Homework 1 (100 points) Due: July 5, 2024 11:59 pm
COMPSCI 735: OPTIMIZATION: TECHNIQUES AND APPLICATIONS

Formulate the following problems as GAMS (LP) models and solve them. Use the given "topbrass" examples to follow the GAMS syntax. Submit this assignment electronically to Canvas. You should hand in exactly 4 files with the following names: hw1-1.gms, hw1-1.lst, hw1-2.gms, hw1-2.lst, hw1-3.gms, and hw1-3.lst. The "lst" files are produced automatically when you execute "gams" model file.

Problem 1:

$$\text{Maximize}_{x_1,x_2,x_3} 45x_1 + 15x_3$$

subject to

$$4x_1 - 2x_2 + 9x_3 = 22$$

$$-2x_1 + 5x_2 - x_3 \leq 1$$

$$x_1 - x_2 \leq 5$$

$$x_1, x_2, x_3 \geq 0$$

Use the statement option limrow=0, limcol=0; to suppress some of the compiler output (not needed in this exercise) from the .lst file. Also use the expression positive variables to get the lower bounds on the variables instead on setting the lower bounds with .lo. You should have your gams file display the solution. You should create parameters objval, x1val, x2val, and x3val to do this as follows. Assuming that you call your (GAMS) decision variables x_1, x_2, and x_3, and your objective variable is obj, your code will look like:

```
parameter x1val, x2val, x3val, objval;
objval = obj.l ;
x1val = x1.l ;
x2val = x2.l ;
x3val = x3.l ;
display objval, x1val, x2val, x3val ;
```

```
Solution:
----     39 PARAMETER objval              =      315.000
            PARAMETER x1val               =        7.000
            PARAMETER x2val               =        3.000
            PARAMETER x3val               =        0.000
```

Problem 2:

Enter and solve the following linear program in GAMS

$$\text{minimize}_{x_1,x_2,x_3} 3x_1 + 2x_2 - 33x_3$$

subject to

$$x_1 - 4x_2 + x_3 \leq 15$$
$$9x_1 + 6x_3 = 12$$
$$5x_1 + 9x_2 \geq 3$$
$$x_1, x_2, x_3 \geq 0$$

Use the statement option limrow=0, limcol=0; to suppress some of the compiler output (not needed in this exercise) from the .lst file. Also use the expression positive variables to get the lower bounds on the variables instead on setting the lower bounds with .lo. You should have your gams file display the solution. You should create parameters objval, x1val, x2val, and x3val to do this as follows. Assuming that you call your (GAMS) decision variables x_1, x_2, and x_3, and your objective variable is obj, your code will look like:

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objval = obj.l ;
x1val = x1.l ;
x2val = x2.l ;
x3val = x3.l ;
display objval, x1val, x2val, x3val ;
```

```
Solution:
----     39 PARAMETER objval                =      -65.333
            PARAMETER x1val                 =        0.000
            PARAMETER x2val                 =        0.333
            PARAMETER x3val                 =        2.000
```

Problem 3: Index sets and bounds

Use an appropriate set J and declare variables $x(J)$ along with upper and lower bound statements to formulate and solve:

$$\text{Maximize}_{x_1,x_2,x_3} 5(x_1 + 2x_2) - 11(x_2 - x_3)$$

subject to

$$3x_1 \geq \sum_{j \in J} x_j$$
$$0 \leq x_j \leq 3, j = 1, \ldots, 3$$

You should enter the problem as written above - there is no need to do arithmetic to simplify the objective or constraints. Ensure the model is called prob2. Look through the solution report in the listing file to ensure that you understand where all the relevant pieces of information are stored. Use a display statement to print out the level values of the variables, their lower and upper bounds, and the value of the objective function as shown below.

```
display x.l, x.lo, x.up, prob3.objval;

Solution:
----     33 MODEL prob3.ObjVal             =       48.000
----     33 VARIABLE x.L

1 3.000,    3 3.000
```