Volunteer Scheduling for the LEARNWorks at Ada Jenkins

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Abstract

We worked with Ada Jenkins' LEARNWorks program, which connects middle and elementary school students with tutors enrolled at Davidson College. They needed to organize tutor hours so that all tutors got enough hours and children had the opportunity to work one-on-one with tutors. We used mathematical modeling techniques to help them achieve these goals with an improved scheduling system.

Introduction

The Ada Jenkins Center serves underprivileged communities in Davidson, Cornelius, Huntersville, Mooresville, Troutman and Mt. Mourne. The Ada Jenkins website states,

"The mission of the Ada Jenkins Center is to empower the people of our communities to break the cycle of poverty through the integration of health, education, and human services."

Operating for over 15 years, LEARNWorks is the oldest program at Ada Jenkins and aims to bring affordable academic assistance to disadvantaged families. The program brings in tutors to aid elementary and middle school students in guided reading, skill-building and enrichment activities to advance academic progress.

The LEARNWorks program approached us with the issue of scheduling tutors appropriately for each of the services offered. We consulted Grace Lopez, one of the directors of LEARNWorks, about the problems she encounters with running an effective scheduling system. In the past, the LEARNWorks directors have had difficultly creating a schedule that maximizes the amount of hours each tutor would like to work. They wanted to create a schedule in which all tutors work a sufficient number of hours while still maintaining an efficient student to tutor ratio. We used a mathematical modeling technique to help LEARNWorks achieve the goal of an improved scheduling system.

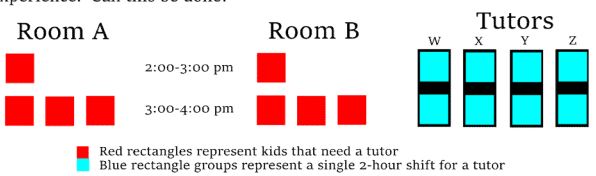
Methodology

The fundamental program LEARNWorks faces is scheduling volunteers in 15 different possible time slots (3:15-4:15, 4:15-5:15, and 5:15-6:15 every Monday, Wednesday, and Friday) in 4 different rooms so that each room has enough workers and workers get as close to working the number of hours they want as possible.

To create a better algorithm for designing a schedule, we created what is called a "binary integer linear program." Binary integer linear programs find solutions to some set of constraints by altering variables (called 'decision variables') between 0 and 1. Our program, created with the help of Dr. Tim Chartier, works as follows: First, LEARNWorks puts in to a MATLAB file an excel spreadsheet containing the available hours for each worker and how many hours a week they want to work. They also put in the number of workers they want to have in each room. Then, the program uses those inputs as constraints – making sure people are not scheduled for hours they are not available at, making sure workers do not work more hours they want to a week, and making sure each room has the number of workers it needs – to create a BILP. The decision variables are whether each worker is working at each hour in any given room. If any solution exists given all the constraints, the BILP will output a table representing a schedule that tells where and when each volunteer is working.

A small example: 4 tutors

Let's say Ada Jenkins wants to serve 8 children, 4 in Room A and 4 in Room B, for one day, from 2:00-4:00 pm. 1 child stays from 2:00-3:00 in each room, and 3 children stay from 3:00-4:00 in each room. Tutors W,X,Y, and Z all can work 2 hours each, and must work in a continuous block. Ada Jenkins wants to create a schedule that enables each of the childen to have a 1:1 tutor/tutee experience. Can this be done?



Without rotating the blue rectangles that are together, can you find a way to move the blue rectangles onto the red rectangles such that every red rectangle is covered by a blue one?

The answer is: **NO**.

There is no solution to this problem that would give Ada Jenkins the desired 1:1 ratio for all of its tutees given the constraints.

Our project covers the same concept, but with 5100 variables instead.

Ada Jenkins CENTER

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Conclusion

Ada Jenkins currently has 85 tutors signed up, each with varying hours and availability, which, given the fact that they have a certain number of tutors who are needed at every hour, makes scheduling difficult for them. However, with this algorithm, all Ada Jenkins will have to do to create a schedule is plug in the availability of each tutor and the number of tutors that are needed in each room, and the program we developed will create a full schedule, from Monday to Friday, creating an optimal schedule if possible. We believe that this program will significantly reduce the amount of time that the administration will need to be able to schedule hours for tutors.

Further steps include teaching the LEARNWorks admins how to use this application, as it requires some very basic MATLAB knowledge (such as how to input a matrix and run commands). Also, the LEARNWorks staff will have to come to Davidson to be able the run the program, since they do not themselves have the MATLAB software. However, even given these considerations, we are confident that our program will be able to make the scheduling process more efficient for their organization.

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