

## CS635 – Problem Set #2

Due Date: February 6, 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: `hw2-1.gms`, `hw2-1.txt`, `hw2-2.gms`, `hw2-2.txt`, `hw2-3.gms`, `hw2-3.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.

Formulate the following problems as linear programming (LP) models in GAMS and solve them.

### 1 Alloy Blending

The company Steelco has received an order for 500 tonnes of steel to be used in shipbuilding. The steel must have the following characteristics:

Chemical Element	Minimum Grade	Maximum Grade
Carbon(C)	2	3
Copper(Cu)	0.4	0.6
Manganese(Mn)	1.2	1.65

The company has seven different raw materials in stock that may be used for the production of this steel. The following table lists the grades, available amounts and prices for all materials:

Raw Material	C%	Cu%	Mn%	Availability in t	Cost in \$/t
Iron alloy 1	2.5		1.3	400	200
Iron alloy 2	3		0.8	300	250
Iron alloy 3		0.3		600	150
Copper 1		90		500	220
Copper 2		96	4	200	240
Aluminium 1		0.4	1.2	300	200
Aluminium 2		0.6		250	165

#### 1.1 Problem

The objective is to determine the composition of the steel that minimizes the production cost.

### 2 Advertising

You are in charge of an advertising campaign for a new product, with a budget of \$1 million. You can advertise on TV or in magazines. One minute of TV costs \$20,000 and reaches 1.8 million potential customers; a magazine page costs \$10,000 and reaches 1 million. You must sign up for at least 10 minutes of TV time.

#### 2.1 Problem

How should you spend your budget to maximize your audience? Formulate the problem in GAMS and solve it.

#### 2.2 Problem

It takes creative talent to create effective advertising; in your organization it takes three person-weeks to create a magazine page, and one person-week to create a TV minute. You have only 100 person-weeks available. Add this constraint to the model and determine how you should spend your budget.

**2.3 Problem**

Radio advertising reaches a quarter million people per minute, costs \$2,000 per minute and requires only 1 person-day of time. How does this medium affect your solutions?

**2.4 Problem**

How does the solution change if you have to sign up for at least two magazine pages? A maximum of 120 minutes of radio?

You should be able to use one gams file for this entire problem, containing several models. In some cases you may want to fix a subset of the variables to zero.

**3 Manufacturing transistors**

Silicon Valley Corporation (Silvco) manufactures transistors. An important aspect of the manufacturing process is the melting of the element germanium in a furnace. Unfortunately, the melting process yields germanium of highly variable quality. The results of the process can be classified into five grades: “defective”, “grade 1”, “grade 2”, “grade 3”, and “grade 4”. Two methods can be used to do the melting. Method 1 costs \$50 per transistor, and method 2 costs \$70 per transistor. The qualities of germanium produced by the melting are shown in the following table (as percentage yields).

	method1	method2
defective	30	20
grade1	30	20
grade2	20	25
grade3	15	20
grade4	5	15

Silvco can refire melted germanium in an attempt to improve its quality. It costs \$25 to refire the melted germanium for one transistor. The results of the refiring process are shown in the table below. For example, if grade 3 germanium is refired, half of the resulting germanium will still be grade 3 while the other half will be grade 4.

	defective	grade1	grade2	grade3	grade4
defective	30	25	15	20	10
grade1		30	30	20	20
grade2			40	30	30
grade3				50	50

Silvco has sufficient furnace capacity to melt or refire germanium for at most 20,000 transistors per month. Silvco’s monthly demands are for 1000 grade-4 transistors, 2000 grade-3 transistors, 3000 grade-2 transistors, and 3000 grade-1 transistors.

**3.1 Problem**

Assuming that just one stage of refiring is allowed, model the melting/refiring process and determine the minimum cost of germanium processing required to meet the demands.