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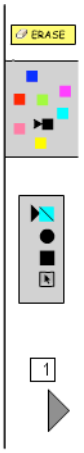
LINEAR PROGRAMMING

EXAMPLE 7.3



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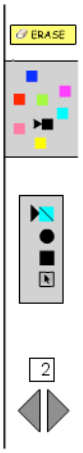
YOU GET TO CHOOSE HOW MANY HOURS ARE DEVOTED TO EACH ACTIVITY

What are the activities?????



Lecture 27

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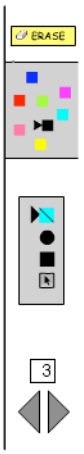
What are the activities?????

It looks like the activities are:

1) sales
2)support



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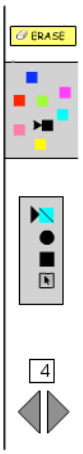
This is confirmed by looking at the information about the objective function.

What are the activities?????

It looks like the activities are:

1) sales
2)support



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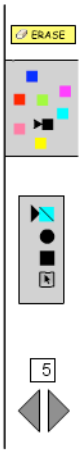
Question: Are "paperwork and reading" sales **and** support activities?

Answer: No, they are support activities only, as can be seen by reading the next two sentences.

What are the activities?????

It looks like the activities are:

1) sales
2)support



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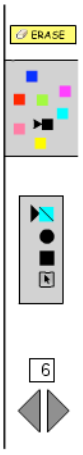
Let

x = # hours devoted to sales
y = # hours devoted to support

What are the activities?????

The activities are:

1) sales
2)support



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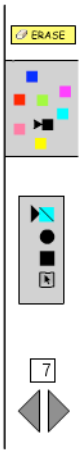
x = # hours devoted to sales
y = # hours devoted to support



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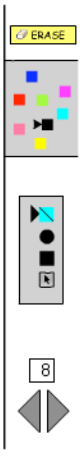
x = # hours devoted to sales
y = # hours devoted to support

$y \geq 5$ +



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Formulate a mathematical problem whose solution gives the number of hours to be devoted to each activity that maximizes the value of his activites.

x = # hours devoted to sales
y = # hours devoted to support

$y \geq 5 + .1x$

ERASE

9

An account executive divides his time between sales and support activities, primarily paperwork and reading up on new products. Keeping up to date on new products requires that he spend at least 5 hours each week reading trade newspapers and magazines (i.e. support activities). In addition, each hour he devotes to sales generates .1 hours of paperwork (i.e. support activities). He prefers sales, and he wants to devote at least half of his time to that activity, but there is enough to do in support activities that any time not devoted to sales can be used for that purpose. He plans to devote at most 50 hours per week to his job. Finally, he estimates that the time he devotes to sales is worth $15 per hour and that the time he devotes to support activities is worth $10 per hour.

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$y \geq 5 + .1x$

ERASE

10

Lecture 27

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Formulate a mathematical problem whose solution gives the number of hours to be devoted to each activity that maximizes the value of his activites.

x = # hours devoted to sales
y = # hours devoted to support

$y \geq 5 + .1x$

$x + y \leq 50$

ERASE

11

An account executive divides his time between sales and support activities, primarily paperwork and reading up on new products. Keeping up to date on new products requires that he spend at least 5 hours each week reading trade newspapers and magazines (i.e. support activities). In addition, each hour he devotes to sales generates .1 hours of paperwork (i.e. support activities). He prefers sales, and he wants to devote at least half of his time to that activity, but there is enough to do in support activities that any time not devoted to sales can be used for that purpose. He plans to devote at most 50 hours per week to his job. Finally, he estimates that the time he devotes to sales is worth $15 per hour and that the time he devotes to support activities is worth $10 per hour.

Formulate a mathematical problem whose solution gives the number of hours to be devoted to each activity that maximizes the value of his activites.

x = # hours devoted to sales
y = # hours devoted to support

$y \geq 5 + .1x$

What does this mean?

$x + y \leq 50$

ERASE

12

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Formulate a mathematical problem whose solution gives the number of hours to be devoted to each activity that maximizes the value of his activites.

x = # hours devoted to sales
y = # hours devoted to support

$y \geq 5 + .1x$

sales all work

x $(x + y)$

$x + y \leq 50$

ERASE

13

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Formulate a mathematical problem whose solution gives the number of hours to be devoted to each activity that maximizes the value of his activites.

x = # hours devoted to sales
y = # hours devoted to support

$y \geq 5 + .1x$

sales all work

$x \geq .5(x + y)$

$x + y \leq 50$

ERASE

14

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Formulate a mathematical problem whose solution gives the number of hours to be devoted to each activity that maximizes the value of his activites.

x = # hours devoted to sales
y = # hours devoted to support

$y \geq 5 + .1x$

sales all work

$x \geq .5(x + y)$ "but there is . . ." ??????????????

$x + y \leq 50$

ERASE

15

An account executive divides his time between sales and support activities, primarily paperwork and reading up on new products. Keeping up to date on new products requires that he spend at least 5 hours each week reading trade newspapers and magazines (i.e. support activities). In addition, each hour he devotes to sales generates .1 hours of paperwork (i.e. support activities). He prefers sales, and he wants to devote at least half of his time to that activity, but there is enough to do in support activities that any time not devoted to sales can be used for that purpose. He plans to devote at most 50 hours per week to his job. Finally, he estimates that the time he devotes to sales is worth $15 per hour and that the time he devotes to support activities is worth $10 per hour.

Formulate a mathematical problem whose solution gives the number of hours to be devoted to each activity that maximizes the value of his activites.

x = # hours devoted to sales
y = # hours devoted to support

$y \geq 5 + .1x$

sales all work

$x \geq .5(x + y)$ "but there is . . ." ??????????????

$x + y \leq 50$

ERASE

16

An account executive divides his time between sales and support activities, primarily paperwork and reading up on new products. Keeping up to date on new products requires that he spend at least 5 hours each week reading trade newspapers and magazines (i.e. support activities). In addition, each hour he devotes to sales generates .1 hours of paperwork (i.e. support activities). He prefers sales, and he wants to devote at least half of his time to that activity, but there is enough to do in support activities that any time not devoted to sales can be used for that purpose. He plans to devote at most 50 hours per week to his job. Finally, he estimates that the time he devotes to sales is worth $15 per hour and that the time he devotes to support activities is worth $10 per hour.

Formulate a mathematical problem whose solution gives the number of hours to be devoted to each activity that maximizes the value of his activites.

x = # hours devoted to sales
y = # hours devoted to support

$y \geq 5 + .1x$

sales all work

$x \geq .5(x + y)$ "but there is . . ."
??????????????

$x + y \leq 50$

value of activities =
$15x + 10y$

This must be the objective function. It is what you are trying to maximize.

17

An account executive divides his time between sales and support activities, primarily paperwork and reading up on new products. Keeping up to date on new products requires that he spend at least 5 hours each week reading trade newspapers and magazines (i.e. support activities). In addition, each hour he devotes to sales generates .1 hours of paperwork (i.e. support activities). He prefers sales, and he wants to devote at least half of his time to that activity, but there is enough to do in support activities that any time not devoted to sales can be used for that purpose. He plans to devote at most 50 hours per week to his job. Finally, he estimates that the time he devotes to sales is worth $15 per hour and that the time he devotes to support activities is worth $10 per hour.

Formulate a mathematical problem whose solution gives the number of hours to be devoted to each activity that maximizes the value of his activites.

x = # hours devoted to sales
y = # hours devoted to support

$y \geq 5 + .1x$

$x \geq .5(x + y)$

$x + y \leq 50$

Maximize
$15x + 10y$

18

Lecture 27

An account executive divides his time between sales and support activities, primarily paperwork and reading up on new products. Keeping up to date on new products requires that he spend at least 5 hours each week reading trade newspapers and magazines (i.e. support activities). In addition, each hour he devotes to sales generates .1 hours of paperwork (i.e. support activities). He prefers sales, and he wants to devote at least half of his time to that activity, but there is enough to do in support activities that any time not devoted to sales can be used for that purpose. He plans to devote at most 50 hours per week to his job. Finally, he estimates that the time he devotes to sales is worth $15 per hour and that the time he devotes to support activities is worth $10 per hour.

Formulate a mathematical problem whose solution gives the number of hours to be devoted to each activity that maximizes the value of his activites.

x = # hours devoted to sales
y = # hours devoted to support

Maximize
$15x + 10y$

Subject to:

$y \geq 5 + .1x$

$x \geq .5(x + y)$

$x + y \leq 50$

19

An account executive divides his time between sales and support activities, primarily paperwork and reading up on new products. Keeping up to date on new products requires that he spend at least 5 hours each week reading trade newspapers and magazines (i.e. support activities). In addition, each hour he devotes to sales generates .1 hours of paperwork (i.e. support activities). He prefers sales, and he wants to devote at least half of his time to that activity, but there is enough to do in support activities that any time not devoted to sales can be used for that purpose. He plans to devote at most 50 hours per week to his job. Finally, he estimates that the time he devotes to sales is worth $15 per hour and that the time he devotes to support activities is worth $10 per hour.

Formulate a mathematical problem whose solution gives the number of hours to be devoted to each activity that maximizes the value of his activites.

x = # hours devoted to sales
y = # hours devoted to support

Maximize
$15x + 10y$

Subject to:

$y \geq 5 + .1x$ $y - .1x \geq 5$

$x \geq .5(x + y)$ $.5x - .5y \geq 0$

$x + y \leq 50$ $x + y \leq 50$

20

An account executive divides his time between sales and support activities, primarily paperwork and reading up on new products. Keeping up to date on new products requires that he spend at least 5 hours each week reading trade newspapers and magazines (i.e. support activities). In addition, each hour he devotes to sales generates .1 hours of paperwork (i.e. support activities). He prefers sales, and he wants to devote at least half of his time to that activity, but there is enough to do in support activities that any time not devoted to sales can be used for that purpose. He plans to devote at most 50 hours per week to his job. Finally, he estimates that the time he devotes to sales is worth $15 per hour and that the time he devotes to support activities is worth $10 per hour.

Formulate a mathematical problem whose solution gives the number of hours to be devoted to each activity that maximizes the value of his activites.

x = # hours devoted to sales
y = # hours devoted to support

Maximize
$15x + 10y$

Subject to:

$y \geq 5 + .1x$ $y - .1x \geq 5$

$x \geq .5(x + y)$ $x - y \geq 0$

$x + y \leq 50$ $x + y \leq 50$

21

An account executive divides his time between sales and support activities, primarily paperwork and reading up on new products. Keeping up to date on new products requires that he spend at least 5 hours each week reading trade newspapers and magazines (i.e. support activities). In addition, each hour he devotes to sales generates .1 hours of paperwork (i.e. support activities). He prefers sales, and he wants to devote at least half of his time to that activity, but there is enough to do in support activities that any time not devoted to sales can be used for that purpose. He plans to devote at most 50 hours per week to his job. Finally, he estimates that the time he devotes to sales is worth $15 per hour and that the time he devotes to support activities is worth $10 per hour.

Formulate a mathematical problem whose solution gives the number of hours to be devoted to each activity that maximizes the value of his activites.

x = # hours devoted to sales
y = # hours devoted to support

Maximize
$15x + 10y$

Subject to:

$y - .1x \geq 5$

$x - y \geq 0$

$x + y \leq 50$

$x \geq 0$

$y \geq 0$

22

x = # hours devoted to sales
y = # hours devoted to support

Maximize
$15x + 10y$

Subject to:

$y - .1x \geq 5$

$x - y \geq 0$

$x + y \leq 50$

$x \geq 0$

$y \geq 0$

23

x = # hours devoted to sales
y = # hours devoted to support

Maximize
$15x + 10y$

Subject to:

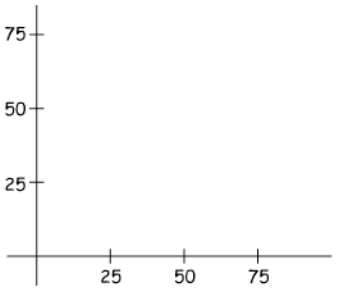
$y - .1x \geq 5$

$x - y \geq 0$

$x + y \leq 50$

$x \geq 0$

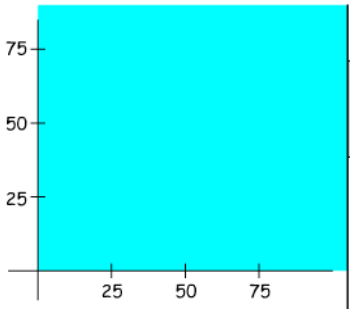
$y \geq 0$



24

x = # hours devoted to sales
y = # hours devoted to support

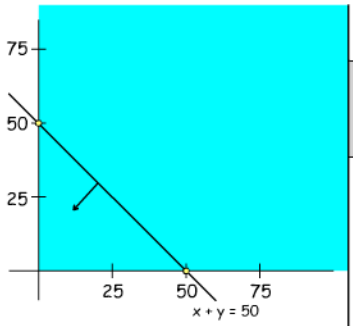
Maximize
15x + 10y
Subject to:
y - .1x ≥ 5
x - y ≥ 0
x + y ≤ 50
x ≥ 0
y ≥ 0



25

x = # hours devoted to sales
y = # hours devoted to support

Maximize
15x + 10y
Subject to:
y - .1x ≥ 5
x - y ≥ 0
x + y ≤ 50
x ≥ 0
y ≥ 0



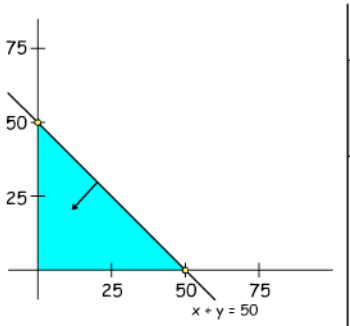
x + y = 50 ⇒ (0, 50) & (50, 0)
(0, 0) works

26

Lecture 27

x = # hours devoted to sales
y = # hours devoted to support

Maximize
15x + 10y
Subject to:
y - .1x ≥ 5
x - y ≥ 0
x + y ≤ 50
x ≥ 0
y ≥ 0

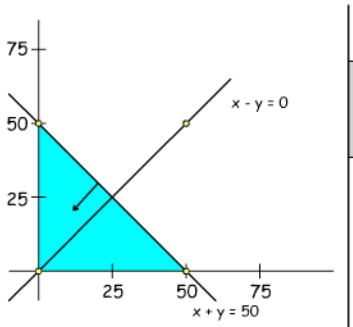


x + y = 50 ⇒ (0, 50) & (50, 0)
(0, 0) works

27

x = # hours devoted to sales
y = # hours devoted to support

Maximize
15x + 10y
Subject to:
y - .1x ≥ 5
x - y ≥ 0
x + y ≤ 50
x ≥ 0
y ≥ 0

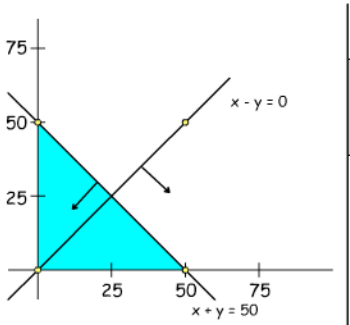


x - y = 0 ⇒ (0, 0) & (50, 50)

28

x = # hours devoted to sales
y = # hours devoted to support

Maximize
15x + 10y
Subject to:
y - .1x ≥ 5
x - y ≥ 0
x + y ≤ 50
x ≥ 0
y ≥ 0

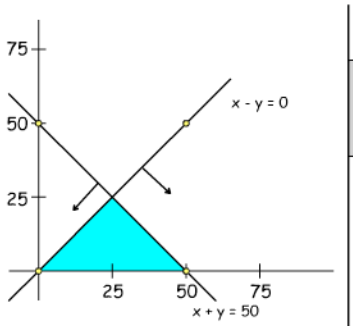


x - y = 0 ⇒ (0, 0) & (50, 50)
(25, 0) works

29

x = # hours devoted to sales
y = # hours devoted to support

Maximize
15x + 10y
Subject to:
y - .1x ≥ 5
x - y ≥ 0
x + y ≤ 50
x ≥ 0
y ≥ 0

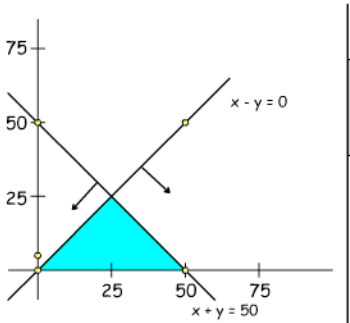


x - y = 0 ⇒ (0, 0) & (50, 50)
(25, 0) works

30

x = # hours devoted to sales
y = # hours devoted to support

Maximize
15x + 10y
Subject to:
y - .1x ≥ 5
x - y ≥ 0
x + y ≤ 50
x ≥ 0
y ≥ 0

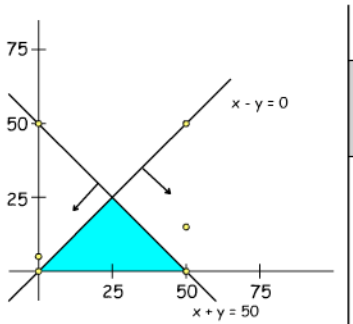


-.1x + y = 5 ⇒ (0, 5) & (-50, 0)
This last point is hard to plot - look for another point.

31

x = # hours devoted to sales
y = # hours devoted to support

Maximize
15x + 10y
Subject to:
y - .1x ≥ 5
x - y ≥ 0
x + y ≤ 50
x ≥ 0
y ≥ 0



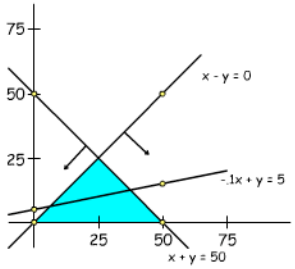
-.1x + y = 5 ⇒ (0, 5) & (-50, 0)
x = 50 ⇒ -.1(50) + y = 5 ⇒ y = 15
⇒ (50, 15)

32

-.1x + y = 5
x = # hours devoted to sales
y = # hours devoted to support

Maximize
15x + 10y

Subject to:
- y - .1x ≥ 5
- x - y ≥ 0
- x + y ≤ 50
- x ≥ 0
- y ≥ 0



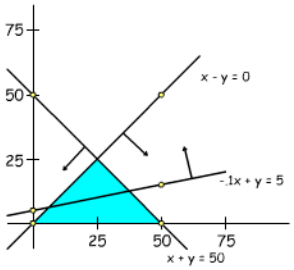
ERASE

33

-.1x + y = 5
x = # hours devoted to sales
y = # hours devoted to support

Maximize
15x + 10y

Subject to:
- y - .1x ≥ 5
- x - y ≥ 0
- x + y ≤ 50
- x ≥ 0
- y ≥ 0



(0, 0) does NOT work.

ERASE

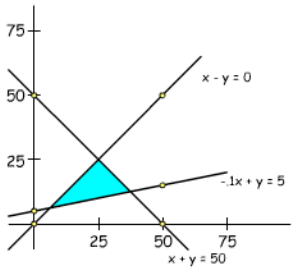
34

Lecture 27

x = # hours devoted to sales
y = # hours devoted to support

Maximize
15x + 10y

Subject to:
- y - .1x ≥ 5
- x - y ≥ 0
- x + y ≤ 50
- x ≥ 0
- y ≥ 0



(0, 0) does NOT work.

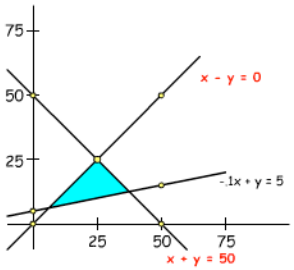
ERASE

35

x = # hours devoted to sales
y = # hours devoted to support

Maximize
15x + 10y

Subject to:
- y - .1x ≥ 5
- x - y ≥ 0
- x + y ≤ 50
- x ≥ 0
- y ≥ 0



x + y = 50
x - y = 0 ⇒ (25, 25)

(25, 25)

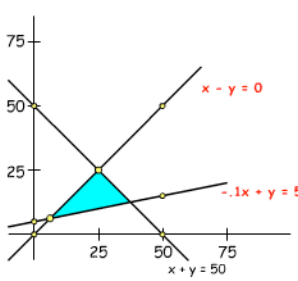
ERASE

36

x = # hours devoted to sales
y = # hours devoted to support

Maximize
15x + 10y

Subject to:
- y - .1x ≥ 5
- x - y ≥ 0
- x + y ≤ 50
- x ≥ 0
- y ≥ 0



-.1x + y = 5
x - y = 0 ⇒ (50/9, 50/9)

(25, 25) (50/9, 50/9)

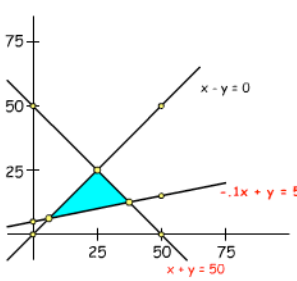
ERASE

37

x = # hours devoted to sales
y = # hours devoted to support

Maximize
15x + 10y

Subject to:
- y - .1x ≥ 5
- x - y ≥ 0
- x + y ≤ 50
- x ≥ 0
- y ≥ 0



-.1x + y = 5
x + y = 50 ⇒ (45/1.1, 10/1.1)

(25, 25) (50/9, 50/9) (45/1.1, 10/1.1)

ERASE

38

x = # hours devoted to sales
y = # hours devoted to support

Maximize
15x + 10y

Subject to:
- y - .1x ≥ 5
- x - y ≥ 0
- x + y ≤ 50
- x ≥ 0
- y ≥ 0

	15x + 10y
(25, 25)	
(50/9, 50/9)	
(45/1.1, 10/1.1)	

Corner points:
(25, 25) (50/9, 50/9) (45/1.1, 10/1.1)

ERASE

39

x = # hours devoted to sales
y = # hours devoted to support

Maximize
15x + 10y

Subject to:
- y - .1x ≥ 5
- x - y ≥ 0
- x + y ≤ 50
- x ≥ 0
- y ≥ 0

	15x + 10y
(25, 25)	625
(50/9, 50/9)	≈ 138.89
(45/1.1, 10/1.1)	≈ 704.55

Corner points:
(25, 25) (50/9, 50/9) (45/1.1, 10/1.1)

ERASE

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ΖΞΧςΒΝΜ<>?

x = # hours devoted to sales
y = # hours devoted to support

Maximize

$15x + 10y$

Subject to:

$y - .1x \geq 5$

$x - y \geq 0$

$x + y \leq 50$

$x \geq 0$

$y \geq 0$

	$15x + 10y$
(25, 25)	625
(50/9, 50/9)	≈ 138.89
(45/1.1, 10/1.1)	≈ 704.55

So the maximum value of the work done is $704.55, and this is achieved by working 45/1.1 ≈ 40.9 hours on sales and 10/1.1 ≈ 9.1 hours on support, for a total of 50 hours per week.

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Lecture 27

43

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45

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