MATH3202/7232 Operations Research & Mathematical Planning 2020

Introductory Exercise – Farmer Jones

Farmer Jones bakes two types of cake (chocolate and plain) to supplement his income. Each chocolate cake can be sold for \$4 and each plain cake can be sold for \$2. Each chocolate cake requires 20 minutes of baking time, 250 mL of milk and 4 eggs, while each plain cake needs 50 minutes baking, 200 mL of milk and only 1 egg. In each day there are eight hours of baking time available. Farmer Jones' hens lay 30 eggs each day and his cows produce 5 L of milk. How many of each type of cake should Farmer Jones bake each day to maximize his revenue?

Sets

C cakes

I ingredients

Data

r_c revenue for each cake $c \in C$

a_i available ingredient $i \in I$

u_{ic} amount of $i \in I$ needed to make cake $c \in C$

Decision Variables

x_c number of cakes to make $c \in C$.

Objective Maximise $4x_{choc} + 2x_{plain}$

Constraints

$20x_{choc} + 50x_{plain} \leq 480$ Time

$4x_{choc} + 1x_{plain} \leq 30$ Eggs

$0.25x_{choc} + .2x_{plain} \leq 5$ Milk

$x_{choc} \geq 0, x_{plain} \geq 0$

x_{choc}, x_{plain} integers.

(Mixed) integer programming problem (IP) (MIP)

Linear Programming Problem (LP)

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Attempt 2

Objective Maximise $\sum_{c \in C} r_c x_c$

Constraints

Ingredient limits: $\sum_{c \in C} a_{ic} x_c \leq a_i \quad \forall i \in I$

$x_c \geq 0 \quad \forall c \in C.$

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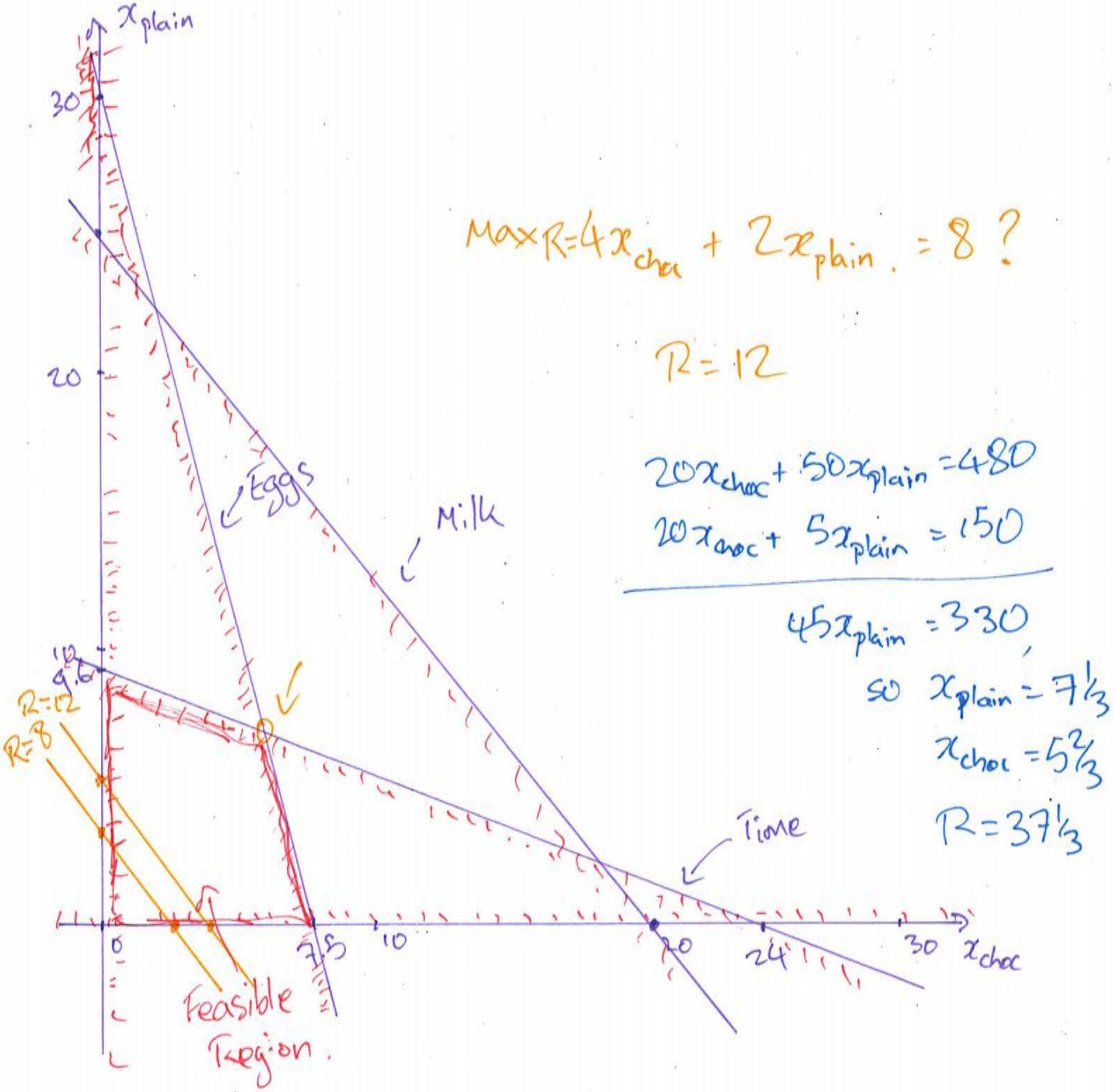

$\text{Max } R = 4x_{choc} + 2x_{plain}$. $= 8$?

$R = 12$

$20x_{choc} + 50x_{plain} = 480$

$20x_{choc} + 5x_{plain} = 150$

$45x_{plain} = 330$,

so $x_{plain} = 7\frac{1}{3}$

$x_{choc} = 5\frac{2}{3}$

$R = 37\frac{1}{3}$

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Wordlock Exercise

Can we do better than this?

0 BDLRPSMTWH
1 AOURYEILTN
2 TALEMNCOSI
3 ASKNEPYTLD

Sets

L letters A, B, C, ...

D dials 0, 1, 2, 3

W words ABET, ABLE, ...

Data

$y_{BATS} = 1, y_{MEAL} = 0$

$x_{0B} = 1, x_{0Q} = 0$

Variables

104 $x_{dl} = \begin{cases} 1, & \text{if letter } l \text{ is on dial } d \\ 0, & \text{if not} \end{cases}$

1537 $y_w = \begin{cases} 1, & \text{if we can spell word } w \in W \\ 0, & \text{if not} \end{cases}$

Objective Max $\sum_{w \in W} y_w$

Constraints $\sum_{l \in L} x_{dl} = 10 \quad \forall d \in D$