



THEME: PATTERNS AND ALGEBRA

TOPIC: LINEAR PROGRAMMING

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Reflection



- Imagine you have 10 hours this weekend, and you want to split your time between studying for an important exam and helping a friend with a project. Studying improves your grade, while helping your friend builds your relationship. However, you can't spend more than 10 hours total, and you want to achieve the best balance between both activities.
- How would you decide how many hours to allocate to each task to get the best outcome?

Competency

- The learner understands and uses linear programming to solve problems.

LEARNING OUTCOMES

- By the end of this lesson you should be able to
 - form linear inequalities based on real life situations

Search for the Key words

V N K Y Q Y C M A Y J E N O K R C T A D
R A S L A T C X V K V D P O P M Z F E S
D L R R O A N G U I X T C W H Q D I K V
C A X I L P B B T I I N N W I T W G J K
R F K S A J M C N M W M R A J C Y F Z A
C J L H R B E Q U S X S Q U G O X H C A
G G T A Z J L M G E M J W Y H N V R W O
B K S R B U Y E N U H V G N G S K R W K
W N G O S H H U T O X L G M R T H L Q N
K T S L L N B D E T D L A K B R R H I O
L V C E F J L N O I T U L O S A E E M R
L T N X P R J N Z M L G H R Z I E E M N
V A E A H P Z O J O C H W E U N U B D U
F G F L L L V I W Z A A Q H H T C F Z Q
Q X L N B B E G O K Y B E W L E W G I F
K F O B J I X E M N R S V K L A O N T P
N C X E C A S R U M V O W X B E S F V U
U I E K L X B A S H Z I Y T N F C A Q Z
B J C Q J Q S D E F U N C T I O N X T H
Z J Q G Q O O Q O F A R N I D F G M P D

V N K Y Q Y C M A Y J E N O K R C T A D
R A S L A T C X V K V D P O P M Z F E S
D L R R O A N G U I X T C W H Q D I K V
C A X I L P B B T I I N N W I T W G J K
R F K S A J M C N M W M R A J C Y F Z A
C J L H R B E Q U S X S Q U G O X H C A
G G T A Z J L M G E M J W Y H N V R W O
B K S R B U Y E N U H V G N G S K R W K
W N G O S H H U T O X L G M R T H L Q N
K T S L L N B D E T D L A K B R R H I O
L V C E F J L N O I T U L O S A E E M R
L T N X P R J N Z M L G H R Z I E E M N
V A E A H P Z O J O C H W E U N U B D U
F G F L L L V I W Z A A Q H H T C F Z Q
Q X L N B B E G O K Y B E W L E W G I F
K F O B J I X E M N R S V K L A O N T P
N C X E C A S R U M V O W X B E S F V U
U I E K L X B A S H Z I Y T N F C A Q Z
B J C Q J Q S D E F U N C T I O N X T H
Z J Q G Q O O Q O F A R N I D F G M P D

KEY WORDS

- Feasible region
- Objective function/Linear function
- Variable
- Constraint
- Optimum solution
- Decision variable
- Maximization
- Minimization

A school has prepared to take students on a tour and has two transport options to choose from. Which mode of transport would you recommend, and why?



Scenario



Mrs. Nicole is preparing for the new school term and wants to ensure her son Frank has everything he needs. She has a total of UGX 100,000 to cover both snacks and pocket money for him. Each snack pack costs UGX 10,000, and Mrs. Nicole wants to provide at most 6 snack packs.

However, Mrs. Nicole believes pocket money is more essential for Frank than snacks. She plans to allocate more money for pocket money than she spends on snacks. With this in mind, she aims to balance her spending while staying within her budget and ensuring Frank is well-provided for.

Can you help Mrs. Nicole decide how many snack packs to buy and how much pocket money to give Frank?

Tasks

- What two things will determine how Mrs. Nicole will spend the money?
- What conditions is Mrs. Nicole working on?
- If Mrs. Nicole buys 4 snacks ,how much pocket money will Frank receive .
- What formula have you used to find the pocket money to be given to frank
- What is the end aim of Mrs. Nicole?



car



bicycle



van



plane



LP APPLICATIONS

1. **Engineering:** Optimizes design and manufacturing processes, including shape optimization for better material use and performance.
2. **Efficient Manufacturing:** Maximizes profits by optimizing production schedules, resource allocation, and minimizing waste.
3. **Energy Industry:** Optimizes electric power systems for cost savings and efficiency, especially in managing renewable energy sources.
4. **Transportation Optimization:** Enhances cost and time efficiency by optimizing routes, scheduling, and fleet management.
5. **Supply Chain Management:** Helps in inventory control, warehouse optimization, and transportation logistics to minimize costs and meet demand efficiently.
6. **Agriculture:** Optimizes resource allocation for crop planting, irrigation, and harvesting to maximize yield and minimize costs.
7. **Finance and Investment:** Used for portfolio optimization, risk management, and maximizing returns on investment by determining the best asset allocation.
8. **Telecommunications:** Optimizes the allocation of bandwidth, minimizing network congestion and improving service delivery.
9. **Healthcare:** Optimizes the allocation of medical resources, such as beds, staff, and equipment, to improve patient care and minimize costs.
10. **Marketing:** Helps companies optimize advertising budgets, customer targeting, and product placement to maximize profits.
11. **Menu Planning:** Optimizes food costs, balances variety and nutrition, maximizes customer satisfaction, and minimizes food waste in the food service and hospitality industries.

Linear programming

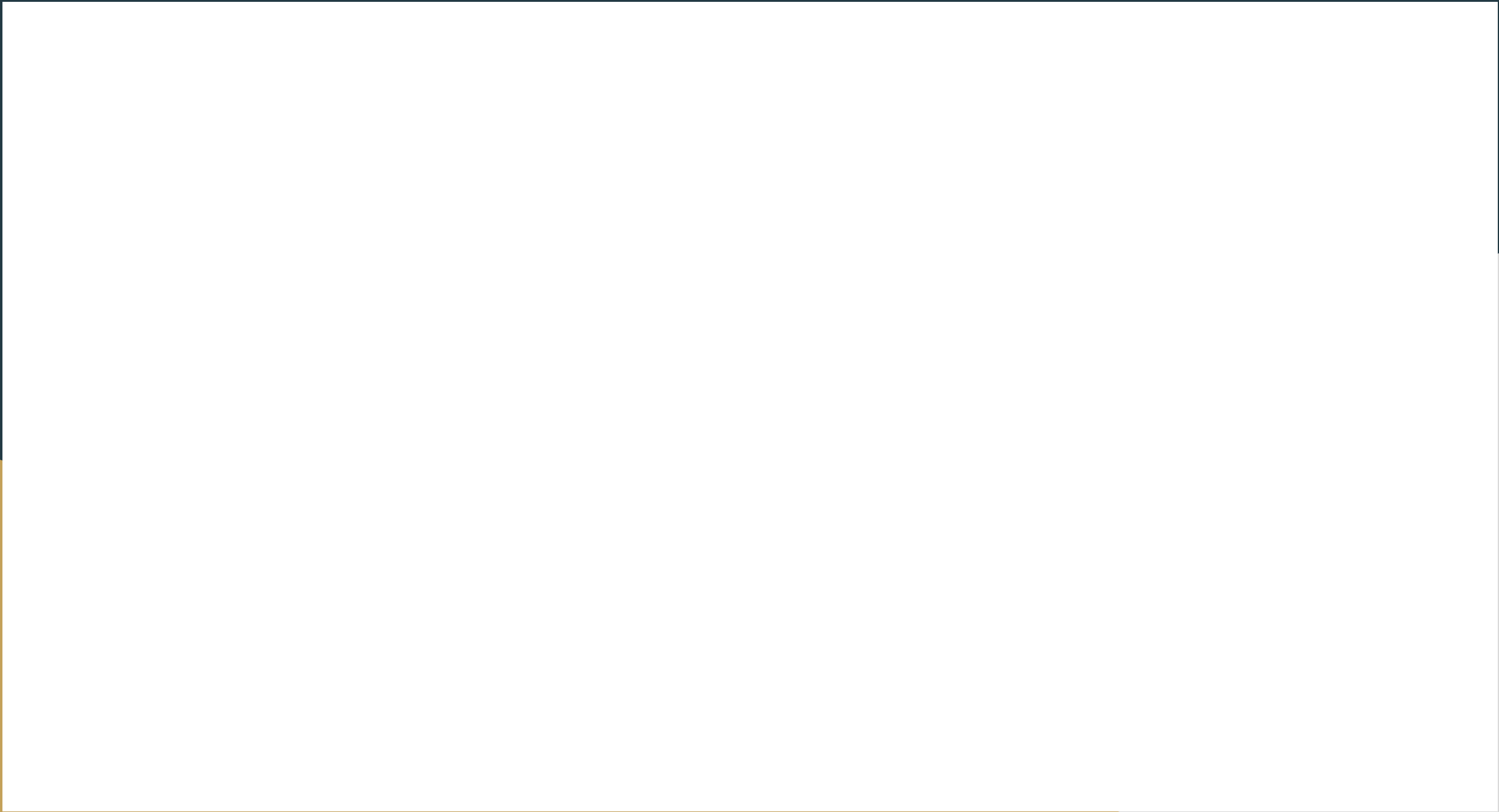
- Linear programming is a mathematical method used to determine the best or optimal solution to a problem that involves making decisions about how to allocate limited resources effectively to achieve a specific goal or set of objectives.
- **Linear programming (LP)** or **Linear Optimisation** may be defined as the problem of maximizing or minimizing a linear function that is subjected to linear constraints.

Components of Linear Programming

- The basic components of the LP are as follows:
- Decision Variables
- Constraints
- Data
- Objective Functions

Symbols used for Specific inequality phrases

<	>	≥	≤
<ul style="list-style-type: none">• Less than• Fewer than• Lower than• Smaller than• Shorter than• Below	<ul style="list-style-type: none">• Greater than• More than• Exceeds• Larger than• Longer than• Above	<ul style="list-style-type: none">• Greater than or equal to• At least• Minimum• Not less than• Not fewer than• Not below• Not smaller than	<ul style="list-style-type: none">• Less than or equal to• At most• Maximum• Not more than• Not greater than• Does not exceed• Not above



Steps of approaching the LPI

- Define the variables to be used i.e x and y
- Form the inequalities satisfying the given conditions including the non negativity constraints
- Formulate the objective function i.e $f(x,y) = ax + by$



ACTIVITY

Forming Linear inequalities Based
on Real life situations



Activity 1

Mr. Opio is a farmer who grows both maize and beans on his farm. He has limited resources and must adhere to certain planting restrictions for optimal crop rotation and yield. The following conditions govern how many fields of maize and beans he can plant:

1. He must plant at least two fields of maize (corn) to meet market demand for maize.
2. He must plant at least two fields of beans to ensure a balanced crop yield for food security.
3. The total number of fields used for maize and beans must not exceed 10 fields in total, as he has limited land space.
4. He must ensure that no more than 6 fields are planted with maize to avoid overuse of soil for that crop.
5. He wants to maximize the overall crop yield from maize and beans, considering the market value of each crop. The value per field of maize is UGX 200,000, while the value per field of beans is UGX 150,000.



Activity 2

A local restaurant is planning its menu for the week. They offer two types of dishes: **vegetarian** and **non-vegetarian**. The restaurant wants to optimize its menu offerings while adhering to certain budget and nutritional requirements.

The following restrictions govern the planning:

- The restaurant must offer **at least 5 vegetarian dishes** to cater to vegetarian customers.
- The total number of dishes (vegetarian and non-vegetarian) should not exceed **15 dishes** in total.
- The budget for purchasing ingredients for the dishes is UGX **2,000,000**.
- Each vegetarian dish costs UGX **100,000** to prepare, while each non-vegetarian dish costs UGX **150,000**.
- The restaurant wants to maximize the nutritional value of the menu. Each vegetarian dish provides 8 nutrition units, and each non-vegetarian dish provides 10 nutrition units.

Activity 3

A furniture company has Shs 120,000 to invest in making tables and chairs. It costs Shs 20,000 to make each table and Shs 12,000 to make each chair. The company has a storage space of at least 8 items altogether. Each table yields a profit of Shs 80,000 and each chair a profit of Shs 45,000.

Find how many tables and chairs should be made so as to maximize profit and calculate this maximum profit

Activity 4

A school is preparing a trip for 400 students. The company who is providing the transportation has 10 buses of 50 seats each and 8 buses of 40 seats, but only has 9 drivers available. The rental cost for a large bus is UGX 800,000 and for a small bus UGX 600,000. Calculate how many buses of each type should be used for the trip for the least possible cost.

Activity 5

A company manufactures two products: **Product A** and **Product B**. The company wants to maximize its profit, but there are several constraints related to the production process. Each product requires different amounts of raw materials, labor, and machine hours.

- **Product A** requires:
 - 2 kg of raw material per unit.
 - 3 hours of labor per unit.
 - 1 machine hour per unit.
 - It sells for UGX 50,000 per unit.
- **Product B** requires:
 - 3 kg of raw material per unit.
 - 4 hours of labor per unit.
 - 2 machine hours per unit.
 - It sells for UGX 70,000 per unit.
- The company has the following resources available:
- **Raw materials:** 500 kg.
- **Labor:** 600 hours.
- **Machine hours:** 300 hours.
- The company aims to maximize its total profit, considering the constraints on available resources.

Exercise

A school has organized a Geography study tour for 90 students. Two types of vehicles are needed; taxis and costa buses. The maximum capacity of the taxis is 15 passengers while that of the costa bus is 30 passengers. The number of taxis will be greater than the number of costa buses. The number of taxis will be less than five. The cost of hiring a taxi is Shs60,000 while that of the costa is Shs 100,000. There is only Shs 600,000 available.

Write mathematical statements that show the relation between the number of taxis and the number of costa buses

Ex 2

You have friends who rear cows and goats. During the festive season, they want to sell at most 10 of their cows and at least 8 of their goats. They also want to ensure that the number of goats they sell are less than twice the number of cows. They also do not want to sell more than 20 animals all together. They wish to maximise sales by selling each goat at Shs200,000/= and each cow at Shs1.5 millions but they do not know the number of goats and cows to sell to fulfil their wish.

- **Task:**

(a) write mathematical statements that show the relation between the cows and goats.

