INSTITUTO POLITÉCNICO DE BRAGANÇA

Course Unit	Operational Research			Field of study	Management		
Bachelor in	Management			School	School of Technology and Management		
Academic Year	2021/2022	Year of study	2	Level	1-2	ECTS credits	6.0
Type	Semestral	Semester	2	Code	9147-707-2204-00-21		

Workload (hours)	162	Contact hours	T -	TP 60	PL -	TC -	S -	E -	OT -	O -

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s): Carla Alexandra Soares Geraldes, Maria Clara Rodrigues Bento Vaz Fernandes, Maria Prudência Gonçalves Martins

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. Formulate linear programming problems
2. Know and apply the simplex algorithm
3. Know and apply the duality theory
4. Perform postoptimality and sensitivity analysis
5. Know and apply the Dantzig algorithm to transport problems
6. Know and apply the Hungarian and the bottleneck assignment problem algorithms to assignment problems
7. Apply CPM and PERT methods to project planning

Prerequisites

Before the course unit the learner is expected to be able to:
1. Perform elementary operations of matrix algebra
2. Solve systems of linear equations

Course contents

Introduction to Operational Research. Linear programming models. Duality theory. Postoptimality and sensitivity analysis. The transportation and assignment problems. Project management.

Course contents (extended version)

1. Introduction to Operational Research
   - The origins of Operational Research
   - Methodology and application domains
2. Linear programming models
   - Mathematical formulation of linear programming models
   - Graphical solution method
   - Simplex method
   - Economic interpretation of simplex
3. Duality theory
   - The essence of duality theory
   - Primal-dual relationships
   - Economic interpretation of duality
   - The dual simplex method
4. Postoptimality and sensitivity analysis
   - Changes in the objective function coefficients (cj)
   - Changes in the right-hand side (bi)
   - Introduction of new variables
   - Introduction of new constraints
   - Allowable range for the objective function coefficients
   - Allowable range for the right-hand sides
5. The transportation and assignment problems
   - The transportation problem
   - The Dantzig algorithm
   - The assignment problem
   - The Hungarian method
   - Bottleneck assigment problem
6. Project management
   - Critical Path Method (CPM)
   - Critical path determination
   - Programme Evaluation and Review Technique (PERT)

Recommended reading

1. Geraldes, C. A. S. , Cruz, C. (2018). Operations Research - Lectures Notes. ESTiG-IPB.
2. Guerreiro, J. , Magalhães, A. , Ramalhete, M. (1995). Programação Linear, Vol. I e II (4ª edição). McGraw-Hill.
3. Hillier, F. S. , Lieberman, G. J. (2010). Introduction to Operations Research (9th edition). McGraw-Hill.
4. Mourão, M. C. , Pato, M. V. , Pinto, L. S. , Simões, O. A. , & Valente, J. (2019). Investigação Operacional, Exercícios e aplicações (2ª Edição). Escolar Editora
5. Pina Marques, M. (2010). Textos de Apoio de Investigação Operacional.

Teaching and learning methods

Contents will be covered with student attendance, in theoretical-practical classes, as well as the analysis and solution of exercises. Non-contact hours should be spent reviewing the lectured contents and solving practical exercises from the worksheets. Tutorial sessions might be held in non-contact hours, if necessary, individually or in groups.

Assessment methods

1. Alternative 1 - (Regular, Student Worker) (Final, Supplementary, Special)
   - Final Written Exam - 100%
2. Alternative 2 - (Regular, Student Worker) (Final)

Assessment methods

- Intermediate Written Test - 50% (Presencial exam. Each student should save the exercises solved during the classes in virtual.ipb.pt)
- Intermediate Written Test - 50% (If the mark in the written exam is higher than 16 the lecturer can take an oral test to the student.)

3. Alternative 3 - (Regular) (Final)
   - Portfolio - 10% (To be held during classes.
     Only available for international students.)
   - Case Studies - 40% (Only available for international students.)
   - Final Written Exam - 50% (Only available for international students.
     To be held at the end of the semester.)
4. Alternative 4 - (Regular, Student Worker) (Supplementary, Special)
   - Final Written Exam - 100% (Only available for international students.)

Language of instruction

Portuguese

Electronic validation

Carla Alexandra Soares Geraldes, Maria Clara Rodrigues Bento Vaz Fernandes	António Jorge da Silva Trindade Duarte	António Borges Fernandes	Paulo Alexandre Vara Alves
03-03-2022	10-03-2022	11-03-2022	19-03-2022