>quinquenios</i>) if applicable</b>	3
<b>Research lines (if applicable)</b>	Continuous Location, Polyhedral Theory, Integer Programming, Spreadsheet Applications to Optimization
<b>Number of six-year periods (<i>sexenios</i>) if applicable</b>	0
<b>Professional experience (if applicable)</b>	Collaboration scholarship in Statistics in C.A.R.M. (1997-1998) Assistant Professor in UMH of Elche (1998-2000)
<b>Other topics of interest</b>	Applications of ICT to learning

### 3. Subject description

#### 3.1. General description

The Operations Research course is to provide students with the knowledge of multiple decision-making situations in the economic and business world that resemble real situations related to the optimization of resources. It is a practical course that explores mathematical modeling techniques and interpretation of results which, in many cases, are obtained by the use of specific software for this type of models.

#### 3.2. How the subject contributes to a professional career

It allows the students to gain insight in how to face real economic and business optimization problems from a Mathematic point of view and to address some of them with tools and algorithms provided in the subject.

#### 3.3. Relationship with other subjects in the programme

The course Operations Research is the natural continuation of the subject Mathematics for Business II (2nd year, 4.5 ECTS, 1st Semester, mandatory) where some fundamentals of Operations Research and Simplex method are presented. It has some points in common with the subject Operations Management (3rd year, 4.5 ECTS, 1st Semester, mandatory). It is also needed some knowledge in Algebra, Calculus and Optimization the student has dealt with in Mathematical subjects within first and second year.

#### 3.4. Incompatibilities defined in the programme

None.

#### 3.5. Recommendations to do the subject

Some previous knowledge in Basic Algebra, Calculus and Optimization provided in Mathematics for Business I and II is needed. It's strongly recommended that students had passed Mathematics for Business II before taking this subject.

It is also advisable that the students had some knowledge on mathematical software.

#### 3.6. Special provisions

As set forth in article 6 of the *Reglamento de las Pruebas de Evaluación de los Títulos Oficiales de Grado de la UPCT* the corresponding vice-rector may establish special adaptations in methodology and the development of lessons for students who suffer from a disability or some limitation, in order to enable them continued studies.

The student who, because of their circumstances, may require special measures of this kind should inform the teacher at the beginning of the semester.

Likewise, foreign students who may have difficulty with the language should notify the teacher.

Also, short seminars on handling specific mathematics software could be given if necessary.

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## **4. Competences and learning outcomes**

### **4.1. Basic curricular competences related to the subject**

CB1 - Que los estudiantes hayan demostrado poseer y comprender conocimientos en un área de estudio que parte de la base de la educación secundaria general, y se suele encontrar a un nivel que, si bien se apoya en libros de texto avanzados, incluye también algunos aspectos que implican conocimientos procedentes de la vanguardia de su campo de estudio.

### **4.2. General curricular competences related to the subject**

CG2 - Aplicar los métodos matemático-estadísticos y las tecnologías de la información y la comunicación para el tratamiento, valoración, y previsión de la información económico-empresarial.

### **4.3. Specific curricular competences related to the subject**

Identificar, formular y resolver problemas de toma de decisiones cuantitativas en el ámbito económico y empresarial.

### **4.4. Transversal curricular competences related to the subject**

CT2 – Trabajar en equipo.

### **4.5. Subject learning outcomes**

1. Identificar y formular modelos de investigación operativa a partir de la descripción verbal de una situación real.
2. Seleccionar y generar la información necesaria para formular y resolver un problema de investigación operativa.
3. Aplicar técnicas cuantitativas de resolución de problemas de optimización en el ámbito empresarial.
4. Resolver problemas de optimización y toma de decisiones en el ámbito empresarial mediante aplicaciones informáticas.
5. Interpretar resultados cuantitativos y proponer decisiones a partir de ellos.

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## 5. Contents

### 5.1. Curricular contents related to the subject

Modeling techniques for resource optimization problems in the field of Economics and Business. Problem-solving methods in Linear and Integer Programming. Other Operations Research models in Economics and Business.

### 5.2. Theory syllabus (teaching modules and units)

1. Formulación de problemas de programación lineal.
2. El método simplex y análisis post-óptimo.
3. Programación entera.
4. Problema del transporte. Problema de la asignación. Otros modelos de redes.

### 5.3. Practice syllabus (name and description of every practical)

#### Risk prevention

Promoting the continuous improvement of working and study conditions of the entire university community is one the basic principles and goals of the Universidad Politécnica de Cartagena.

Such commitment to prevention and the responsibilities arising from it concern all realms of the university: governing bodies, management team, teaching and research staff, administrative and service staff and students.

The UPCT Service of Occupational Hazards (*Servicio de Prevención de Riesgos Laborales de la UPCT*) has published a "Risk Prevention Manual for new students" (*Manual de acogida al estudiante en materia de prevención de riesgos*), which may be downloaded from the e-learning platform ("Aula Virtual"), with instructions and recommendations on how to act properly, from the point of view of prevention (safety, ergonomics, etc.), when developing any type of activity at the University. You will also find recommendations on how to proceed in an emergency or if an incident occurs.

Particularly when carrying out training practices in laboratories, workshops or field work, you must follow all your teacher's instructions, because he/she is the person responsible for your safety and health during practice performance. Feel free to ask any questions you may have and do not put your safety or that of your classmates at risk.

### 5.4. Theory syllabus in english (teaching modules and units)

1. Formulating linear programming models.
2. Simplex method and post optimality analysis.
3. Integer programming.
4. Transportation problem. Assignment problem. Other network models.

### 5.5. Detailed description of learning goals for every teaching module

1. Modeling easy to intermediate economic and business situations using mathematical reasoning.
2. Knowing the basics of Simplex Method and how to apply the method in real-life

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situations. Using specific Operations Research software to solve problems and interpreting information provided by the software in terms of the original real situation. Applying post optimality analysis to obtain important economic information about the problem under study which is only achieve through that analysis.

3. Solving Linear Integer problems through Branch and Bound method with some specific Operations Research software.
4. Solving transportation, assignment problems and other network-related problems with some specific Operations Research software.

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## 6. Teaching method

6.1. Teaching method			
Teaching activity	Teaching techniques	Student workload	Hours
<b>Theory classes</b>	Presentation lesson taught using the lecture method. Answering questions raised by students. The lecturer will be able to formulate questions that could be gradable or not. All the written materials will be in English, but some classes or part of classes could be taught in Spanish.	In-class: Taking notes, asking questions  <u>Self-study:</u>	<b>15</b>
	Solving practical problems, usually with specific software for Operations Research as a tool for the computations. Answering questions raised by Students. Some of the activities should be done by groups. All the written materials will be in English, but some classes or part of classes could be taught in Spanish.	In-class: Active participation, solving problems, asking questions.  <u>Self-study:</u>	<b>30</b>
<b>Practical classes and problems</b>	Studying exercises, assignments, reports, to present or give to the lecturer. The study of theoretical and practical contents by students is included. Some of the activities should be done by groups and/or by using computers.	In-class:  <u>Self-study:</u> Solving exercises, assignments, preparing reports. Studying theoretical and practical contents. Training with computer.	<b>57</b>
	Written exams and assessable tasks. Some of them will be able to be done by groups and/or by using computers. All the assessable tasks will be done in English.	In-class: Doing exams and assessable exercises, assignments or project presentations.  <u>Self-study:</u>	<b>8</b>
<b>Evaluation</b>	Answering questions about theoretical and practical contents, checking the development process of assignments and exercises by students (either in the classroom, lecture's office or on-line). English and Spanish could be used.	In-class: Asking questions during the lectures or the tutorial hours.  <u>Self-study:</u> Asking questions by e-mail and forum participation	<b>2,25</b>
			<b>2,25</b>
			<b>112,5</b>

## 6.2. Learning outcomes (4.5) / teaching activities (6.1)

Teaching activities (6.1)	Learning outcomes (4.5)									
	1	2	3	4	5	6	7	8	9	10
Theory classes	X	X	X	X	X					
Practical classes and problems	X	X	X	X	X					
Student self-work	X	X	X	X	X					

## 7. Assessment method

7.1 Assessment method					
Assessment activity	Type		Assessment methods and criteria	Percentage (%)	Assessed learning outcomes (4.5)
	Summative	Formative			
Written or oral exams	X		Written exams in English with theoretical and/or practical exercises. Part of these exams could need the use of specific software.	Between 40% and 100%	1, 2, 3, 4, 5
Participation and involvement in the teaching-learning process	X		Participation during the lectures and on the web forums. Contribution to the web page (answering classmates' questions, links of interest, etc.). General attitude, motivation, involvement and regular attendance to classes.	Between 0 and 20%	1, 2, 3, 4, 5
Evaluation of projects and reports	X		Oral or written presentation of assessable activities, individually or in groups, some of them could need the use of specific software.	Between 0 and 60%	1, 2, 3, 4, 5
Project defense presentation	X		Exposition of a theoretical or practical project proposed by the lecturer. Answering questions raised at the end of the presentation.	Between 0 and 20%	1, 2, 3, 4, 5
In June exams session 50% of the total marks will be awarded for the activity 'Written or oral exams', 10% for 'Participation and involvement in the teaching-learning process' and 40% for 'Evaluation of projects and reports'. Optionally students could do a 'Project defense presentation'. In that case 'Project defense presentation' will be awarded up to 20% of the total mark and 'Evaluation of projects and reports' will be awarded with the difference between 40% and percentage of mark awarded for 'Evaluation of projects and reports'. In September and February exams session the activity 'Written or oral exams' will be awarded with 100% of the total mark and the other assessment activities with 0%.					

As set forth in article 5.4 of the *Reglamento de las pruebas de evaluación de los títulos oficiales de grado y de máster con atribuciones profesionales* (UPCT), students in the special circumstances listed in the article 5.4 are entitled to a comprehensive assessment test, upon justified request which must be granted by the Department. This does not exempt them from carrying out compulsory tasks included in the teacher's guide of the subject (official syllabus).

## 7.2. Control and monitoring methods (optional)

The learning track will be made through the following activities (all of them to be done in English):

- Participation of the student in both theoretical and practical lessons and also contributions by the students to subject's website in Aula Virtual (answering classmates questions, links of interest, etc.).
- Solving assignments proposed by the teacher, either individually or by groups.
- One or more partial tests will be done on the contents covered during the course which will include theoretical and practical questions and problems to be solved. The characteristics of the exams, as well as the date, time and location will be indicated on the announcement.
- Different tests (exams, classroom participation, solving practical cases, etc) in order to detect and correct possible gaps and make it possible to consolidate the most important concepts of the course.

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## 8. Bibliography and resources

### 8.1. Basic bibliography

- Hillier, F.S. and Lieberman, G.J. Introduction to Operations Research. McGraw-Hill, 2001.
- Taylor III, B. W. Introduction to Management Science. Pearson Education, 2013.

### 8.2. Supplementary bibliography

- Chang, Y., Desai, K. WinQSB version 2.0: decision support software for MS-OM. John Wiley & Sons.
- Taha, H.A. Operations Research: an introduction. Pearson Education, 2010.

### 8.3. On-line resources and others

AIMMS. AIMMS Optimization Modeling.

<http://www.aimms.com/downloads/manuals/optimization-modeling.html>

Cañavate, R. Canal en YouTube channel.

<http://es.youtube.com/robertocanavate>.

Chinneck, J. W. Practical Optimization: A Gentle Introduction.

<http://www.sce.carleton.ca/faculty/chinneck/po.html>

Cobacho, B. Lisa de reproducción en canal YouTube con resolución de problemas de Investigación Operativa (en inglés).

<http://www.youtube.com/watch?v=EHgz3boRxZg&list=PLVR22oSaf6MlvBEmikQlVbJ-PaW1hmtYJ>

Cornuejols, G. and Trick, M. Quantitative Methods for the Management Sciences.

<http://mat.gsia.cmu.edu/classes/QUANT/>

Quesada Ibarguen, V.M., Vergara Schmalbach, J.C. Análisis Cuantitativo con WINQSB.

<http://www.eumed.net/libros/2006c/216/index.htm>

#### Pronunciation

Amazon. Ivona Text to Speech. <http://www.ivona.com/en/>

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