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Assignment 1

1. Decision Variables:

a. x_i = ingredient, i: 1 to 5

Cost Minimization: $2.5x_1 + 1.5x_2 + 2x_3 + 3.5x_4 + 3x_5$

Subject To:

$20x_1 + 10x_2 + 10x_3 + 30x_4 + 20x_5 \geq 40$ (vitamin requirement)

$7x_1 + 4x_2 + 5x_3 + 9x_4 + 3x_5 \geq 15$ (mineral requirement)

$4x_1 + 2x_2 + x_3 + 10x_4 + x_5 \geq 10$ (protein requirement)

$450x_1 + 160x_2 + 500x_3 + 300x_4 + 500x_5 \geq 600$ (calorie requirement)

Weight Requirements

$x_1 \geq 0.05(x_1 + x_2 + x_3 + x_4 + x_5)$

$x_2 \geq 0.05(x_1 + x_2 + x_3 + x_4 + x_5)$

$x_3 \geq 0.05(x_1 + x_2 + x_3 + x_4 + x_5)$

$x_4 \geq 0.05(x_1 + x_2 + x_3 + x_4 + x_5)$

$x_5 \geq 0.05(x_1 + x_2 + x_3 + x_4 + x_5)$

$x_1 \leq 0.5(x_1 + x_2 + x_3 + x_4 + x_5)$

$x_2 \leq 0.5(x_1 + x_2 + x_3 + x_4 + x_5)$

$x_3 \leq 0.5(x_1 + x_2 + x_3 + x_4 + x_5)$

$x_4 \leq 0.5(x_1 + x_2 + x_3 + x_4 + x_5)$

$x_5 \leq 0.5(x_1 + x_2 + x_3 + x_4 + x_5)$

$x_i \geq 0$ (non negative)

b. (See Attached Excel Spreadsheet)

c. The optimal solution Tuckered Outfitters is to have a mix that contains 0.75 pounds of Raisins, 0.1 pounds of Grain, 0.1 pounds of Chocolate Chips, 0.95 pounds of Peanuts, and 0.1 pounds of Almonds. This mixture will minimize the total cost at $5.85 per package.

2. a. Decision Variables:

x_{hc} h: 1 to 3, c: 1 to 4

x_h = cargo hold
x_c = load commodity

Objective:
Maximize profits=
$70(x_{11} + x_{21} + x_{31}) + 50(x_{12} + x_{22} + x_{32}) + 60(x_{13} + x_{23} + x_{33}) + 80(x_{14} + x_{24} + x_{34})$

Inventory:
$x_{11} + x_{21} + x_{31} \leq 4800$ (amount of commodity 1 available)
$x_{12} + x_{22} + x_{32} \leq 2{,}500$ (amount of commodity 2 available)
$x_{13} + x_{23} + x_{33} \leq 1{,}200$ (amount of commodity 3 available)
$x_{14} + x_{24} + x_{34} \leq 1{,}700$ (amount of commodity 4 available)

Available Weight Capacity:
$x_{11} + x_{12} + x_{13} + x_{14} \leq 3{,}000$ (weight capacity forward)
$x_{21} + x_{22} + x_{23} + x_{24} \leq 6{,}000$ (weight capacity center)
$x_{31} + x_{32} + x_{33} + x_{34} \leq 4{,}000$ (weight capacity rear)

Available Space:
$40x_{11} + 25x_{12} + 60x_{13} + 55x_{14} \leq 145{,}000$ (volume capacity forward)
$40x_{21} + 25x_{22} + 60x_{23} + 55x_{24} \leq 180{,}000$ (volume capacity center)
$40x_{31} + 25x_{32} + 60x_{33} + 55x_{34} \leq 155{,}000$ (volume capacity rear)

Balance:
$0.9(x_{31} + x_{32} + x_{33} + x_{34}) \leq (x_{11} + x_{12} + x_{13} + x_{14}) \leq 1.1(x_{31} + x_{32} + x_{33} + x_{34})$

$0.4(x_{11} + x_{12} + x_{13} + x_{14} + x_{21} + x_{22} + x_{23} + x_{24} + x_{31} + x_{32} + x_{33} + x_{34}) \leq x_{21} + x_{22} + x_{23} + x_{24} \leq 0.6(x_{11} + x_{12} + x_{13} + x_{14} + x_{21} + x_{22} + x_{23} + x_{24} + x_{31} + x_{32} + x_{33} + x_{34})$

Non negative:
$x_{hc} \geq 0$
b. (See Attached Excel Spreadsheet)
c. The optimal solution for Paul Bergey to maximize profits would be to split Commodity 1 by putting 1,198 tons of in the front, 382 tons in the center, and 3,220 tons in the rear cargo hold. Commodity 2 will be entirely loaded into the center cargo hold with 2,500 tons. 1,700 tons of Commodity 3 will be loaded into the forward cargo hold. This will maximize profits at $669,000.

3. a. Decision Variables:

A_i = balance allowance for month, i: 1 to 6
B_i = borrowed against for month, i: 1 to 6
D_i = delayed payments for month, i: 1 to 6
E_i = ending balance for month, i: 1 to 6
G_i = beginning balance for month, i: 1 to 6
V_i = amount available for month, i: 1 to 6
L = short term loan

Cost Minimization:

$(1.02(D_1 + D_2 + D_3 + D_4 + D_5 + D_6) + 1.015(B_1 + B_2 + B_3 + B_4 + B_5 + B_6) + 1.01L) – (0.005(G_1 + G_2 + G_3 + G_4 + G_5 + G_6))$

Subject To:

L = integer

Ending Balance Requirement

$E_1 \geq 0.25$, $E_2 \geq 0.25$, $E_3 \geq 0.25$, $E_4 \geq 0.25$, $E_5 \geq 0.25$, $E_6 \geq 0.25$

$E_1 \geq A_1$, $E_2 \geq A_2$, $E_3 \geq A_3$, $E_4 \geq A_4$, $E_5 \geq A_5$, $E_6 \geq A_6$

Borrowed Against Requirement

$B_1 \leq V_1$, $B_2 \leq V_2$, $B_3 \leq V_3$, $B_4 \leq V_4$, $B_5 \leq V_5$, $B_6 \leq V_6$

$A_i, B_i, D_i, E_i, G_i, V_i, L \geq 0$ (non negative)

b. (See Attached Excel Spreadsheet)

c. The optimal solution for Eagle Beach Wear and Gift Shops is to minimize costs to the cash management plan this is equal to $299,050.50. Considering that the spreadsheet shows values in terms of $100,000. It is suggested that a short-term loan is not taken out.