Homework 2 Due Friday February 21 (Monday 9 am Feb 24 is ok).

Since I am asking you to solve in software, there is a possibility that your branch and bound tree may not terminate in a reasonable amount of time (5 minutes). If this happens to you, solve the LP relaxation. Clearly state what happened and I won’t count off points, if the model is correct.

To get OPL installed on your computer, see the IBM initiative handout.

1. You are a supervisor assigning people to jobs. Every person must perform at least one job and a person cannot perform four or more jobs. Jobs 1, 2 and 9 require two people to complete the jobs. Every job must be done. Anyone doing job 5 cannot do job 2, 7 or 9. The table below provides the benefit that you expect to get from the individual performing the job. Create an IP to optimize this problem and solve it in EXCEL.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Person\Job** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **1** | 12 | 8 | 5 | 8 | 9 | 5 | 4 | 6 | 11 |
| **2** | 11 | 7 | 3 | 10 | 6 | 4 | 7 | 3 | 9 |
| **3** | 7 | 4 | 2 | 7 | 8 | 7 | 6 | 2 | 4 |
| **4** | 9 | 10 | 6 | 6 | 6 | 4 | 4 | 1 | 7 |
| **5** | 3 | 10 | 1 | 3 | 9 | 6 | 5 | 5 | 2 |

2. Daily fantasy sports allow individuals to select players that form a team. In DraftKings® basketball the team consists of 8 players. This team has 1 PG, 1SG, 1 guard (SG or PG), 1SF, 1PF, 1 Forward (PF or SF), 1 center and 1 utility (any position). To require some skill, every player is given a virtual salary and every entered fantasy must spend less than 50,000 points. Players receive fantasy points for rebounds, steals, blocks, points, 3 pointers and assists. They lose points for turnovers. The average fantasy points are known. The DraftKings excel file has the data for $1 Friday, Feb 1 2018 contest. So that I could model this in excel all players with a salary of $3,000 were eliminated as most of them are on injured list. Build a model to find the team that maximizes the average fantasy points. As a note, entering this team into a $1 contest resulted $1.50, a 50 cent gain. In fact, the team earned 261.75 fantasy points. Compared to the other 40,000 teams, it was about 24%. If it was 1.25 points lower, it would have lost. Also note that I was in a rush and I am ok if you can merely pull a feasible team off of your model. But your model may not generate a feasible team every time.

3. You own a machine shop with 4 machines. These machines all have the same processing speeds. You have a set of jobs. No job can be interrupted once it starts nor can a job be simultaneously processed on two machines. The processing time for each job is listed below.

A. Model and solve this problem in some software for the total completion time. The total completion time is the sum of the time of completion for every job. (makes customers most happy)

B. Model and solve this problem in some software for maximum completion time. The time it takes for the last job to be finished (the go home time).

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Job | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| Processing time | 23 | 14 | 7 | 62 | 21 | 17 | 19 | 55 | 16 | 13 | 27 | 31 | 35 | 18 | 9 |

4. Create an IP to optimize this problem and solve it in some software.

You just finished school and you want to eliminate debt as quickly as possible. You have $30,000 in student loans at .75% interest with a minimum payment of $300. You have a car loan for $8,000 with an interest rate of .5% and the minimum payment is $50. You also have credit cards with $12,000 interest rate 1% and a minimum payments of $125. All interest rates are per month. You are going to spend $800 each month to help you get out of debt. To help you feel better, you are going to require that each month you make at least $50 over the minimum payment to at least two different debts. That is paying $300, $50 and $350 would not be considered ok, but paying $300, $100 and $300 is ok. What happens to the answer if you do not require paying two loans off extra fast?

5. Given the following distance matrix. Assume that row 1 represents the home base of a vehicle routing problem. Each customer needs to be visited exactly one time and you want to minimize the total distance traveled.

Model this problem as an IP, solve it in OPL and report the solution (use a script file).

1. Do this if you have 6 vehicles and each vehicle must visit exactly two customers.
2. Try to do this for 3 vehicles where each vehicle must visit at least two customers.

[[0,2457,712,1433,66,2141,1616,635,2407,1104,644,1167,1057],

[2457,0,1752,1374,2409,365,851,1853,958,2339,1817,1688,1775],

[712,1752,0,954,672,1452,906,275,1737,1195,167,838,778],

[1433,1374,954,0,1368,1010,871,829,1891,967,878,336,445],

[66,2409,672,1368,0,2090,1572,577,2383,1047,593,1101,991],

[2141,365,1452,1010,2090,0,593,1522,1111,1974,1498,1324,1412],

[1616,851,906,871,1572,593,0,1039,1033,1710,987,1078,1124],

[635,1853,275,829,577,1522,1039,0,1956,920,108,633,550],

[2407,958,1737,1891,2383,1111,1033,1956,0,2732,1874,2110,2151],

[1104,2339,1195,967,1047,1974,1710,920,2732,0,1028,654,587],

[644,1817,167,878,593,1498,987,108,1874,1028,0,713,640],

[1167,1688,838,336,1101,1324,1078,633,2110,654,713,0,117],

[1057,1775,778,445,991,1412,1124,550,2151,587,640,117,0]];