

CS524 – Problem Set #2

Due Date: September 22, 2023. **9.00AM.**

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 a single zip file containing exactly 6 files with the following names:

hw2-1.gms, hw2-2.gms, hw2-3.gms, hw2-1.lst, hw2-2.lst, hw2-3.lst.

Ensure you use self-explanatory variable and equation names.

1 Alloy Blending

A company makes a blend consisting of two chemicals, 1 and 2, in the ratio of 5:2 by weight. These chemicals can be manufactured by three different processes using two different raw materials and a fuel. Production data is given in the following table:

Process	Requirements per Unit Time			Output per Unit Time	
	Raw Material 1 (units)	Raw Material 2 (units)	Fuel (units)	Chemical 1 (units)	Chemical 2 (units)
1	9	5	50	9	6
2	6	8	75	7	10
3	4	11	100	10	6
Amount available	200	400	1850		

1.1 Problem

For how much time should each process be run in order to maximize the total amount of *blend* manufactured? Ensure your model is called `chemmod`, you save the `modelstat` and `solvestat` of the optimization to scalars `mstat` and `sstat`, and you save the processing times into a parameter `proctime` that you display as follows:

```
display mstat, sstat, blend.l, proctime;
```

2 Woodcrafters

Woodcrafters of Madison is a small artesean wood shop that turns out four different items: bookcases, desks, chairs, and bedframes.

- A bookcase requires three hours of work, one unit of metal, and four units of wood, and it brings in a net profit of \$19.
- A desk requires two hours of work, one unit of metal, and three units of wood and it brings in a net profit of \$13.
- A chair requires one hour of work, one unit of metal, and three units of wood, and it brings in a profit of \$12.
- A bedframe requires two hours of work, one unit of metal, and four units of wood, and it brings in a net profit of \$17.
- Only 225 hours of labor, 117 units of metal, and 420 units of wood are available per day.

2.1 Problem

Determine the production quantities that maximize (daily) net profit. Display in the listing file the values (levels) of the optimal solution (variables) and the objective function.

2.2 Problem

The optimal solution calls for 39 bookcases, 48 chairs, and 30 bedframes to be produced every day. (You should verify that your model produces this solution before continuing).

You have been brought in to do some “what-if” analysis on their operations. Solve the following variations:

1. The net profit brought in by each desk increases from \$13 to \$15.
2. The availability of metal increases from 117 to 125 units per day.
3. The company may also produce coffee tables, each of which requires three hours of work, one unit of metal, two units of wood, and brings in a net profit of \$14.

(You should assume that the changes are cumulative. Thus, for example, the net profit for desks is \$15 in the second and third questions).

For each of these three instances, be sure to extract and display the same optimal values in the listing file. You should be able to solve this problem with one model, and capture all the instances with solves of that model with adjusted data. Full credit will only be given if your solution has a single model `books`.

Additionally, use the following code to save the values of the objective after each run and display at the end of the file together with the production values from the last model:

```
parameter resprof(*);
resprof('2.1') = profit.l;
...
display resprof, produce.l;
```

3 Tree planting

A forestry company has four sites on which they grow trees. They are considering four species of trees, the pines, spruces, walnuts and other hardwoods. Data on the problem are given below.

Site No.	Area (ka)	Expected annual yield (m^3/ka)				Expected annual revenue (money units per ka)			
		Pine	Spruce	Walnut	Hardwd	Pine	Spruce	Walnut	Hardwd
1	1500	17	14	10	9	16	12	20	18
2	1700	15	16	12	11	14	13	24	20
3	900	13	12	14	8	17	10	28	20
4	600	10	11	8	6	12	11	18	17
Min. req. yield (thousand m^3)		22.5	9	4.8	3.5				

3.1 Problem

How much area should the company devote to the growing of various species in the various sites? Note that you should use sets and parameters to read in data and use these to define variables and equations. For this please use model name `forest` and display the amounts grown (which may be a two dimensional variable).

```
display profit.l, grow.l;
```

Additionally, for this problem set `limrow` and `limcol` to 0, turn off solution printing, extract and display the model and solution status in parameters `mstat` and `sstat`.