Midterm Exam

Due Oct 13, 2021 at 11:59pm **Points** 100 **Questions** 21
Available Oct 12, 2021 at 11:59pm - Oct 13, 2021 at 11:59pm 1 day
Time Limit 90 Minutes

Instructions

Instructions:

- You will have 1 hour 15 minutes to complete the exam. Make sure you are ready to start before opening the exam. Once you open the exam, the timer starts and it cannot be stopped.
- Chrome browser is recommended. If you cannot see some of the images in the Exam, close it and try a different browser. If the problem persist, send a screenshot of the problem to the instructor ASAP.
- This is an open book, open handouts, open-class-notes exam. You may view and download any course material from the current Canvas website and notes you have taken during the term. You may **not** use any other material or software, besides a calculator, and Excel.
- The problems are not ordered by level of difficulty. Given that there are multiple questions, if you get stuck on one, move on and revisit the difficult question if time permits.
- Good Luck!

This quiz was locked Oct 13, 2021 at 11:59pm.

Attempt History

	Attempt	Time	Score
LATEST	Attempt 1	77 minutes	92 out of 100

ⓘ Correct answers are hidden.

Score for this quiz: **92** out of 100
Submitted Oct 13, 2021 at 12:51pm
This attempt took 77 minutes.

问题 1

22 / 30 pts

Terrapin University

Terrapin University's Herpetology Department is offering 3 courses this fall. They have 3 faculty members each of whom can teach any of the courses. Based on past student reviews, the department estimates the following teaching effectiveness for each faculty-course combination.

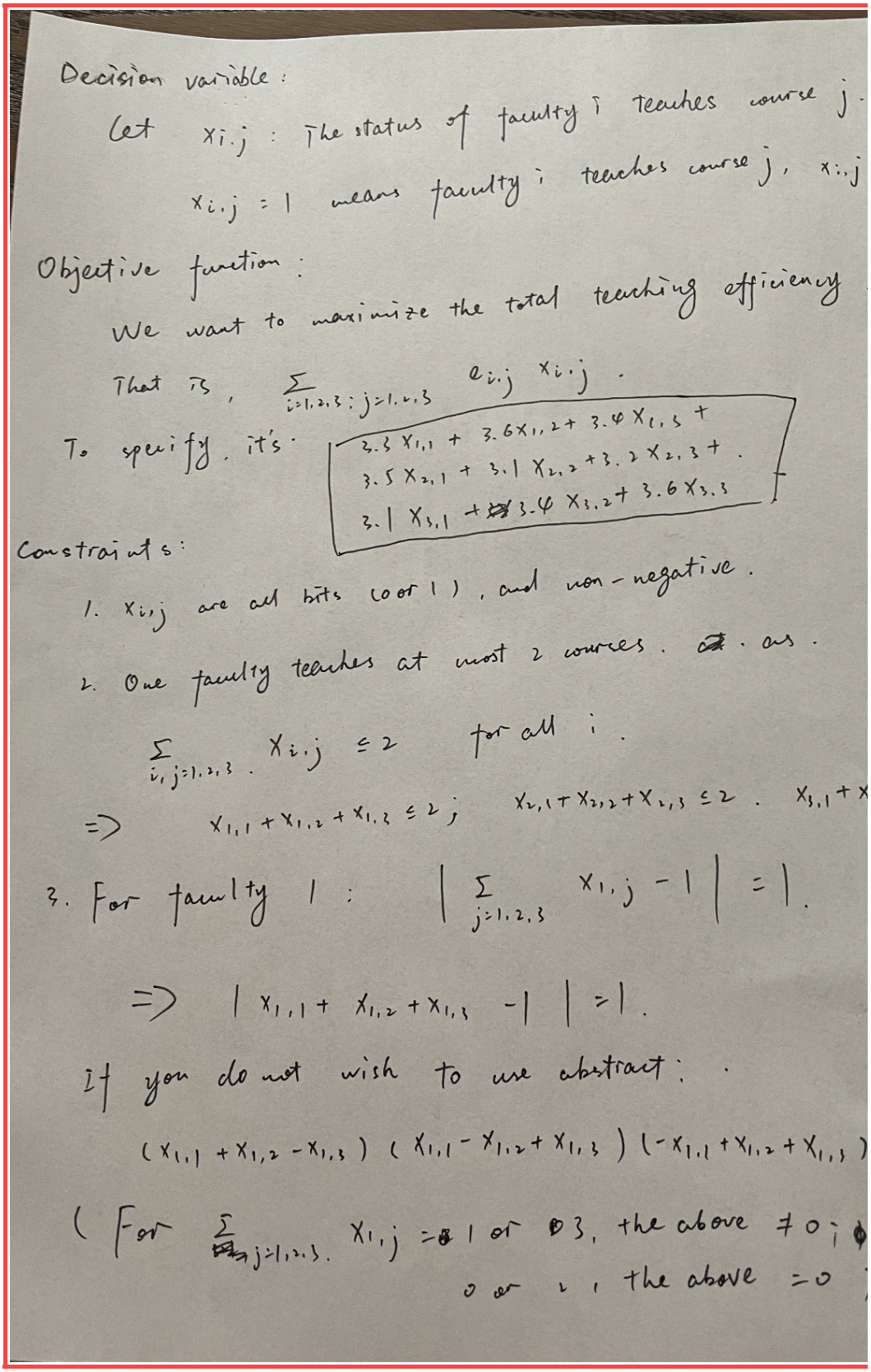
	Course 1	Course 2	Course 3
Faculty 1	3.3	3.6	3.4
Faculty 2	3.5	3.1	3.2
Faculty 3	3.1	3.4	3.6

The department needs to assign the three faculty members to the courses so as to maximize the overall teaching effectiveness. However, the department needs to ensure two key requirements:

- Department rules stipulate that a faculty member can teach at most 2 courses per semester. Some faculty members might not teach anything in the fall.
- Faculty 1 is willing to teach in the fall only if he gets assigned 2 courses.

Provide the linear programming formulation for this problem. Do not solve. Clearly define decision variables, objective function and constraints.

Your Answer:



Decision variable:

Let $x_{i,j}$: The status of faculty i teaches course j.

$x_{i,j} = 1$ means faculty i teaches course j, $x_{i,j}$

Objective function:

We want to maximize the total teaching efficiency.

That is, $\sum_{i=1,2,3;\ j=1,2,3} e_{i,j}\, x_{i,j}$.

To specify, it's:

$$3.3x_{1,1} + 3.6x_{1,2} + 3.4x_{1,3} + 3.5x_{2,1} + 3.1x_{2,2} + 3.2x_{2,3} + 3.1x_{3,1} + 3.4x_{3,2} + 3.6x_{3,3}$$

Constraints:

1. $x_{i,j}$ are all bits (0 or 1), and non-negative.

2. One faculty teaches at most 2 courses. as.

$$\sum_{i,j=1,2,3} x_{i,j} \le 2 \quad \text{for all } i.$$

$$\Rightarrow \quad x_{1,1} + x_{1,2} + x_{1,3} \le 2; \quad x_{2,1} + x_{2,2} + x_{2,3} \le 2. \quad x_{3,1} + x$$

3. For faulty 1: $\left| \sum_{j=1,2,3} x_{1,j} - 1 \right| = 1.$

$$\Rightarrow \quad |x_{1,1} + x_{1,2} + x_{1,3} - 1| = 1.$$

If you do not wish to use abstract:

$$(x_{1,1} + x_{1,2} - x_{1,3})(x_{1,1} - x_{1,2} + x_{1,3})(-x_{1,1} + x_{1,2} + x_{1,3})$$

(For $\sum_{j=1,2,3} x_{1,j}$ = 1 or 3, the above $\neq 0$;

0 or 2, the above $= 0$

Non-linear constraint - 2 You didn't specify the constraint that restricts one subject to be taught by only one professor - 6

问题 2

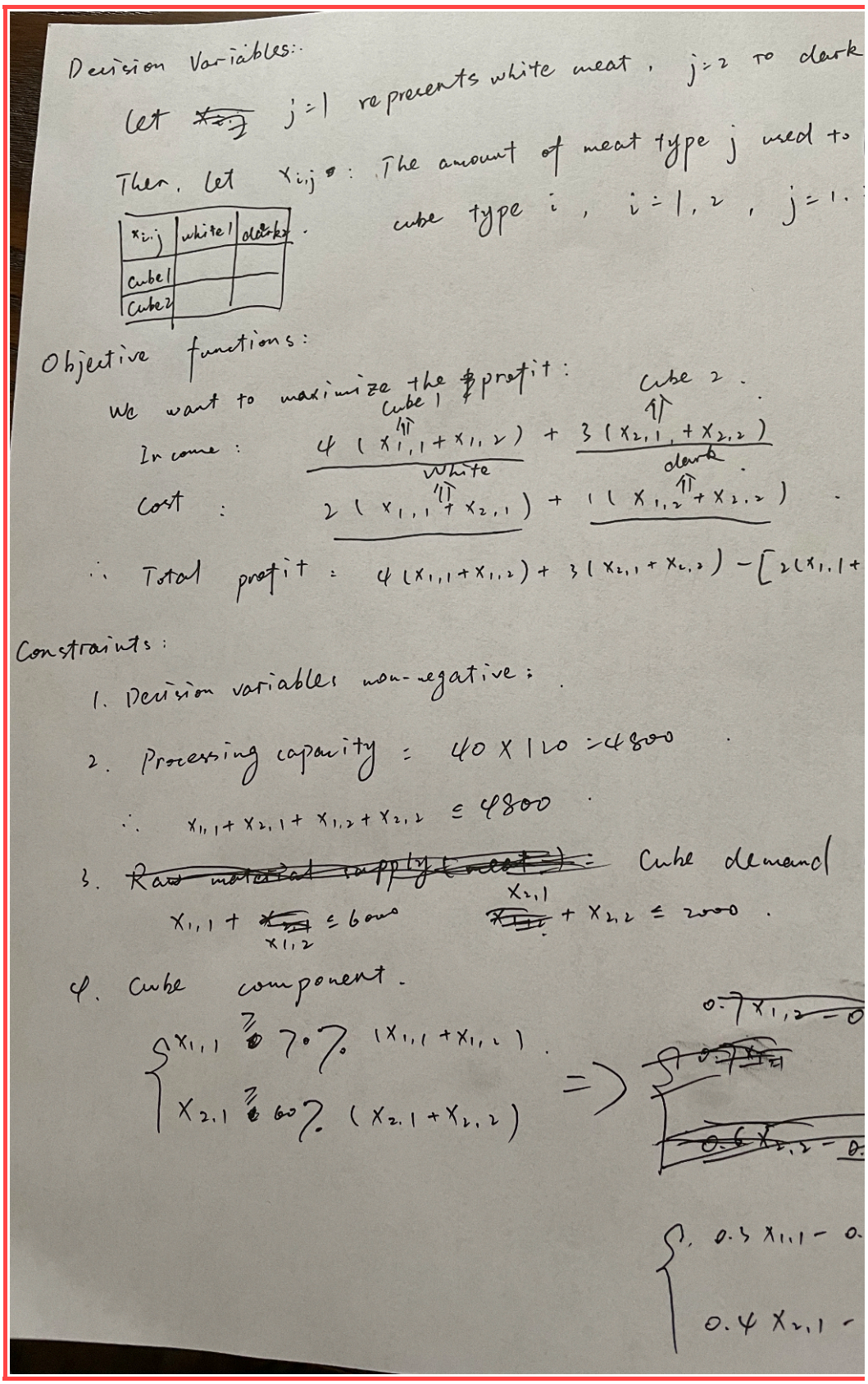
30 / 30 pts

Assateague Foods Company

Assateague Foods Company, produces two types of chicken cubes (or chunks). Each type of cube consists of white meat and dark meat. Cube 1 sells for $4 per pound and must consist of at least 70% white meat. Cube 2 sells for $3 per pound and must consist of at least 60% white meat. Each week, at most 6000 pounds of cube 1 and 2000 pounds of cube 2 can be sold. The company gets chicken meat from a local farm for $2 per pound of white meat and $1 per pound of dark meat. In addition, the company uses a processing machine to make the cubes that can process 120 pounds of chicken per hour (regardless if it is cube 1 or cube 2). The machine is available 40 hours a week.

Provide the linear programming formulation for this problem. Do not solve. Clearly define decision variables, objective function and constraints.

Your Answer:



Decision Variables:

Let ~~$x_{i,j}$~~ $j=1$ represents white meat, $j=2$ to dark

Then, let $x_{i,j}$: The amount of meat type j used to cube type i, $i=1,2$, $j=1$

$x_{i,j}$	white 1	dark 2
cube 1		
cube 2		

Objective functions:

We want to maximize the profit:

Income: $4(x_{1,1}+x_{1,2}) + 3(x_{2,1}+x_{2,2})$ (cube 1 ↑, white ↑; cube 2 ↑, dark ↑)

Cost: $2(x_{1,1}+x_{2,1}) + 1(x_{1,2}+x_{2,2})$

∴ Total profit: $4(x_{1,1}+x_{1,2}) + 3(x_{2,1}+x_{2,2}) - [2(x_{1,1}+$

Constraints:

1. Decision variables non-negative:
2. Processing capacity: $40 \times 120 = 4800$

$\therefore x_{1,1}+x_{2,1}+x_{1,2}+x_{2,2} \le 4800$

3. ~~Raw material supply (cost)~~ = Cube demand

$x_{1,1} + x_{1,2} \le 6000$ $\quad x_{2,1} + x_{2,2} \le 2000$

4. Cube component.

$$\begin{cases} x_{1,1} \ge 70\%\,(x_{1,1}+x_{1,2}) \\ x_{2,1} \ge 60\%\,(x_{2,1}+x_{2,2}) \end{cases} \Rightarrow$$

$0.7x_{1,2} = 0$

$0.6x_{2,2} - 0$

$0.3x_{1,1} - 0$

$0.4x_{2,1} -$

Try to make your answers a bit more legible next time. It took me a while to figure out 60% and 70 %

Animal Houses

Uncle Peter operates a small business: he produces three types of houses to sell to people wanting to get back to nature. Based on your discussion with your uncle you construct the following table based on your understanding of his weekly availability of labor.

Item	Profit	Fabrication	Assembly	Painting	Crating
Birdhouse	$15	1	2.5	1	0.25
Doghouse	$35	1.25	1.5	0.5	0.5
Outhouse	$58	1.75	4	2	0.75
Capacity		30 hours	50 hours	20 hours	20 hours

Based on the information in the table, you formulate the problem as a linear program. The labor needed for fabrication, assembly, painting, and crating is all dedicated solely to each function, i.e., none of the workers have been cross-trained. The Excel sensitivity report is shown below.

Sensitivity Report

Variable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase
C4	Birdhouse	0.00	-17.15	15.00	17.15
D4	Doghouse	15.38	0.00	35.00	6.43
E4	Outhouse	6.15	0.00	58.00	82.00

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase
F5	Fabricate	30.00	25.23	30	3.75
F6	Assemble	47.69	0.00	50	1E+30
F7	Paint	20.00	6.92	20	1.58
F8	Crate	12.31	0.00	20	1E+30

问题 3

3 / 3 pts

The optimal production quantities for each product are (round to two decimals):

Birdhouses: 0.00

Doghouses: 15.38

Outhouses: 6.15

Answer 1:

0.00

Answer 2:

15.38

Answer 3:

6.15

问题 4

5 / 5 pts

The maximum weekly profit that Uncle Peter can make is $ 895.00 (round to two decimals.)

Answer 1:

895.00

问题 5

4 / 4 pts

Which additional resources would you recommend that Uncle Peter try to obtain to increase his weekly profit? (Mark all that correspond)

- [ ] crate
- [x] paint
- [ ] assembly
- [x] fabrication

问题 6

6 / 6 pts

Some teens in the neighborhood have started to make and sell their own doghouses. To stay competitive Uncle Peter is considering lowering the price of his doghouse, which would reduce the profit per doghouse from $35 to $25. If he does, what would be the effect on his bottom line (total profit)? and production quantities?

Your Answer:

Solution:

Since the allowable decrease for doghouse is $20.50, which is greater than (35-25)$=10$, the production quantities (optimal solution) would not be affected.

However, the total profit do change, with a decrease of 15.38(35-25)=$153.8, and the new total profit would change to $741.2

问题 7

4 / 4 pts

Suppose Uncle Peter is required by contract with the American Birding Association to make at least one birdhouse each week. How would this affect his profits?

Your Answer:

Solution:

The reduced cost for birdhouse is -17.15, meaning that the total profit would decrease 17.15 in order the make one unit of the birdhouse. Therefore, this would affect his profit to decrease for 17.15.

问题 8

4 / 4 pts

Uncle Peter feels that his prices are too low, particularly for his birdhouses. How much would he have to charge for his birdhouses before it is profitable for him to make and sell them?

- 47.15
- 17.15
- 15
- 32.15

问题 9

4 / 4 pts

Your sister is willing to help your uncle with painting after school for one hour, three times a week. She wants to get paid $15 per hour of work. What is your recommendation for Uncle Peter?

- Hire her for fabrication.
- Don't hire her.
- Cannot make a recommendation
- Hire her.

问题 10

1 / 1 pts

What happens to the optimal solution (decision variables) when one of the coefficients in the objective function increases within the allowable increase?

The values in the optimal solution decrease.

Some values in the optimal solution increase and others decrease.

The values in the optimal solution increase.

The values in the optimal solution do not change.

问题 11

1 / 1 pts

If the objective function is parallel to a constraint, the constraint is infeasible.

True

False

问题 12

1 / 1 pts

The feasible region of an ILP is (mark all that correspond)

a set of disconnected points

a polygon

convex

- continuous

问题 13

1 / 1 pts

In a 0-1 integer programming model, if the constraint $x1 - x2 = 0$, it means when project 1 is selected, project 2 _____ be selected.

- can also
- can never
- must also
- can sometimes

问题 14

1 / 1 pts

In a mixed integer model, some solution values for decision variables are integer and others can be non-integer.

- True
- False

问题 15

1 / 1 pts

Which of the following are assumptions or requirements of the transportation problem?

- There must be multiple destinations.
- Goods are the same, regardless of source.
- There must be multiple sources.
- There must be multiple routes between each source and destination.

问题 16

1 / 1 pts

For most real-world applications, an unbalanced transportation model is a more likely occurrence than a balanced transportation model.

- True
- False

问题 17

1 / 1 pts

In an assignment problem all supply and demand values are equal to one.

- True

False

问题 18

1 / 1 pts

A plant has four jobs to be assigned to four machines, and each machine has different manufacturing times for each product. The production manager wants to determine the optimal assignments of four jobs to four machines to minimize total manufacturing time. This problem can be most efficiently solved using the _____ model.

transporation

transshipment

assignment

shortest path

问题 19

1 / 1 pts

What of the following situations does not require the LP problem to be revised?

Multiple optimal solutions

Non-linear constraints

LP infeasibility

LP unboundedness

nanswered

问题 20

0 / 0 pts

Optional: Upload here any additional work. Make sure that the work is labeled and clear. Also leave a note in the corresponding question (if possible) about the work attached.

问题 21

0 / 0 pts

I pledge in my honor that I have not received or provided any unauthorized assistance on this exam.

Failure to comply will result in a grade of XF in the course.

- (•) True
- ( ) False

Quiz Score: **92** out of 100