

okay friends today lecture five
on linear programming problem

so let us discuss some problem in order to supplement daily diet a person wishes to take x and y tablets the contents of iron calcium and beta means in x and y are given as below we have two types of tablets tablet x y the iron content in x is six calcium content three vitamin content two and in tablets y iron

content is 2 calcium 3 and vitamin four the person needs to supplement at least 18 mg

of iron 21 mg of calcium and 16 mg of beta means the price of each tablet of x and y is rupees

2 and rupees 1 respectively how many tablets of each type should the person take in order to

satisfy the above requirements at the minimum cost make an lpp and solve it graphically so

different information is given this problem and first of all we have to formulate this problem

as lpp and then we try to solve it graphically solution let the number of tablets x and the number of tablet equal to y let that be the minimum cost

so z equal to two x plus y we have to minimize it subject to the constants the constants is the iron contents in x and y six and two and the person needs to supplement at least eighteen mg of the iron

so first constants is $6x + 2y$ is greater than equal to 18.

that is three x plus y is greater than equal to nine this is iron constants now in tablet x and y the calcium is 3 and 3 units and person needs to supplement at

least twenty one mg of calcium

so three x plus three y is greater than equal to 21 that is x plus y is greater than equal to 7

this is calcium constants again in tablet x and y beta means is two and four and according to question

the person needs to supplement at least 16 mg of vitamins

so $2x + 4y$ is greater than equal to sixteen that is x plus two y is greater than

equal to eight and the number of tablet and number of tablet x and number of tablet y is never negative

so x greater than equal

to zero and y greater than equal to zero

so the formulation of this problem is like this we have to minimize the objective function z equal to two x plus y subject to three x plus y greater than equal to nine this is iron constants and x plus y greater than equal to

seven this is calcium constants and x plus two y greater than equal to eight is determine constants first of all we should take the different

linear constants

so linear constants three x plus y greater than equal to nine x plus y greater than equal to seven x plus two y greater than equal to eight associated equation equation say this is 1 this is second and this is third associated equation 4

first second and third are three x plus y equal to nine we

can write it as in the form of intercept form that is x by

three plus y by nine equal to one x plus y equal to 7 this is x by 7 plus y by 7 equal to 1 and x plus two y equal to eight this can be written as x by eight

plus y by four equal to one now draw the graph of these three lines

so intercept of equation first is

x intercept 3 and y intercept 9

so x intercept 3 and y intercept 9.

for second x intercept seven and y intercept seven and fourth third equation x intercept

is eight and y intercept is four says y greater than equal to zero and this is x greater than equal to zero now the inequality of linear constants is greater than equal to greater than equal to greater than equal to

so we just check the origin test horizon just four first three into $0 + 0$ equal to 0 is

greater than equal to 9 is false

so for first constant three x plus y equal to nine the half plane does not include origin and this is x plus two y equal to eight

so solution reason of one does not include origin origin test for second zero plus zero equal to zero is greater

than equal to seven is again false

so solution reason of second does not include origin similarly for origin test four third zero plus two into zero equal to zero is greater than equal to eight is again false

so again origin does not include insolution region it means

so solution reason for these three constants is open feasible reason

so its fair graph is like this

so here we have open region a b c d and the corner points of this open region is a $8 \ 0$ b $6 \ 1$ c $1 \ 6$ and d $0 \ 9$ now let us find the value of objective function at different corner points corner points are a eight zero b six one c one six and d zero nine

so value of z at corner points value of z at a is equal to two into eight plus zero equal to sixteen the value of z at b two into six plus one equal to thirteen value of z rc two into one plus six equal to eight and value of z at d equal to 2 into 0 plus 9 equal to 9.

so

z c the value of z rc is minimum since reason is open feasible reason

so we have to check z less than 8 that is $2x + y < 8$ we have to check the half plane $2x + y < 8$ having any point common with the will

often possible with feasible reason or not

so draw this line we will get this

half plane two x plus y less than eight which have no any common points with the op and feasible reason

so we can say since half plane two x plus y less than eight have no any common point with the open feasible reason

so z c equal to eight will be the minimum value of z at c one six

so number of tablet x equal to one and number of tablet y equal to six

so in this way we can use the concept of linear

programming problem in pharmaceutical company also now let us take another problem this is diet

problem of linear programming a dietician has to develop a special diet using two foods p and q

each packet of food p contains 12 unit of calcium 4 unit of iron 6 unit of cholesterol and 6 units of vitamin a each packet of food q contains three unit of

calcium 20 units of iron four units of cholesterol and three units of vitamin a the diet

requires at least 240 units of calcium at least 460 units of iron and at most 300 units

of cholesterol how many packet of each food should be used to minimize the amount of vitamin

a what is the minimum amount of vitamin a

so first let us formulate the problem let the number of food packet p equal to x and the number of food packet q equal to y

so we have two type of packet that is p and q and its numbers the x and y calcium twelve and three iron contents four twenty cholesterol six four and vitamin a 6 3

so according to cos question the diet requires at least 240 unit of calcium it means $12x$ plus three y is greater

than equal to two forty again at least four sixty units of iron

so $4x$ plus twenty y is greater than equal to four sixty and four cholesterol at most

three hundred units of cholesterol

so $6x$ plus four y at most means less than equal to three hundred units and we have to find how many packets of each food should be used

to minimize the amount of vitamin a it means the objective function is $6x$ plus three y and ah food packet p the number of packets is never negative

formulation of this problem is like this this is calcium constants and this is iron constants and this is cholesterol constants and this x greater than equal to zero y

greater than equal to zero is obviously non negative constants

so after formulation of problem

let us find its feasible reason

so linear constants constants are $4x$ plus y greater than equal to a t says is first x plus five y greater than equal to one one five second $3x$ plus two i less than equal to one fifty third associated equation for first second and third are $4x$ plus y equal to eight

so this implies we can write it as

in intercept form as x by 2 plus y by 8 equal to 1 x plus phi y equal to say 80 $4x$ plus y equal to 80 .

so

x by twenty and y by t equal to one x plus five y equal to one one five this implies x by one one five plus y by twenty three equal to one $3x$ plus 2 i equal to 150 this implies x by fifty plus y by seventy five equal to one now draw the graph of these three lines

so for first equation x intercept is 20 and y intercept is 80.

so 20 80.

and for second equation x intercept is one one five and y intercept is twenty three

so 1 1 0 1 1 20 one twenty

so one one five means this twenty three

so here we somehow get 23

so join these two points x plus y equal to one one five x plus five y equal to one one five this is $4x$ plus y equal to eighty and third equation is

x by fifty plus y by seventy five equal to one

so x intercept is fifty and y intercept is seventy five

so this is seventy five say $3x$ plus two i equal to one fifty origin test

for first four into zero plus zero equal to zero
 is greater than equal to eighty is false
 so origin does not include in the reason
 so half plane will be the solution region for
 first four $x + y$ greater than equal to eighty in the region origin test four
 second zero plus five into zero equal to zero greater
 than equal to one one five is again false
 so origin does not include in the solution region
 so this half plane will be the solution region orion does not include in the
 reason origin test four third three into zero plus two into zero equal to zero
 is less than equal to one fifty this is true it means origin includes in the
 solution region and its sphere graph is here
 so feasible
 reason is bonded and convex reason abc
 so feasible reason a b c is bonded and convex
 so corner points are a fifteen twenty b forty fifteen and c two seventy two a
 fifteen twenty b forty fifteen
 and c two seventy two now find the value of objective function z equal to six x
 plus three
 y at different corner points
 so value of z at corner points z at a equal to six into fifteen plus three into
 twenty z equal to six x plus three y
 so z at a
 equal to six into fifteen plus three into twenty 90 plus 60 equal to 150 z at b
 6 into 40 plus 3 into 15 240 plus five equal to two eighty five and z rc 6 into
 2 plus 3 into 72 equal to 6 plus two one six twelve six into two twelve
 plus two one six equal to two two eight
 so z rc equal to six into two plus
 three into seventy two equal to twelve plus two one six equal to two two eight
 so we have to
 find the minimum value of z
 so minimum value of z is 150 at a since region is bonded
 so minimum value of z exist at a fifteen twenty that is z minimum equal to 150
 when fifteen packets of food queue and 20 packets of food p 15 packets of food
 p and 20 packets of food q
 so in this way we can use the concept of lpp
 in diet problem
 so let us discuss some problem use of lpp in agriculture
 so there
 are two types of fertilizers a and b a consists of 12 percent of nitrogen and
 5
 percent of phosphoric acids whereas b consists of 4 percent nitrogen and 5
 percent phosphoric
 acid after testing the soil conditions farmer finds that he needs at least 12
 kg of nitrogen
 and 12 kg of phosphoric acid for his crops if a costs rupees 10 per kg and b
 cost rupee rupees
 8 per kg then graphically determine how much of each type of fertilizer should
 be used
 so that
 nutrient requirements are met at a minimum cost let fertilizer of type a used
 equal to x kg and fertilizer of type b used equal to y k g now
 formulate this problem as lpp
 so type of fertilizer type a and b quantity used x kg and y kg nitrogen

contains 12 percent means 12 by 100 in fertilizer a and in fertilizer b nitrogen four percent four by hundred phosphoric acid five percent in fertilizer a means five by hundred and five percent in fertilizer b so five by hundred and cost of fertilizer per kg so fertilizer a cost rupees 10 per kg and fertilizer b cost rupees 8 per kg in problem given farmer finds that he needs at least 12 kg of nitrogen at least 12 kg of nitrogen it means twelve by hundred plus four by hundred is greater than equal to twelve $12x$ by 100 and $4y$ by 100 is greater than equal to 12 and for phosphoric acid at least 12 kg of phosphoric acid and $5x$ by hundred plus $5y$ by hundred is greater than equal to five x by hundred and $5y$ by hundred is greater than equal to twelve and we have to minimize the cost if a cost rupees ten per kg and b cost rupees eight per kg then graphically determine how much of each type of fertilizer should be used so that nutrients requirement are met at minimum cost so we have to minimize the cost it means $10x + 8y$ and the amount of fertilizer is never negative so finally we formulate this problem like this so formulation of this problem we have to minimize the total cost that is z equal to $10x + 8y$ subject to constants $12x + 4y$ by hundred is greater than equal to 12 that is $3x + y$ is greater than equal to 300 $5x + 5y$ by hundred is greater than equal to 12 that is $x + y$ is greater than equal to 240 and x greater than equal to 0 and y greater than equal to 0.

so linear constants constants are $3x + y$ is greater than equal to 300 say this is first and $x + y$ is greater than equal to 240 say this is second associated equation $4x + 3y$ is equal to 300 and $3x + y$ is equal to 240 this implies $x + y$ by 300 equal to 1 and $x + y$ equal to 240 this implies $x + y$ by 240 plus y by 240 equal to one now draw the graph of these two lines so x intercept is one hundred and y intercept three hundred $3x + y$ equal to three hundred and four second line the x intercept is two forty y intercept is two forty so two forty in just before two fifty $x + y$ equal to two forty we can find this for this point by solving this two equation also so this point the point of intersection between this two line is thirty two one zero and this point is now determine the feasible region so we can use again origin test $4(0) + 3(0)$ equal to 0 is greater than equal to 300 is false so origin does not include in the region it means the feasible region is this

half plane and origin test for second zero plus zero equal to zero is greater than equal to two forty is again false
 so origin does not include in the solution region
 so again this half plane will be the solution reason for second constants this is y greater than equal to 0 this is x greater than equal to zero
 so feasible reason will be again open region and the corner points is a two forty zero b thirty two hundred ten and c zero three hundred since the original reason is feasible reason
 so the minimum value may exist or may not exist we have to check it so fair graph for this problem is like this feasible reason is opened reason corner points are a two forty zero b thirty two one zero c zero three hundred
 so value of z value of z that equal to ten x plus i two i at different corner points that is z a equal to ten into two forty plus eight into zero equal to twenty four hundred z b equal to ten into thirty plus eight into two hundred ten equal to one nine eight zero and z c equal to 10 into 0 plus 8 into 300 equal to 2400
 so 1980 will be the minimum value if it satisfy the condition
 so since z is minimum at b 1980
 so $10x + 8y < 1980$ this half plane must does not contains any points of the feasible region
 so when you draw the graph of this half plane this dotted line will represent the half plane ten x plus eight y equal to one nine eight zero
 so the points on this sub plane does not includes any points of feasible reason
 so we can say half plane ten x plus i two i less than one ninety eight zero doesn't includes any point of open reason
 so minimum value minimum of z exist
 so z minimum equal to one nine eight zero and the fertilizer
 so fertilizer a used used equal to 30 kg and fertilizer be used equal to 210 kg
 so in this way we can see the linear programming problem can be applicable in the field of agriculture also okay friends we discuss some more problem in next session thank you you