4040-849 Optimization Methods

Written Assignment 1

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PROBLEM 1.

Solution.

The information provided about the mixed nuts, their content percentage, and cost can be displayed in tabular form as follows:

Nut	**Type A (%)**	**Type B (%)**
Almonds	0.20	0.10
Cashew nuts	0.10	0.20
Walnuts	0.15	0.25
Peanuts	0.55	0.45
Cost	\$2.50	\$3.00

From this information we can determine the following properties of the problem:

Design variables:

$$x = \text{ the number of pounds of mixed nut type} A$$
$$y = \text{ the number of pounds of mixed nut type} B$$

Constraints:

$$0.2x + 0.1y \geq 4$$
$$0.1x + 0.2y \geq 5$$
$$0.15x + 0.25y \geq 6$$

Cost function:

$$f(x, y) = 2.5x + 3y$$

TODO: convert into standard form now... (equality with constraints, etc..)

PROBLEM 2.

Solution.

Based on the problem description, we can identify the following properties of the problem:

Design variables:

$x_{1,1}$ = #resources between New York to Seattle
$x_{1,2}$ = #resources between New York to Houston
$x_{1,3}$ = #resources between New York to Detroit
$x_{2,1}$ = #resources between Los Angeles to Seattle
$x_{2,2}$ = #resources between Los Angeles to Houston
$x_{2,3}$ = #resources between Los Angeles to Detroit

Constraints:

$$\begin{aligned} x_{1,1} + x_{1,2} + x_{1,3} &\leq 3 \\ x_{2,1} + x_{2,2} + x_{2,3} &\leq 3 \\ x_{1,1} + x_{2,1} &= 2 \\ x_{1,2} + x_{2,2} &= 3 \\ x_{1,3} + x_{2,3} &= 1 \end{aligned}$$

Cost function:

$$f(x_{1,1}, x_{1,2}, x_{1,3}, x_{2,1}, x_{2,2}, x_{2,3}) = 4x_{1,1} + 3x_{1,2} + x_{1,3} + 2x_{2,1} + 7x_{2,2} + 5x_{2,3}$$

TODO: convert into standard form now... (equality with constraints, etc..)

PROBLEM 3.

Solution. This problem can be classified as an optimal control problem with 9 total states (including an initial state where no money has been invested yet). Thus, the problem can be formulated with the following parameters:

Design variables:

i = current state of the problem (state)
$X_{i,j}$ = amount of money invested in CD type j at state i (control)
$y_{i,a}$ = amount of money available for investment at state i (state)
$y_{i,c}$ = amount of money accumulated thus far at state i (state)

Constraints:

$$\begin{aligned} y_{0,a} &= 50000 \\ y_{i,a} &\geq 0 \\ x_{i,1} + x_{i,2} + x_{i,3} + x_{1,4} &\leq y_{i,a} \end{aligned}$$

Cost function:

$$f(X) = \sum_{i=0}^{8} y_{i,c} = 0.05X_{i-1,1} + 0.07X_{i-2,2} + 0.1X_{i-4,3} + 0.15X_{i-8,4}$$