consider, among other things, movement of patients between hospitals within the network, the modification of the capacity of the network over time, the modification of the beds types, the possible creation of new care units, and the design of contracts for outsourcing capacity with private clinics.

To support the design of these policies for the Public Health system in Chile, we have constructed Markov decision models to represent the system, and we have used them to evaluate the expected impact of certain decisions

3 - Financial performance index for hospitals: DEA approach. Case of Poland
Justyna Rój

Abstract: Hospitals' financial conditions is very important, in terms of their availability. Moreover, in Poland, inpatient's services consume is an important part of National Health Fund resources. The objective of the study is to use a financial performance index (FPI) for regional hospitals using Data Envelopment Analysis (DEA), and to evaluate and then to compare also this measure with various financial ratios commonly used to indicate performance levels. This employed approach of FPI is based on the financial ratios and DEA method and was proposed by Ozcan and McCue. This method allows to overcome the weaknesses of financial ratios analysis. The DEA model generated FPI scores are based on four maximizing oriented financial performance ratios: return on assets, operating cash flow per bed, operating margin and total asset turnover ratios. The research has been conducted on the nonprofit general regional Polish hospitals, using data covering the period of the 2017 year. The results will allow to identify efficient and poor performing hospitals and also to provide their financial ratios characteristics and optimal combination.

■ TA-58

Tuesday, 8:30-10:00 - 4D UPV 2.4

Teaching OR/MS III

Stream: OR Education
Chair: *Marta Pascoal*

1 - Students' preferences for learning operations research elicited by using qualitative and AHP methods
Marina Segura, Concepcion Maroto, Concepción Ginestar, José Ramónn Navarro

The increasing availability of online resources for learning Operations Research, developed mainly for online courses and flipped classroom approaches, is having a great influence on students' performance in face-to-face teaching. The objectives of this paper are to elicit students' preferences for learning resources, which include books, slides, videos and exams, as well as assessing their influence on students' performance in learning Operations Research in Business Administration and Management degree. Preferences for different types of learning resources have been elicited by qualitative and quantitative methods. Firstly, we have used the Likert scale as the most frequent procedure to measure students' perceptions of higher education studies. Secondly, the AHP method provides a new and quantitative approach, appropriate for eliciting individual preferences and aggregating them to build group preferences. In addition, AHP allows us to analyse inconsistent responses from students. We have carried out appropriate statistical analyses in both cases. The results show that students use a blend of traditional and online materials, although there are significant differences in the preferences for resources amongst different groups of students. Finally, we discuss the students' performance, which depends on the relative degree to which they used specific resources and their personal goals for the subject mark, as well as strategies to improve Operations Research learning.

2 - How dropping their worst homework might be prejudicial to your students: an application of Simpson's paradox and its impact on equity
Javier Rubio-Herrero

Dropping the worst homework, or the homework with the lowest grade, is a common practice that instructors do when they intend to increase their students' grades. The following article shows that if this measure is taken at some stage during the course, other than at the end of it, the grade of some students worsens after dropping their worst homework and the perception of their performance is biased. To illustrate this phenomenon, we provide an example in which this decrease can be of almost 4% and we find that this effect is more felt if a student has performed poorly in a midterm exam, i.e. it targets those to whom this policy is supposed to help. While in terms of equality this policy is usually extended to all the students, we conclude that its performance fails when it comes to assessing its equity. This is due to the effect of the so-called Simpson's Paradox.

3 - OR for children: robotic warehouse simulation using Lego Mindstroms
Lin Xie

In this paper, we aim at introducing one of the well-known OR-methods, called simulation, to children. Instead of using classical programming language, we choose the hand-on simulation to teach 20 children, between 8 and 12 years old, to simulate a robotic warehouse, similar to Amazon Kiva System. In such system, robots are sent to carry storage units from the inventory and bring them to human operators, who work at picking stations. At the stations, the items are packed according to the customers' orders. Such hand-on simulation utilizes storage and retrieval robots made from Lego Mindstorms'. The children are divided into groups to simulate different parts of the robotic warehouse, such as picking station, storage area, in a given control system (called "RawSim-O"). Because of utilizing such hand-on simulation, the children should understand the process of e-commerce and operations within a robotic warehouse.

4 - Introducing network optimization problems to middle school students
Marta Pascoal

In this work we describe a set of activities for middle school students, with the goal of presenting them graphs/networks and simple optimization problems that can be defined on those structures. The problems are presented from the most intuitive to solve to the most complex one, showing the students the increasing difficulty of the problems. This motivates the introduction of both exact and heuristic methods. This general structure has been used in lectures at schools and in problem solving workshops for students with interest in Mathematics.

■ TA-59

Tuesday, 8:30-10:00 - 4D UPV 2.5

Policy-Enabling Models for the Power Sector

Stream: Technical and Financial Aspects of Energy Problems
Chair: *Afzal Siddiqui*

1 - Analysis of storage and water value in power systems for policymaking on renewable energies
Diego Tejada, Afzal Siddiqui, Sonja Wogrin, Efraim Centeno Hernáez

As variable Renewable Energy Source (vRES) production, e.g., solar and wind, increases, additional Energy Storage (ES) capacity may be desirable in order to manage vRES intermittency. Moreover, since Battery Energy Storage Systems (BESS) cost is expected to decrease in the next 10 to 15 years, intra-day storage, e.g., BESS, dispatch could affect inter-day storage, e.g., hydropower, dispatch and its opportunity costs, i.e., water value. Existing medium- or long-term hydrothermal dispatch models provide the water value only on a weekly or monthly