

程序代写代做 CS编程辅导
Integer Linear Programming



Barry Dominik Jena

WeChat: cstutorcs
Master of Business Administration

Assignment Project Exam Help
ESG UQAM

Email: tutores@163.com



QQ: 749389476

<https://tutorcs.com>

MBA 8419 - Decision Making Technology

Overview of the presentation

程序代写代做 CS编程辅导



- Integrality constraints
 - Definitions of integrality constraint
 - Applications of integer linear programming
 - Revenue management
 - Airline Company
 - Schedule planning
 - Call center
 - 0-1 Formulations
 - Location problem
 - Product design problem
- WeChat: cstutorcs
Assignment Project Exam Help
Email: tutorcs@163.com
QQ: 749389476
<https://tutorcs.com>

Integrality constraints

Definitions and importance

程序代写代做 CS编程辅导

Integrality constraints



- General integer variables

Description : Decision that are represented using general discrete variables.

Examples : Production decisions expressed in number of lots (skus) ; Assignment decisions (employees → schedules) ; etc.

Email: tutorcs@163.com

- Binary variables

Description : Decision that are represented using discrete variables that can take one of two values, either 0 or 1.

QQ: 749389476
<https://tutorcs.com>

Examples : Decisions that represent choices ; Design decisions ; etc.

Integrality constraints

Definitions and importance

程序代写代做 CS编程辅导

Why are these decisions important ?

Example 1 : consider a



should call for 1 054.75 chairs to be produced.

2 rounding options :

- 1 054 chairs
- 1 055 chairs

WeChat: cstutorcs

Impact : the production of 1 extra chair has a relatively small marginal impact for the company.

Assignment Project Exam Help

Example 2 : consider a plan that would call for 14.33 houses to be built.

Email: tutorcs@163.com

2 rounding options :

- 14 houses
- 15 houses

QQ: 749389476

<https://tutorcs.com>

Impact : the construction of 1 extra house will have a much higher marginal impact for the developer.

Integrality constraints

Definitions and importance

程序代写代做 CS 编程辅导

Consider the following optimization problem

$$\max z = 100x_1 + 15x_2$$



Subject to

$$80x_1 + 40x_2 \leq 400 \quad (1)$$

$$15x_1 + 30x_2 \leq 200 \quad (2)$$

$$x_1, x_2 \geq 0 \quad (3)$$

$$x_1, x_2 \text{ integers} \quad (4)$$

Email: tutorcs@163.com

If the problem is solved by excluding the integrality requirements :

QQ: 749389476

$$x_1 = 2, 222, x_2 = 5, 555 \text{ et } z = 1055, 556$$

<https://tutorcs.com>

Simple solution method

- ① Find all the rounded solutions
- ② Identify the best integer solutions

Integrality constraints

Definitions and importance

程序代写代做 CS 编程辅导

Rounded solutions



- $(x_1 = 2, x_2 = 5) \Rightarrow$ Feasible and $z = 950$
- $(x_1 = 2, x_2 = 6) \Rightarrow$ Infeasible $15(2) + 30(6) = 210 \not\leq 200$
- $(x_1 = 3, x_2 = 5) \Rightarrow$ Infeasible $80(3) + 40(5) = 440 \not\leq 400$
- $(x_1 = 3, x_2 = 6) \Rightarrow$ Infeasible, constraints (3) and (4)

WeChat: cstutorcs

Only one solution is feasible. Assignment Project Exam Help

$x_1 = 2, x_2 = 5$ et $z = 950$

Email: tutorcs@163.com

However,

The optimal solution: QQ: 749389476

$x_1 = 1, x_2 = 6$ et $z = 1000$ <https://tutorcs.com>

Simple methods do not necessarily produce optimal solutions.

Also, the number of rounded solutions can grow rapidly.

Applications of integer linear programming

Revenue management

程序代写代做 CS 编程辅导

Description : A discipline that aims to understand customers' perception of products and accurately aligning product prices, placement and availability with each customer segment with the objective of maximizing revenues.

Examples :

WeChat: cstutorcs

- Airline industry
- Railway industry
- Hotels
- etc.

Assignment Project Exam Help

Email: tutorcs@163.com

QQ: 749389476

Question : How should the rates of products be set such as to maximize the revenues generated?

<https://tutorcs.com>

Specificities : pricing strategies vs. overbooking policies vs. managing supplies

Applications of integer linear programming

Revenue management

程序代写代做 CS编程辅导

Aircrafts:



Flight planning: WeChat: cstutorcs



FIGURE – General context - flight planning

Applications of integer linear programming

Revenue management

程序代写代做 CS编程辅导

Leisure Air : Fare type optimization



Context :

Ressources :

- Boeing 737-400 (132 seats E)
Currently in Pittsburgh
- Boeing 737-400 (132 seats E)
Current in Newark

WeChat: cstutorcs

Assignment Project Exam Help

Email: tutorcs@163.com

Operations :

- Leg no.1 : P → C,
- Leg no.2 : N → C,
- Leg no.3 : C → M,
- Leg no.4 : C → O.

QQ: 749389476

<https://tutorcs.com>

Illustration of the legs



Applications of integer linear programming

Revenue management

程序代写代做 CS编程辅导

Leisure Air

Context (cont'd) :

The companies propose to set fares for its economy class :



- discount-fare Q
- full-fare Y

WeChat: cstutorcs

Reservations using the discount-fare Q class must be made 14 days in advance and must include a Saturday night stay in the destination city.

Reservations using the full-fare Y class may be made anytime, with no penalty for changing the reservation at a later date.

Email: tutors@163.com

QQ: 749389476

The company is interested in planning the itineraries and tarifs that it should propose to its clientele. To determine the itineraries and fares, the company would like to know :

<https://tutorcs.com>

- How many seats should be assigned to each O-D itinerary and fare type ? ODIF \Rightarrow Origin-Destination-Itinerary Fare

Applications of integer linear programming

Revenue management

程序代写代做 CS编程辅导

Tickets, Prices and Predicted Demand



		Price	Demand
1	POQ	178\$	33
2	PCY	268\$	44
3	POQ	228\$	45
4	PCY	380\$	16
5	PMY	456\$	6
6	POY	560\$	11
7	NCQ	199\$	26
8	NMQ	249\$	56
9	NOQ	349\$	39
10	NCY	885\$	15
11	NMY	444\$	7
12	NOY	580\$	9
13	CMQ	179\$	64
14	CMY	380\$	8
15	COQ	224\$	46
16	COY	582\$	10

WeChat: cstutorcs

Assignment Project Exam Help

Email: tutors@163.com

QQ: 749389476

<https://tutores.com>

Applications of integer linear programming

Revenue management

程序代写代做 CS编程辅导

Optimization Model

Definitions

- P=Pittsburgh,
- N=Newark,
- C=Charlotte,
- O=Orlando,
- M=Myrtle Beach



WeChat: cstutorcs

Assignment Project Exam Help

Email: tutorcs@163.com

QQ: 749389476

<https://tutorcs.com>

NCQ = nb. of seats assigned to flight N-C for fare Q

⋮

COY = nb. of seats assigned to flight C-O for fare Y

Applications of integer linear programming

Revenue management

程序代写代做 CS编程辅导

Optimization Model (cont'd)

Objective Function

$$\max 178PCQ + 268PMQ -$$



$$380PCY + \dots + 224COQ + 582COY$$

Subject to

Aircraft capacity

4 Legs

WeChat: cstutorcs

$$P-C : PCQ + PMQ + POQ + PCY + PMY + POY \leq 132$$

$$N-C : NCQ + NMQ + NOQ + NCY + NMY + NOY \leq 132$$

$$C-M : PMQ + PMY + NMQ + NMY + CMQ + CMY \leq 132$$

$$C-O : POQ + POY + NOQ + NOY + COQ + COY \leq 132$$

Demands

$$PCQ \leq 33 \quad PMQ \leq 44 \quad POQ \leq 45 \quad PCY \leq 16 \quad PMY \leq 6 \quad POY \leq 11$$

$$NCQ \leq 26 \quad NMQ \leq 56 \quad NOQ \leq 39 \quad NCY \leq 15 \quad NMY \leq 7 \quad NOY \leq 9$$

$$CMQ \leq 64 \quad CMY \leq 8 \quad COQ \leq 46 \quad COY \leq 10$$

Non-negativity and integrality for all decision variables

Applications of integer linear programming

Schedule planning

程序代写代做 CS编程辅导

Call Center



- Operators daily shifts that last 9 hours
- Shifts can start at the beginning of every 3 hour period
- Minimum number of operators for each period :

Period	0-3	3-6	6-9	9-12	12-15	15-18	18-21	21-24
Need	6	4	12	20	20	24	14	14

- Salaries :
 - Base : 75\$ per shift of 9h
- Premiums
 - QQ: 749389476
 - 11 \$ for shifts starting at 0h, 3h ou 6h
 - 5 \$ for shifts starting at 18h ou 21h

Q : How many operators to hire to start at each of the periods ?

Applications of integer linear programming

Schedule planning

程序代写代做 CS编程辅导

Decision variables

- x_j = nb. of operators will begin their shifts at hour j , where $j = 0, 3, 6, 9, 12, 15, 18, 21$.



WeChat: cstutorcs



FIGURE – Graphical Representation

Applications of integer linear programming

Schedule planning

程序代写代做 CS编程辅导

Optimization Model



$$\min z = 86x_0 + 86x_3 + 86x_6 + 86x_9 + 75x_{12} + 75x_{15} + 80x_{18} + 80x_{21}$$

subject to

$$x_0 + x_{18} + x_{21} \geq 6$$

$$x_0 + x_3 + x_{21} \geq 4$$

$$x_0 + x_3 + x_6 \geq 12$$

$$x_3 + x_6 + x_9 \geq 20$$

$$x_6 + x_9 + x_{12} \geq 20$$

$$x_9 + x_{12} + x_{15} \geq 24$$

$$x_{12} + x_{15} + x_{18} \geq 14$$

$$x_{15} + x_{18} + x_{21} \geq 14$$

$$x_j \geq 0 \text{ and integer for } j = 0, 3, 6, 9, 12, 15, 18, 21.$$

WeChat: cstutorcs

Assignment Project Exam Help

Email: tutorcs@163.com

QQ: 749389476

<https://tutorcs.com>

Applications of integer linear programming

Schedule planning

程序代写代做 CS编程辅导

Call Center (cont'd)

Description : A company t
the number of operators to
of operations.



an after sales service for its clients needs to plan
over the demand over the period of a normal day

Minimum requirements for switchboard operators								
Period	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8
Need	6	5	4	4	3	3	4	12
Period	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16
Need	20	23	24	24	20	22	24	25
Period	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
Need	22	20	18	16	15	14	9	7

Email: tutorcs@163.com

Daily work shift \Rightarrow 8h. = 7h. of work and 1h. break (meal)

Beginning hour for shifts : 7 h., 8 h., 9 h., 15 h., 16 h., 23 h. and midnight Salaries

QQ: 749389476

- Base \Rightarrow 80\$
- Premiums \Rightarrow 5\$ (shift beginning at 23 h.) & 10\$ (shifts beginning at midnight)

Meals : the meal break can be taken either 3 or 4 hours after the beginning of the shift.
However, breaks can only be taken when the company's cafeteria is open.

Cafeteria's opening hours : from 11 h. to 14 h., from 17 h. to 20 h. and from 2 h. to 4 h.

Applications of integer linear programming

Schedule planning

程序代写代做 CS编程辅导

Optimization Model



Decision Variables

Beginning				Break + 4h.
7h.	Break scheduled at 11h. \Rightarrow Caf. closed		Caf. closed	Break scheduled at 11h. \Rightarrow Caf. opened
		Impossible		
8h.	Break scheduled at 11h. \Rightarrow Caf. opened	x_8	Break scheduled at 12h. \Rightarrow Caf. opened	y_7
9h.	Break scheduled at 12h. \Rightarrow Caf. opened		Break scheduled at 13h. \Rightarrow Caf. opened	y_8
:				:

WeChat: estutorcs

Assignment Project Exam Help

Email: tutorcs@163.com

Therefore,

Examples

QQ: 749389476

x_8 = nb. of operators that will begin their shifts at 8 h. and that will take a meal break between 11 h. and 12 h.

<https://tutorcs.com>

y_8 = nb. of operators that will begin their shifts at 8 h. and that will take a meal break between 12 h. and 13 h.

Applications of integer linear programming

Schedule planning

程序代写代做 CS编程辅导

General Representation



Salaire	90	80	80	80	85	85				
Variable	x_0	y_1	y_9	x_{15}	y_{15}	x_{16}	x_{23}	y_{23}	Min	Dom
0 h – 1 h	x						x	x	6	
1 h – 2 h	x						x	x	5	0 h – 1 h
2 h – 3 h	x						x		2	
3 h – 4 h							x		2	
4 h – 5 h	x						x	x	3	0 h – 1 h
5 h – 6 h	x						x	x	3	0 h – 1 h
6 h – 7 h	x						x	x	4	0 h – 1 h
7 h – 8 h	x						x	x		
8 h – 9 h	x	x	x						20	
9 h – 10 h	x	x	x	x	x				23	11 h – 12 h
10 h – 11 h									24	11 h – 12 h
11 h – 12 h			x	x	x				24	
12 h – 13 h	x	x		x					20	
13 h – 14 h	x	x	x	x	x				22	
14 h – 15 h	x	x	x	x	x	x			24	11 h – 12 h
15 h – 16 h	x	x	x	x	x	x			25	
16 h – 17 h		x	x	x	x	x	x		22	
17 h – 18 h		x	x	x	x	x	x		20	
18 h – 19 h		x	x	x	x	x	x		18	
19 h – 20 h			x	x	x	x	x	x	16	
20 h – 21 h			x	x	x	x	x	x	15	19 h – 20 h
21 h – 22 h			x	x	x	x	x	x	14	19 h – 20 h
22 h – 23 h			x	x	x	x	x	x	9	19 h – 20 h
23 h – 24 h			x	x	x	x	x	x	7	

WeChat: cstutorcs

Assignment Project Exam Help

Email: tutorcs@163.com

QQ: 749389476

<https://tutorcs.com>

Applications of integer linear programming

Schedule planning

程序代写代做 CS编程辅导

Optimization Model



Objective function

$$\min z = 90x_0 + 80(y_7 + x_7 + y_8 + x_8 + y_9 + x_9 + y_{15} + x_{15} + y_{16} + x_{16}) + 85(x_{23} + y_{23})$$

Subject to

$$x_0 + x_{23} + y_{23} \geq 6$$

$$x_0 + y_{23} \geq 2$$

$$x_{23} \geq 2$$

$$x_0 + y_7 \geq 12$$

$$y_7 + x_8 + y_8 \geq 20$$

:

$$x_{16} + x_{23} + y_{23} \geq 7$$

Non-negativity and integrality for all decision variables

WeChat: cstutorcs

Assignment Project Exam Help

Email: tutorcs@163.com

QQ: 749389476

<https://tutorcs.com>

Applications of integer linear programming

Location coverage planning

程序代写代做 CS编程辅导

Location Problems

Description : The long-range plan of the Ohio Trust Company bank is considering expanding its customer service



department for the Ohio Trust Company bank is a 20-county region in the northeastern Ohio.



FIGURE – Region considered for expansion

Applications of integer linear programming

Location coverage planning

程序代写代做 CS编程辅导

Description (cont'd)

Ohio Trust does not have its principal place of business (PPB) in any of the 20 counties.



According to the banking laws in Ohio, if a bank establishes a PPB in any county, branch banks can be established in that county and in any adjacent county.

WeChat: cstutorcs

Assignment Project Exam Help

However, to establish a new PPB, Ohio Trust must either obtain approval for a new bank from the state's superintendent of banks or purchase an existing bank.

Email: tutorcs@163.com

QQ:749389476

Question : Ohio Trust would like to determine the minimum number of PPBs necessary to do business throughout the 20-county region.

<https://tutors.com>

Applications of integer linear programming

Location coverage planning

程序代写代做 CS 编程辅导

Description (cont'd)



Adjacent Counties (by Number)

1. Lake	2, 12, 16
3. Cuyahoga	1, 3, 12
4. Lorain	2, 4, 9, 10, 12, 13
5. Huron	3, 5, 7, 9
6. Richland	4, 5, 6, 8, 9, 17, 18
7. Ashland	5, 7, 17
8. Wayne	7, 9, 10, 11, 18
9. Medina	7, 9, 10, 11, 18
10. Summit	3, 8, 9, 11, 12, 13
11. Stark	8, 10, 13, 14, 15, 18, 19, 20
12. Geauga	1, 2, 10, 13, 16
13. Portage	3, 10, 11, 12, 15, 16
14. Columbiana	11, 15, 20
15. Mahoning	11, 13, 14, 16
16. Trumbull	12, 13, 15
17. Knox	6, 7, 18
18. Holmes	7, 8, 11, 17, 19
19. Tuscarawas	11, 18, 20
20. Carroll	11, 14, 19

WeChat: cstutorcs

Assignment Project Exam Help

Email: tutorcs@163.com

QQ: 749389476

<https://tutorcs.com>

FIGURE – Counties and adjacent ones

Applications of integer linear programming

Location coverage planning

程序代写代做 CS编程辅导

Optimization Mode



Decision Variables



$x_i = 1$ if a PPB is established in county i ; 0 otherwise.

For $i = 1, \dots, 20$ WeChat: cstutorcs

Fonction objectif :

Assignment Project Exam Help

Minimize the number of PPBs that are necessary to achieve the necessary to cover the considered region

QQ: 749389476

$$\min x_1 + x_2 + \dots + x_{20}$$

<https://tutorcs.com>

Applications of integer linear programming

Location coverage planning

程序代写代做 CS编程辅导

Optimization Model



Subject to :

Ohio Trust must cover each county to be able to do business :

WeChat: cstutorcs

Ashtabula

$$x_1 + x_2 + x_{12} + x_{16} \geq 1$$

Lake

$$x_1 + x_2 + x_3 + x_{12} \geq 1$$

Cuyahoga

$$x_2 + x_3 + x_4 + x_9 + x_{10} + x_{12} + x_{13} \geq 1$$

:

Carroll

QQ: 749389476

$$x_{11} + x_{14} + x_{19} + x_{20} \geq 1$$

Integrality constraints : $x_i = 0$ or 1 , $i = 1, \dots, 20$

<https://tutorcs.com>

Applications of integer linear programming

Location coverage planning

程序代写代做 CS编程辅导



FIGURE – Optimal solution - 3 PPBs

Applications of integer linear programming

0-1 Formulations

程序代写代做 CS 编程辅导

Product Design and Market Share Optimization

General Context : [QR code] that can be used to learn how prospective buyers of a [QR code] valued the product's attributes.

Salem Foods

WeChat: cstutorcs

Company that is planning to enter the frozen pizza market. There are currently two existing brands, Antonio's and King's, that have the major share of the market.

Email: tutorcs@163.com

Four important attributes to define the product :

QQ: 749389476

- crust (thin and thick)
- cheese (mozzarella and blend)
- sauce (smooth and chunky)
- sausage (mild, medium and hot)

<https://tutorcs.com>

Applications of integer linear programming

0-1 Formulations

程序代写代做 CS编程辅导



Salem Foods (con)

The two competitors, which are currently in the market, propose the following products :

WeChat: cstutorcs

Description of the proposed pizzas

Assignment Project Exam Help

Types of pizza	Email: tutorcs@163.com	cheese	sauce	sausage
Antonio's	QQ: 749389476	thick	mozzarella	chunky
King's		thin	blend	medium smooth

<https://tutorcs.com>

Applications of integer linear programming

0-1 Formulations

程序代写代做 CS编程辅导

Salem Foods (cont'd)

Part-worths for the Salem

Consumer	crust		Tutor CS	sauce	sauce flavor				
	thin	thick			blend	smooth	chunky	mild	medium
1	11	2	13	7	3	17	26	27	8
2	11	7	13	17	16	26	14	1	10
3	7	5	8	14	16	7	29	16	19
4	13	20	20	17	17	14	25	29	10
5	2	8	6	11	30	20	15	5	12
6	12	17	11	9	2	30	22	12	20
7	9	19	12	10	16	25	30	23	19
8	5	9	4	14	23	16	16	30	3

8 potential consumers expressed their preference (utility) for specially prepared pizzas with chosen levels for the attributes. A regression analysis → part-worth for each of the attribute levels.

QQ: 749389476

Interpretation

		ideal pizza				
		thin crust 11	+ cheese blend + 7	+ sauce chunky + 17	+ sausage medium + 27	total utility = 62
pizza Antonio's						
consumer 1	⇒	crust thick 2	+ cheese mozzarella + 6	+ sauce chunky + 17	+ sausage medium + 27	total utility = 52
pizza King's						
consumer 1	⇒	crust thin 11	+ cheese blend + 7	+ sauce smooth + 3	+ sausage mild + 26	total utility = 47

Applications of integer linear programming

0-1 Formulations

程序代写代做 CS编程辅导

Salem Foods (con



General Objective



1. Salem is interested in designing a pizza which will please potential consumers such that the company will obtain a majority of the market.

WeChat: cstutorcs
Assignment Project Exam Help

2. In order to be profitable for Salem, the proposed pizza will have to generate a maximum utility for the largest number of potential consumers.

Email: tutorcs@163.com
QQ: 749389476

Hypothesis : the considered sample of potential consumers is representative of the market that is pursued.

Applications of integer linear programming

0-1 Formulations

程序代写代做 CS编程辅导

Optimization Model



Decision Variables



Product design :

$x_{ij} = 1$ if Salem chooses level i for attribute j ; 0 otherwise

Market share :

$y_k = 1$ if consumer k chooses the Salem brand, 0 otherwise

Objective Function

Email: tutorcs@163.com

The objective for the company is to carve out the highest possible market share.

<https://tutorcs.com>

$$\max y_1 + y_2 + \dots + y_8$$

Applications of integer linear programming

0-1 Formulations

程序代写代做 CS编程辅导



Optimization Model

Subject to

Product design

WeChat: cstutorcs

Assignment Project Exam Help

Attributes choice restrictions

crust $x_{11} + x_{21} = 1$

cheese $x_{12} + x_{22} = 1$

sauce $x_{13} + x_{23} = 1$

sausage flavor $x_{14} + x_{24} + x_{34} = 1$

Email: tutorcs@163.com
QQ: 749389476
<https://tutorcs.com>

Applications of integer linear programming

0-1 Formulations

程序代写代做 CS编程辅导

Optimization Model (cont'd)

Subject to (cont'd)

Defining the market share



Example for consumer 1 :

Total utility function for Salem's pizza :

$$11x_{11} + 2x_{21} + 6x_{12} + 7x_{22} + 3x_{13} + 17x_{23} + 26x_{14} + 27x_{24} + 8x_{34}$$

Joint analysis :

Assignment Project Exam Help

Types of pizza	Total utility
Ideal	62

Antonio's 52*

King's 47

To modify the present choice of consumer 1

<https://tutorcs.com>

$$11x_{11} + 2x_{21} + 6x_{12} + 7x_{22} + 3x_{13} + 17x_{23} + 26x_{14} + 27x_{24} + 8x_{34} > 52$$

Therefore,

$$11x_{11} + 2x_{21} + 6x_{12} + 7x_{22} + 3x_{13} + 17x_{23} + 26x_{14} + 27x_{24} + 8x_{34} \geq 1 + 52y_1$$

Applications of integer linear programming

0-1 Formulations

程序代写代做 CS编程辅导

Optimization Model



Subject to (cont'd)



Consumer	pizza	Constraint
1	Antonio's	$11x_{11} + 2x_{21} + 6x_{12} + 7x_{22} + 9x_{13} + 17x_{23} + 26x_{14} + 27x_{24} + 8x_{34} \geq 1 + 52y_1$
2	King's	$11x_{11} + 7x_{21} + 15x_{12} + 17x_{22} + 16x_{13} + 26x_{23} + 14x_{14} + 1x_{24} + 10x_{34} \geq 1 + 58y_2$
3	King's	$7x_{11} + 5x_{21} + 8x_{12} + 4x_{22} + 16x_{13} + 23x_{23} + 29x_{14} + 16x_{24} + 19x_{34} \geq 1 + 66y_3$
4	Antonio's	$13x_{11} + 20x_{21} + 20x_{12} + 17x_{22} + 17x_{13} + 14x_{23} + 25x_{14} + 29x_{24} + 10x_{34} \geq 1 + 83y_4$
5	King's	$2x_{11} + 8x_{21} + 6x_{12} + 11x_{22} + 30x_{13} + 20x_{23} + 15x_{14} + 5x_{24} + 12x_{34} \geq 1 + 58y_5$
6	Antonio's	$12x_{11} + 17x_{21} + 11x_{12} + 9x_{22} + 2x_{13} + 30x_{23} + 22x_{14} + 12x_{24} + 20x_{34} \geq 1 + 70y_6$
7	Antonio's	$9x_{11} + 19x_{21} + 12x_{12} + 16x_{22} + 16x_{13} + 25x_{23} + 30x_{14} + 23x_{24} + 19x_{34} \geq 1 + 79y_7$
8	Antonio's	$5x_{11} + 9x_{21} + 4x_{12} + 14x_{22} + 23x_{13} + 16x_{23} + 16x_{14} + 30x_{24} + 3x_{34} \geq 1 + 59y_8$

Integrality constraints <https://tutorcs.com>

$x_{ij} = 0$ or 1 , for all i and j

$y_k = 0$ or 1 , for $k = 1, \dots, 8$