

CS635 – Problem Set #5

Due Date: February 27, 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 6 files with the following names: `hw5-1.gms`, `hw5-1.txt`, `hw5-2.gms`, `hw5-2.txt`, `hw5-3.gms`, `hw5-3.txt`.

Use an editor to extract the required lines of output to the “txt” file, namely the model and solution status, the optimal values for the variables and the optimal value of the objective function. Ensure you use self-explanatory variable names, and that you comment any assumptions made to clarify your model formulation.

1 Tax Office Location

The income tax administration is planning to restructure the network of income tax offices in a region. The population of a number of cities (in thousands) is given below.

```
parameter pop(cities) 'Population of cities' /  
  1 15, 2 10, 3 12, 4 18, 5 5, 6 24, 7 11, 8 16, 9 13, 10 22, 11 19, 12 20/;
```

The data below indicates the distances (in kilometers) along the major roads between cities.

```
parameter len(cities,cities) 'Road lengths' /  
  1.2 15, 1.5 24, 1.7 18, 2.3 22, 3.4 18, 3.5 16, 3.9 20, 4.6 12,  
  5.8 12, 5.9 24, 6.9 12, 6.12 22, 7.8 15, 7.10 22, 8.9 30, 8.11 25,  
  9.11 19, 9.12 19, 10.11 19, 11.12 21 /;
```

The income tax administration has decided the offices should be established in three cities to provide sufficient coverage.

1.1 Problem

Without issuing a “solve” statement, calculate the distance matrix `dist(cities,cities)` that indicates the shortest path between any two cities.

1.2 Problem

Using the data generated above, determine where the offices should be located to minimize the average distance per inhabitant to the closest income tax office.

2 Auditing Company

When an accounting firm audits a corporation, the first phase of the audit involves obtaining “knowledge of the business”. This phase of the audit requires the following activities:

	Description	Predecessor	Duration
Activity A	Determine terms of engagement		3 days
Activity B	Appraisal of risk	A	6
Activity C	Identify transactions and possible errors	A	14
Activity D	Systems description	C	8
Activity E	Systems verification	D	4
Activity F	Control evaluation	B, E	8
Activity G	Design of audit	F	9

2.1 Problem

What is the critical path, and the minimum number of days to complete the first phase of the project?

2.2 Problem

Assume the first phase must be completed in 30 days. The duration of each activity can be reduced by incurring the following costs:

Activity	Cost/day of reducing duration	Max reduction
A	\$100	3 days
B	\$80	4
C	\$60	5
D	\$70	2
E	\$30	4
F	\$20	4
G	\$50	4

What strategy minimizes the cost of meeting the deadline?

3 Composing Flight Crews

During the Second World War, the Royal Air Force (RAF) had many foreign pilots speaking different languages and more or less trained on the different types of aircraft. The RAF had to form pilot/co-pilot pairs ('crews') for every plane with a compatible language and a sufficiently good knowledge of the aircraft type. Suppose there are 8 pilots and each pilot is characterized by a mark between 0 (worst) and 20 (best) for his language skills

```
table langrate(language,pilot)
      1  2  3  4  5  6  7  8
English 20 14  0 13  0  0  8  8
French  12  0  0 10 15 20  8  9
Dutch   0 20 12  0  8 11 14 12
Norwegian 0  0  0  0 17  0  0 16;
```

and his experience with two-seater aircraft

```
table planerate(type,pilot)
      1  2  3  4  5  6  7  8
reconnaissance 18 12 15  0  0  0  8  0
transport      10  0  9 14 15  8 12 13
bomber         0 17  0 11 13 10  0  0
fighter-bomber 0  0 14  0  0 12 16  0
supply         0  0  0  0 12 18  0 18;
```

A valid flight crew consists of two pilots that both have at least 10/20 for the same language and 10/20 on the same aircraft type.

3.1 Problem

Is it possible to have all pilots fly?

3.2 Problem

Subsequently, calculate for every valid flight crew, the sum of their scores for every aircraft type for which both pilots are rated at least 10/20.

3.3 Problem

Which is the set of crews with maximum total score?