Mining the Profile of Successful IE Students: Using Historical Data to Drive Curricular Interventions

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Abstract

Industry is rapidly moving towards data-driven solutions. Mining historical data on manufactured goods and services is becoming the customary approach for decision-making these days. This work proposes to extend these now standard operating procedures in industry to the educational arena. The Department of Industrial Engineering at University of Puerto Rico-Mayagüez (IE@UPRM) is currently planning a curricular reform. Unidentified student records from students enrolled in the IE program within the last ten years were used to create a profile of successful IE students. The approach was to retrospectively examine students before starting at UPRM, throughout their undergraduate careers, and via exit metrics; in order to determine curricular reform efforts that will increase retention and improve a student's likelihood to obtain a degree from IE@UPRM on time. Traditional multivariate statistics and machine learning algorithms were used to extract the structural patterns of successful alumni from IE@UPRM. These patterns allowed to identify core courses that require an intervention during a curricular reform and those elective courses that should be evaluated as core courses in the near future. Last but not least, these retrospective analyses allowed pin-point specific populations on which to focus future retention efforts.

Keywords
Curricular reform, decision trees, association rules

1. Introduction
Nowadays the industrial engineering profession, one of the most versatile branches of engineering, is facing many challenges including globalization, accelerated innovation and product development cycles, new business models, new competitive factors, industrial growth towards non-traditional industries including service related industries, and ever-changing technology and applications of IE tools [1]–[3]. But are the Industrial Engineering programs preparing students to face these challenges? The article by [4] points out that, in recent years, many national reports from the United States have urged engineering education stakeholders to change both the curriculum and pedagogy that traditionally have been standard parts of engineering education. Reviewing periodically and enhancing curricula in engineering is fundamental to maintaining the currency of undergraduate degree programs. However, the process of reforming the curriculum is complex since it must comply not only with ABET accreditation requirements but also prepare students to undertake the challenges of the IE profession in the 21st Century, consider demographic factors and the ever-increasing costs of higher education.

The Department of Industrial Engineering at University of Puerto Rico at Mayagüez (IE@UPRM) is currently planning a major curricular reform and, in order to propose changes, a retrospective analysis on students that were at some point enrolled in the IE program at UPRM is considered. A data mining approach is used to understand the current status of the program in terms of important indicators; such as retention and graduation times, discover structural patterns that identify the students that are more likely to succeed, identify core courses that require intervention, and evaluate the effectiveness of elective IE offerings.

1.1 Industrial Engineering at UPRM
The Department of Industrial Engineering at the University of Puerto Rico at Mayagüez (IE@UPRM) offers both undergraduate and graduate programs. The undergraduate program, the focus of this effort, is an ABET-accredited program with a relatively large enrollment of 493 students, of which 110 are freshman and nearly 100% are of Hispanic