

CS635 – Problem Set #7

Due Date: March 13, 2009

Instructions for Handing In Homework

Formulate the following problems in GAMS and solve them. Submit this assignment electronically using the instructions on the course web page. You should hand in exactly 4 files with the following names: `hw7-1.gms`, `hw7-2.gms`, `hw7-3.gms`, `hw7-3.lst`.

Ensure you use self-explanatory variable names, and that you comment any assumptions made to clarify your model formulation. Also, ensure that answers required for the question are displayed as the last line of the listing file produced.

1 Jerry Mander

Governor Jerry Mander of the state of Taxis is attempting to get the state legislator to gerrymander Taxis's congressional districts. The state consists of ten cities, and the numbers of registered Republicans and Democrats (in thousands) in each city are shown below

	republicans	democrats
1	80	34
2	60	44
3	40	44
4	20	24
5	40	114
6	40	64
7	70	14
8	50	44
9	70	54
10	70	64;

Taxis has five congressional representatives. To form congressional districts, cities must be grouped together according to the following restrictions:

- All voters in a city must be in the same district.
- Each district must contain between 150,000 and 250,000 voters (there are no independent voters).

Governor Mander is a Republican. Assume that each voter always votes a straight party ticket.

1.1 Problem

Formulate and solve an optimization problem to help Governor Mander maximize the number of Republicans who will win congressional seats.

2 Machine scheduling

A job consists of making three parts. Part 1 has two operations (1,2) that have to be done in order. Part 2 has three operations (3,4,5), both operation 3 and 4 must be done before operation 5. Part 3 has three operations (6,7,8), operation 7 must be done before operation 8.

There are two machines. Each operation has to be done on a particular machine.

Processing times are given below:

```
parameter procdata(part,oper,machine) /
p1.o1.m1      4
p1.o2.m2      2
p2.o3.m2      3
p2.o4.m1      2
p2.o5.m1      2
p3.o6.m2      3
p3.o7.m1      2
p3.o8.m2      1
/;
```

2.1 Problem

Find the schedule that minimizes makespan. The key issues to deal with are:

- A machine cannot process two tasks at once.
- Two operations on the same part cannot be processed concurrently.

3 SuDoku Problems

Sudoku is a puzzle game craze that is sweeping the world. According to a popular sudoku web site (<http://www.sudoku.com/>) “There’s no math involved.” But we will show them that we can needlessly and endlessly complicate *all* things with math, even a fun puzzle like sudoku.

In sudoku, you are given an $n \times n$ grid with some of the entries of the grid being filled in with numbers from $\{1, 2, \dots, n\}$. Typically $n = 9$, and in every sudoku puzzle \sqrt{n} is an integer. The object of the game is to fill in the grid so that every row, every column, and every $\sqrt{n} \times \sqrt{n}$ “box” contains the digits 1 through n .

3.1 Problem

Formulate sudoku as a MIP in GAMS and use it to solve the 9 by 9 instance on the course web site. Is the solution unique?

3.2 Problem

Bonus: Modify your model to (try) and solve the 25 by 25 sudoku on the course web site. Ensure that the final grid is displayed within the listing file.