CS325 - Project 4

Group #6
William Jernigan, Alexander Merrill, Sean Rettig

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Problem 1: mmmm ... tofu

Mathematical Representation

Variables:
u_f = working day flavored blocks of tofu
m_f = working day flavored bags of edamame
p_f = working day flavored blocks of tempeh
u_o = overtime flavored blocks of tofu
m_o = overtime flavored bags of edamame
p_o = overtime flavored blocks of tempeh
u_p = plain blocks of tofu
m_p = plain bags of edamame
p_p = plain blocks of tempeh

Objective: $\max \{4u_p + 12u_f + 7u_o + 8m_p + 14m_f + 11m_o + 4p_p + 13p_f + 9p_o\}$

Set of Constraints:
$u_f + u_o + u_p \leq 480$
$m_f + m_o + m_p \leq 400$
$p_f + p_o + p_p \leq 230$
$u_f + m_f + p_f \leq 420$
$u_o + m_o + p_o \leq 250$
$-u_f \leq 0$
$-m_f \leq 0$
$-p_f \leq 0$
$-u_o \leq 0$
$-m_o \leq 0$
$-p_o \leq 0$
$-u_p \leq 0$
$-m_p \leq 0$
$-p_p \leq 0$

Matrix Representation

$$\underbrace{\begin{bmatrix} 1 & 0 & 0 & 1 & 0 & 0 & 1 & 0 & 0 \\ 0 & 1 & 0 & 0 & 1 & 0 & 0 & 1 & 0 \\ 0 & 0 & 1 & 0 & 0 & 1 & 0 & 0 & 1 \\ 1 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 1 & 1 & 0 & 0 & 0 \\ -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 \end{bmatrix}}_{\text{"}A\text{"}} \underbrace{\begin{bmatrix} u_f \\ m_f \\ p_f \\ u_o \\ m_o \\ p_o \\ u_p \\ m_p \\ p_p \end{bmatrix}}_{X^T} \leq \underbrace{\begin{bmatrix} 480 \\ 400 \\ 230 \\ 420 \\ 250 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}}_{\text{"}b\text{"}}$$

Optimal Solution

The maximum profit that can be made is $10,610 with the following plan:
tofu plain = 60
tofu flavored on regular time = 420
tofu flavored on overtime = 0
edamame plain = 380
edamame flavored on regular time = 0
edamame flavored on overtime = 20
tempeh plain = 0
tempeh flavored on regular time = 0
tempeh flavored on overtime = 230

Environment Used to Solve

GUSEK is an open source Windows GUI which provides a SciTE editor for describing LPs and solves them with GLPK, a standalone tool usable in command line.

Code

```
Maximize
 obj: 4up + 12uf + 7uo + 8mp + 14mf + 11mo + 4pp + 13pf + 9po
Subject To
 c1: uf + uo + up <= 480
 c2: mf + mo + mp <= 400
 c3: pf + po + pp <= 230
 c4: uf + mf + pf <= 420
 c5: uo + mo + po <= 250
Bounds
 uf >= 0
 mf >= 0
 pf >= 0
 uo >= 0
 mo >= 0
```

```
 po >= 0
 up >= 0
 mp >= 0
 pp >= 0
End
```

Problem 2: least squares isn't good enough for me

Linear Program for General Problem

Objective: min t

Subject to:
$-t + ax_i + by_i - c \leq 0$ for $1 \leq i \leq n$
$t + ax_i + by_i - c \leq 0$ for $1 \leq i \leq n$
$t \geq 0$

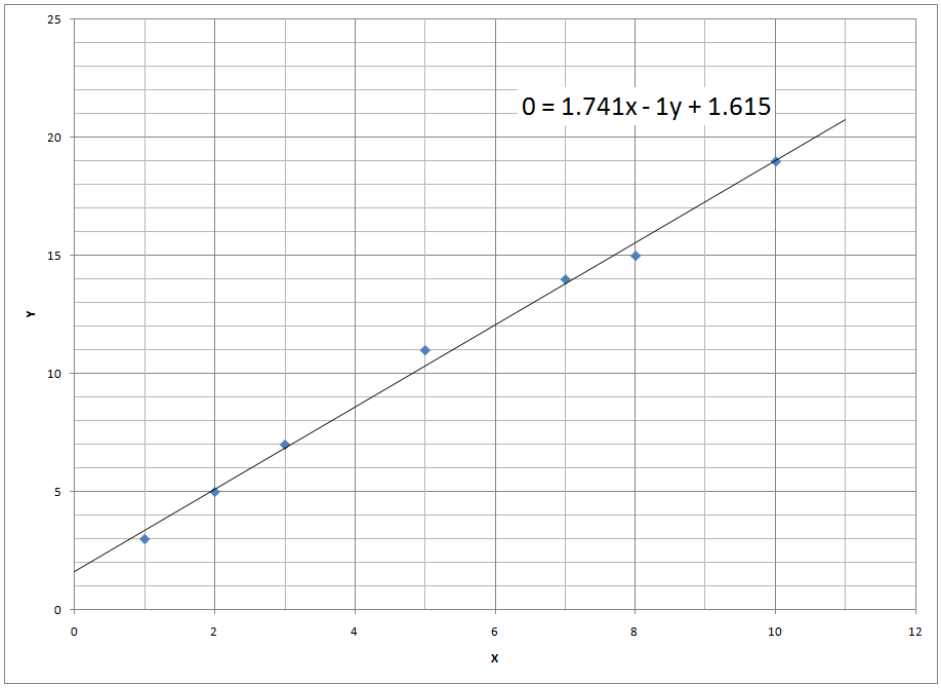
Best Solution for Specific Problem

Objective: min t

Subject to:
$t - a1 - b3 + c \leq 0$
$-t + a + 3b - c \leq 0$
$t + a + 3b - c \leq 0$
$-t + 2a + 5b - c \leq 0$
$t + 2a + 5b - c \leq 0$
$-t + 3a + 7b - c \leq 0$
$t + 3a + 7b - c \leq 0$
$-t + 5a + 11b - c \leq 0$
$t + 5a + 11b - c \leq 0$
$-t + 7a + 14b - c \leq 0$
$t + 7a + 14b - c \leq 0$
$-t + 8a + 15b - c \leq 0$
$t + 8a + 15b - c \leq 0$
$-t + 10a + 19b - c \leq 0$
$t + 10a + 19b - c \leq 0$
$-t \leq 0$

Solution:
$0 = 1.741x - 1y + 1.615$
$a = 1.741$
$b = 1$
$c = 1.615$

Plot and Solution



$0 = 1.741x - 1y + 1.615$

Code

```
Minimize
 obj: t
Subject To
 -t + a + 3b - c <= 0
 t + a + 3b - c <= 0
 -t + 2a + 5b - c <= 0
 t + 2a + 5b - c <= 0
 -t + 3a + 7b - c <= 0
 t + 3a + 7b - c <= 0
 -t + 5a + 11b - c <= 0
 t + 5a + 11b - c <= 0
 -t + 7a + 14b - c <= 0
 t + 7a + 14b - c <= 0
 -t + 8a + 15b - c <= 0
 t + 8a + 15b - c <= 0
 -t + 10a + 19b - c <= 0
 t + 10a + 19b - c <= 0
 -t <= 0
Bounds
End
```

Work Shown

Attached are copies of our work and scratch paper.