Wissenschaftliches Rechnen / Scientific Computing
4. Assignment (Due date 14.12.2012)

Exercise 1

The patient gets two types of medicine M_1 and M_2. The cost of each of the medicine is
6 \$ and 8 \$ per package, respectively. Each of the medicine contains two vitamins V_1 and
V_2. The amount of each vitamin in the package and the minimal requirement for each
vitamin are presented below.

Vitamin	Medicine M_1	Medicine M_2	Min. requirement
V_1	5	10	**60**
V_2	4	4	**40**
Cost/package	6	8	

Formulate the above problem as a linear programming problem and find the optimal dose
of each medicine which satisfies the minimum requirement of each vitamin and minimizes
the costs incurred by the patient.

Use MATLAB build in function `[x,obj] = linprog(c,A,b)` to solve the resulting line-
ar programming problem. Make sure that your formulation of the linear programming
problem is consistent with the one used by `linprog`, see e.g. `help linprog`.

2 pts.

Exercise 2

*Multiperiod Financial Model from WinstonW.L. Operations Research: Applications and
Algorithms, PWS-KENT Publishing Company, Boston, 1987.*

Finco Invest. Corp. must determine an investment strategy for the next three years. At
present (time 0), 100 000\$ is available for investment. Investments A, B, C, D and E
are available. The cash flow associated with investing 1\$ in each investment is given in
the table below.

	t=0	t=1	t=2	t=3
A	-1\$	+0.5\$	+1\$	0\$
B	0\$	-1\$	+0.5\$	+1\$
C	-1\$	+1.2\$	0\$	0\$
D	-1\$	0\$	0\$	+1.9\$
E	0\$	0\$	-1\$	+1.5\$

For example, 1\$ invested in B requires 1\$ in cash at time $t = 1$ and returns 0.5\$ at time
$t = 2$ and 1\$ at time $t = 3$. To ensure that the company's portfolio is diversified, Finco
requires that at most 75 000\$ be placed in any single investment. In addition, Finco can
earn interest at 8% per year by keeping uninvested cash in money market funds. Returns
from investments may be immediately reinvested. Finco can not borrow funds.

Formulate a linear programming problem whose solution will maximize the amount of cash in hand at time $t = 3$. Finco must decide how much money should be placed in each investment (including the money market funds).

Hint: Remember about the money invested in money market funds at time t.

Use MATLAB build in function `[x,obj] = linprog(c,A,b, Aeq, beq, lb, ub)` to solve the resulting linear programming problem. Make sure that your formulation of the linear programming problem is consistent with the one used by `linprog`, see e.g. `help linprog`.

2 pts.

Exercise 3

Write the MATLAB function `LPGeoSol.m`

```
function [x,p]=LPGeoSol(c,A,b)
```

which geometrically solves the linear programming problem

$$\begin{aligned} \max \ z &= c^T x \\ Ax &\leq b \\ x &\geq 0, \end{aligned}$$

with two variables x_1, x_2 and draws the set of feasible solutions with the optimal solution pointed out.

Vector `c` contains objective function coefficients, `A` is a constraint matrix and vector `b` a right hand side vector. Vector `x` should contain the optimal solution and vector `p` all extreme points of the set of feasible solutions. You may use the MATLAB build in function `convhull`.

Test your implementation for the problem from Exercise 1 and compare your result with the one obtained by `linprog`.

6 pts.