

ok friends now we discuss some more problem on linear programming problem that is application based problem

so problem is like this a retired person wants to invest an amount of rupees 50 000 his blocker requirements investing in two types of bonds a and b yielding ten percent and nine percent returns respectively on the invested amounts he decides to invest at least rupees 20 000 in

bond a and at least rupees 10 000 in bond b he also wants to invest at least as much in bond a as in bond b solve this l b p graphically to maximize the times

now first of all we try to formulate this problem let the person invest rupees x in bond a and rupees y in bond b now type of bond we have two type of bond that is bond a and bond b the number of bond number of bond that is x and y means number of bond a is

x and number of bond b is y now returns on bonds

so returns on bonds a is given as ten percent and nine percent returns respectively

so ten percent on bond a and nine percent on bond b

so according to problem a person has to invest and amount of rupees fifty thousand

so x plus y less than equal to fifty thousand and by investing in bond a and b he wants maximum returns

so returns

total return z equal to 10 percent of x plus nine percent of y that is zero point one x plus zero point zero nine y obviously an x greater than equal to zero

y greater than equal to zero

so formulation is maximized total returns that is z equal to zero point one x plus zero point zero nine y under the condition that is subject to constants constants x plus y less than equal to fifty thousand and in bond he decide to invest at least two

piece twenty thousand in bond a that is x is greater than equal to twenty thousand and at least rupees ten thousand in bond b

that is y is greater than equal to ten thousand he also wants to invest at least as much in bond a

as in bond b it means x is greater than equal to y and x greater than equal to zero y greater

than equal to zero

so formulation of problem is like this maximize z equal to zero point one x plus zero point nine y that is returns subject to x plus y less than equal to fifty

thousand this is investment constants and x greater than equal to twenty thousand

is a investment on bond a constants and y greater than equal to ten thousand say

investment on bond b constants x greater than equal to y and x greater than equal to zero y

greater than equal to zero this is non negative non-negative constants now we have to define the feasible

reason by using these constants

so associated equation for these constants are x plus y equal to fifty thousand

so x by fifty thousand plus y by fifty thousand equal to one x equal to twenty thousand y equal to ten thousand and x equal to

y now draw the lines of these equations $10k$ $20k$ $30k$ $40k$ $50k$ $60k$ $10k$ $20k$ $30k$ $40k$ $50k$ $60k$
 so y intercept fifty x intercept fifty
 so join these two points say $x + y = 50$ thousand now $x = 20$ thousand
 is a line parallel to y axis say $x = 20$ thousand
 $y = 10$ thousand
 so $y = 10$ thousand
 is a line parallel to x axis
 so $y = 10$ thousand and $x = 1$ is a line passing through origin and one one two two three three points
 so this is $x = y$ now we have to define solution region for each line
 so we have constant $x + y \leq 50$ thousand
 to fifty thousand
 so origin test origin test $40 + 0 = 40 < 50$ is true
 so origin lies in the solution region reason for one arbitrary point test test
 for $x \geq y$ check one zero
 so one is greater than equal to zero is true
 so one zero lies in the solution region for $x \geq 20$ thousand solution reason will
 be right of the line $x = 20$ thousand $y \geq 10$ thousand for $y \geq 10$ thousand solution reason lies above the
 line $y = 10$ thousand
 so after considering all these four conditions the feasible region in the graph right of this f of this
 so when we consider the feasible region for all these four constants will get the solution region is this and its corner points
 these four points are corner points
 so its fair picture pair graph is like this so corner point a is twenty thousand ten thousand corner point b is forty
 thousand ten thousand and corner point c twenty five thousand twenty five thousand and
 corner point d is twenty thousand twenty thousand
 so these are four corner points at which we have to check the optimum value of z
 so z a equal to zero point one into twenty thousand plus zero point zero nine
 into ten thousand equal to twenty nine hundred z b equal to zero point one into
 forty thousand plus zero point zero nine into ten thousand equal to forty nine hundred z c equal to zero point one
 into twenty five thousand plus zero point zero nine into twenty five thousand equal to four seven five zero and
 z d equal to zero point one into twenty thousand plus zero point zero nine into
 twenty thousand equal to thirty eight hundred
 so forty nine hundred will be the maximum value
 so z max equal to forty nine hundred at b forty thousand and ten thousand it means hence the retired person should invest rupees forty thousand in
 bond a and rupees ten thousand in bond b to get maximum returns rupees forty nine hundred on his investment

so in this way we can see the linear programming problem can be also used in banking sector how to invest the hard money in different bonds or different share or in different scheme

so that we can get maximum return now let us take another example if a young man rides his motorcycle

at twenty five kilometer per hour he has to spend rupees two per kilometer in petrol if he rides at a faster speed of 40 kilometer per hour the petrol cost increases to rupees five per kilometer he has rupees 100 to spend on petrol and wishes to find the maximum distance he can travel within one hour express this as lpp and then solve it

so this is a problem based on how to utilize the precious fuel economically let x kilometer and y kilometer be the distance covered by the young man at the speed of 25 kilometer per hour and 40 kilometer per hour respectively time consumed in covering these distances are x by twenty five hour and y by forty hour respectively

so total distance distance travelled that is z equal to x plus y kilometer subject to constants constants are the total amount he has to spend on petrol is rupees 100 that is $2x$ plus five y is less than equal to one hundred and total distance x by twenty five plus y by fifty

so total time he can travel within one hour

so total time is one hour eight x plus five y less than equal to two hundred and x

so finally we formulate this problem like this maximize distance d or you can say z equal to x plus y subject to two x plus five y less than equal to hundred this is money constant and x by twenty five plus y by forty less than equal to one within one hour that is time constant and distance is never negative

so x greater than equal to zero and y greater than equal to zero

so in this way we can formulate the given problem as lpp now to find the feasible region for these constants

so linear constraints are two x plus five y less than equal to hundred say first i takes plus five y less than equal to two hundred say second

so associated equation for one and two two x plus five y equal to hundred i tax plus five y equal to two hundred say x by fifty plus y by twenty equal to one x by twenty five plus y by twenty equal to one forty y by forty equal to one

so so first equation x by fifty plus y by twenty equal to one

so x intercept fifty and y intercept twenty

so join these two points two x plus 5 y equal to 100 then second equation is x by 25 plus y by 40

x by 25 and y by 40 means y intercept forty

so join these two points eight x plus y it x plus five y equal to two hundred now origin test for one and two origin test four one two into zero plus five into zero equal to zero less than equal to hundred this is true

so origin lies in the solution region of one origin test
so four one this will be the solution region origin test four second height
into zero plus 5 into 0 equal to 0 less than equal to
200 this is again true

so origin lies in the solution region of second
so this will be the solution reason for

second this x greater than equal to zero y greater than equal to zero
and solution region will be this and these are corner points of
the feasible region say o a b c now the fair graph of this region is like this
so corner points corner points of the feasible region will be a twenty five
zero b fifty by three forty by three and c zero twenty we can find this point b
fifty

by three or forty by three by solving associated equation one and two and will
get the value that
is point of intersection between these two lines at b fifty by three forty by
three

so we can
check by using solution of these two equation now optimization of objective
function at
this corner points

so objective function objective function z equal to x plus y
so z at a z at a twenty five plus 0 equal to 25 z at b fifty by three plus
forty by three equal to thirty and z at c zero plus twenty equal to
twenty

so z at b is maximum hence total distance covered equal to thirty kilometer
fifty by three three kilometer
at twenty five kilometer per hour and forty by three kilometer at forty
kilometer per
hour now let us take another example

so this is example of allocation problem a factory owner purchases two types of
machine a and b for his factory the requirements and
limitations for the machine are as follows machine a area occupied by machine
is

1000 square meter labour force required for machinery equal to twelve men and
daily outputs in unit by machine a sixty similarly for machine b area occupied
by machine

b is 1200 square meter and labor or manpower required for machine b is eight
men and

daily output in units by machine b is forty now problem says he has an area of
9000 square
meter available and 72 skilled men who can operate the machines how many
machine of each

type should he buy to maximize the daily output

so here the constants is space constant and
main power constant skilled main power constants

so let us try to formulate this problem as lpp let the number of machine a
equal to x and number of machine b equal to y

so maximum dairy production daily production that is z equal to because the
daily output of machine a is

60 and daily output of machine b is 40

so maximum daily production

or maximum daily output is sixty x plus forty y and this has to be maximized
subject to constants we have a space constants

that is hundred square meter for machining twelve hundred

square meter for machine b and we have total available space is nine thousand square meter

so thousand tax plus twelve hundred y this must be less than equal to nine thousand that is five x plus six y less than equal to forty five then we have a skilled main power constant

so for machine a to operate machine a the skilled main power 12 skill manpower is required and to operate machine b eight

skill main power is required

so $12x + 8y$ less than equal to 72 that is $3x + 2y$ less than equal to 18.

obviously number of machine is never negative

so in this way we can

formulate the given problem

so linear constants constants are five x plus six y less than equal to forty five say one and three x plus two y less than equal

to forty five say second associated equation equation 4 1 and 2 are five x plus six y equal

to forty five

so this implies x by nine plus y by seven point five equal to one and three x plus two y equal to eighteen

so three x plus two y equal

to eighteen

so this implies x by six plus y by nine equal to one now draw the graph of these two lines

so first equation is x by nine plus y by seven point five

so nine and seven point five

so join these two points and second equation is x by six plus y by nine equal to one

so x by six means x intercept six and y by nine means y intercept nine

so join these two points

so this is equation five x plus six y equal to forty five this is three x plus two y equal to eighteen now origin test for one and two origin test for one five into zero plus six into zero equal to zero less than equal to forty five this is true

so origin lies in the solution region of one it means the solution region for one is this half plane origin test for second three into zero plus two into zero equal to zero less

than equal to eighteen this is again true

so origin lies in the solution region of second

so again solution for second is this half plane and y greater than equal to zero and x greater than equal to zero

so solution region will be this

so its graph is pair graph is like this

so corner points of feasible region are a six zero b nine by four forty five by eight and c zero fifteen by two again we can find the point of intersection between these two lines by solving these two equations simultaneously

and check the point of intersection now we have to optimize the objective function

at these corner points find the optimum value

so z a objective function z equal to sixty x plus forty y

so z at a equal to sixty into six plus

forty into zero means three sixty z at b sixty into nine by four plus
forty into forty five by eight equal to one thirty five plus equal to three
sixty and z at c sixty into zero plus forty into fifteen by two equal to three
hundred

so we have to maximize the
output

so output is maximum at two points a and b output is maximum at two points a
and b

so all the points lying on this line segment

a b gives the same value that is three sixty but the number of machine

so maximum value of z lies on line segment a b but the number of machine
is never in fraction

so the number of machine will be always in integral value hence zmax equal to
360 occurs at six zero and four three only

so either six machine a and no machine b are poor machine a and three machine b
will give maximum output

so in this way we can use lpp in

allocation problem as well ok friends we shall discuss some more
problem in next session thank you you