Slide 1 **Math 1520, Lecture 8**

In this lecture, we practice taking word problems and setting up mathematical models, which are linear minimization and maximization problems. All these mathematical formulations can be solved using linear programming, as we will see in future lectures.

Slide 2 **iClicker**

A division of the Winston Furniture Company manufactures dining tables and chairs. Each table requires 40 board feet of wood and 3 labor-hours. Each chair requires 16 board feet of wood and 5 labor-hours. The profit for each table is \$45 and the profit for each chair is \$20. In a certain week the company has 3200 board feet of wood available and 450 labor hours. How many tables and chairs should Winston manufacture to maximize its profits? (Set up the problem, but do not solve.)

Question What is the best choice of variables for this problem?

A. Let x be the hours for tables and y be the hours for chairs.

B. Let x be the number of tables produced and y be the number of chairs produced.

C. Let x be the profit on tables and y be the profit on chairs.

D. Let x be the board feet for tables and y be the board feet for chairs.

E. None of the above

Answer to Question What is the best choice of variables for this problem?

A. Let x be the hours for tables and y be the hours for chairs.

B. Let x be the number of tables produced and y be the number of chairs produced. is the correct answer.

C. Let x be the profit on tables and y be the profit on chairs.

D. Let x be the board feet for tables and y be the board feet for chairs.

E. None of the above

Slide 3 **iClicker**

A division of the Winston Furniture Company manufactures dining tables and chairs. Each table requires 40 board feet of wood and 3 labor-hours. Each chair requires 16 board feet of wood and 5 labor-hours. The profit for each table is \$45 and the profit for each chair is \$20. In a certain week the company has 3200 board feet of wood available and 450 labor hours. How many tables and chairs should Winston manufacture to maximize its profits? (Set up the problem, but do not solve.)

Question What is the optimization model for this problem?

A. Maximize $20x + 45y$ subject to
$x \geq 0,\ y \geq 0,\ 40x + 3y \leq 3200,\ 16x + 5y \leq 450.$

B. Maximize $20x + 45y$ subject to
$x \geq 0,\ y \geq 0,\ 4x + 16y \leq 3200,\ 3x + 5y \leq 450.$

C. Maximize $45x + 20y$ subject to
$x \geq 0,\ y \geq 0,\ 40x + 3y \leq 3200,\ 16x + 5y \leq 450.$

D. Maximize $45x + 20y$ subject to
$x \geq 0,\ y \geq 0,\ 40x + 16y \leq 3200,\ 3x + 5y \leq 450.$

E. None of the above

Answer to Question What is the optimization model for this problem?

A. Maximize $20x + 45y$ subject to
$x \geq 0,\ y \geq 0,\ 40x + 3y \leq 3200,\ 16x + 5y \leq 450.$

B. Maximize $20x + 45y$ subject to
$x \geq 0,\ y \geq 0,\ 4x + 16y \leq 3200,\ 3x + 5y \leq 450.$

C. Maximize $45x + 20y$ subject to
$x \geq 0,\ y \geq 0,\ 40x + 3y \leq 3200,\ 16x + 5y \leq 450.$

D. Maximize $45x + 20y$ **subject to**
$x \geq 0,\ y \geq 0,\ 40x + 16y \leq 3200,\ 3x + 5y \leq 450.$ **is the correct answer.**

E. None of the above

Slide 4 **iClicker**

Deluxe River Cruises operates a fleet of river vessels. The fleet has two types of vessels: A type A vessel has 60 deluxe cabins and 160 standard cabins, whereas a type B vessel has 80 deluxe cabins and 120 standard cabins. Under a charter agreement with Odyssey Travel Agency, Deluxe River Cruises is to provide Odyssey with a minimum of 360 deluxe and 680 standard cabins for the 15-day cruise starting May 18th. It costs $44,000 to operate a type A vessel and $54,000 to operate a type B vessel for that period. How many of each type vessel should be used to keep the operating cost at a minimum? (Set up the problem, but do not solve.)

Question What is the best choice of variables for this problem?

A. Let x be the number of type A vessels and y be the number of type B vessels.

B. Let x be the number of deluxe cabins and y be the number of standard cabins.

C. Let x be the length of the cruise and y be the start date of the cruise.

D. Let x be the total operating cost and y be the total number of cabins.

E. None of the above

Answer to Question What is the best choice of variables for this problem?

A. Let x be the number of type A vessels and y be the number of type B vessels. is the correct answer.

B. Let x be the number of deluxe cabins and y be the number of standard cabins.

C. Let x be the length of the cruise and y be the start date of the cruise.

D. Let x be the total operating cost and y be the total number of cabins.

E. None of the above

Slide 5 **iClicker**

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Question What is the optimization model for this problem?

A. Maximize $44000x + 54000y$ subject to
$x \geq 0,\ y \geq 0,\ 60x + 80y \geq 360,\ 160x + 120y \geq 680.$

B. Maximize $44000x + 54000y$ subject to
$x \geq 0,\ y \geq 0,\ 60x + 80y \leq 360,\ 160x + 120y \leq 680.$

C. Minimize $44000x + 54000y$ subject to
$x \geq 0,\ y \geq 0,\ 60x + 80y \geq 360,\ 160x + 120y \geq 680.$

D. Minimize $44000x + 54000y$ subject to
$x \geq 0,\ y \geq 0,\ 60x + 80y \leq 360,\ 160x + 120y \leq 680.$

E. None of the above

Answer to Question What is the optimization model for this problem?

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B. Maximize $44000x + 54000y$ subject to
$x \geq 0,\ y \geq 0,\ 60x + 80y \leq 360,\ 160x + 120y \leq 680.$

C. Minimize $44000x + 54000y$ **subject to**
$x \geq 0,\ y \geq 0,\ 60x + 80y \geq 360,\ 160x + 120y \geq 680.$ **is the correct answer.**

D. Minimize $44000x + 54000y$ subject to
$x \geq 0,\ y \geq 0,\ 60x + 80y \leq 360,\ 160x + 120y \leq 680.$

E. None of the above

Slide 6 **iClicker**

Everest Deluxe World Travel has decided to advertise in two major magazines. These advertisements are directed at 3 different groups of potential customers. Each advertisement in Magazine I is seen by 70,000 Group A customers, 40,000 Group B customers, and 20,000 Group C customers. Each advertisement in Magazine II is seen by 10,000 Group A, 20,000 Group B, and 40,000 Group C customers. Each advertisement in Magazine I costs \$1000 and each advertisement in Magazine II is costs \$800. Everest would like their advertisements to be read by at least 2 million people from Group A, 1.4 million people from group B, and 1 million people from Group C. How many advertisements should Everest place in each magazine to achieve its advertisement goals at a minimum cost? (Set up the problem, but do not solve.)

Question What is the best choice of variables for this problem?

A. Let x be how many Group A customers, y be how many Group B customers and z be how many Group C customers.

B. Let x be how many Group A ads, y be how many Group B ads and z be how many Group C ads.

C. Let x be the profit from Group A, y be the profit from Group B, and z be the profit from Group C.

D. Let x be the number of Magazines, y be the number of Newspapers, and z be the number of Books.

E. None of the above

Answer to Question What is the best choice of variables for this problem?

A. Let x be how many Group A customers, y be how many Group B customers and z be how many Group C customers.

B. Let x be how many Group A ads, y be how many Group B ads and z be how many Group C ads.

C. Let x be the profit from Group A, y be the profit from Group B, and z be the profit from Group C.

D. Let x be the number of Magazines, y be the number of Newspapers, and z be the number of Books.

E. None of the above is the correct answer.

The right answer is to let x be the number of ads put in Magazine I and to let y be the number of ads put in Magazine II.

Slide 7 **iClicker**

Everest Deluxe World Travel has decided to advertise in two major magazines. These advertisements are directed at 3 different groups of potential customers. Each advertisement in Magazine I is seen by 70,000 Group A customers, 40,000 Group B customers, and 20,000 Group C customers. Each advertisement in Magazine II is seen by 10,000 Group A, 20,000 Group B, and 40,000 Group C customers. Each advertisement in Magazine I costs \$1000 and each advertisement in Magazine II is costs \$800. Everest would like their advertisements to be read by at least 2 million people from Group A, 1.4 million people from group B, and 1 million people from Group C. How many advertisements should Everest place in each magazine to achieve its advertisement goals at a minimum cost? (Set up the problem, but do not solve.)

Question What is the optimization model for this problem?

A. Minimize $1000x + 800y$ subject to
$x \geq 0,\ y \geq 0,\ 40000x + 20000y \geq 1400000,\ 20000x + 40000y \geq 1000000$

B. Minimize $1000x + 800y$ subject to
$x \geq 0,\ y \geq 0,\ 70000x + 10000y \geq 2000000,\ 20000x + 40000y \geq 1000000$

C. Minimize $1000x + 800y$ subject to
$x \geq 0,\ y \geq 0,\ 70000x + 10000y \geq 2000000,\ 40000x + 20000y \geq 1400000,$

D. Minimize $1000x + 800y$ subject to $x \geq 0,\ y \geq 0,\ 70000x + 10000y \geq 2000000,\ 40000x + 20000y \geq 1400000,\ 20000x + 40000y \geq 1000000$

E. None of the above

Answer to Question What is the optimization model for this problem?

A. Minimize $1000x + 800y$ subject to
$x \geq 0,\ y \geq 0,\ 40000x + 20000y \geq 1400000,\ 20000x + 40000y \geq 1000000$

B. Minimize $1000x + 800y$ subject to
$x \geq 0,\ y \geq 0,\ 70000x + 10000y \geq 2000000,\ 20000x + 40000y \geq 1000000$

C. Minimize $1000x + 800y$ subject to
$x \geq 0,\ y \geq 0,\ 70000x + 10000y \geq 2000000,\ 40000x + 20000y \geq 1400000,$

D. Minimize $1000x + 800y$ **subject to** $x \geq 0,\ y \geq 0,\ 70000x + 10000y \geq 2000000,\ 40000x + 20000y \geq 1400000,\ 20000x + 40000y \geq 1000000$ **is the correct answer.**

E. None of the above

Slide 8 **iClicker**

Beyer Pharmaceutical produces three kinds of cold formulas: Formula I, Formula II, and Formula II. It takes 2.5 hours to produce 1000 bottles of Formula I, 3 hours to produce 1000 bottles of Formula II, and 4 hours to produce 1000 bottles of Formula III. The profits for each 1000 bottles of Formula I, Formula II, and Formula II are \$180, \$200, and \$300, respectively. For a certain production run, there are enough ingredients on hand to make at most 9,000 bottles of Formula I, 12,000 bottles of Formula II, and 60,000 bottles of Formula III. Furthermore, the time for the production run is limited to a maximum of 70 hours. How many bottles of each formula should be produced in this production run so that the profit is maximized? (Set up the problem, but do not solve.)

Question What is the best choice of variables for this problem?

A. Let x be the number bottles of formula I, y be the number bottles of formula II, z be the number bottles of formula III, all measured in thousands

B. Let $x = 9$, $y = 12$, $z = 6$

C. Let $x = 9000$, $y = 12000$, $z = 6000$

D. Let x be profit and y be cost.

E. None of the above

Answer to Question What is the best choice of variables for this problem?

A. Let x be the number bottles of formula I, y be the number bottles of formula II, z be the number bottles of formula III, all measured in thousands is the correct answer.

B. Let $x = 9$, $y = 12$, $z = 6$

C. Let $x = 9000$, $y = 12000$, $z = 6000$

D. Let x be profit and y be cost.

E. None of the above

Slide 9 **iClicker**

Beyer Pharmaceutical produces three kinds of cold formulas: Formula I, Formula II, and Formula II. It takes 2.5 hours to produce 1000 bottles of Formula I, 3 hours to produce 1000 bottles of Formula II, and 4 hours to produce 1000 bottles of Formula III. The profits for each 1000 bottles of Formula I, Formula II, and Formula II are \$180, \$200, and \$300, respectively. For a certain production run, there are enough ingredients on hand to make at most 9,000 bottles of Formula I, 12,000 bottles of Formula II, and 60,000 bottles of Formula III. Furthermore, the time for the production run is limited to a maximum of 70 hours. How many bottles of each formula should be produced in this production run so that the profit is maximized? (Set up the problem, but do not solve.)

Question What is the optimization model for this problem?

A. Maximize $180x + 200y + 300z$ subject to
$x \geq 0,\ y \geq 0,\ z \geq 0,\ x = 9,\ y = 12,\ z = 60,\ 2.5x + 3y + 4z \leq 70$

B. Maximize $180x + 200y + 300z$ subject to
$x \geq 0,\ y \geq 0,\ z \geq 0,\ x = 9,\ y = 12,\ z = 60,\ 2.5x + 3y + 4z \geq 70$

C. Maximize $180x + 200y + 300z$ subject to
$x \geq 0,\ y \geq 0,\ z \geq 0,\ x \leq 9,\ y \leq 12,\ z \leq 60,\ 2.5x + 3y + 4z \geq 70$

D. Maximize $180x + 200y + 300z$ subject to
$x \geq 0,\ y \geq 0,\ z \geq 0,\ x \leq 9,\ y \leq 12,\ z \leq 60,\ 2.5x + 3y + 4z \leq 70$

E. None of the above

Answer to Question What is the optimization model for this problem?

A. Maximize $180x + 200y + 300z$ subject to
$x \geq 0,\ y \geq 0,\ z \geq 0,\ x = 9,\ y = 12,\ z = 60,\ 2.5x + 3y + 4z \leq 70$

B. Maximize $180x + 200y + 300z$ subject to
$x \geq 0,\ y \geq 0,\ z \geq 0,\ x = 9,\ y = 12,\ z = 60,\ 2.5x + 3y + 4z \geq 70$

C. Maximize $180x + 200y + 300z$ subject to
$x \geq 0,\ y \geq 0,\ z \geq 0,\ x \leq 9,\ y \leq 12,\ z \leq 60,\ 2.5x + 3y + 4z \geq 70$

D. Maximize $180x + 200y + 300z$ **subject to**
$x \geq 0,\ y \geq 0,\ z \geq 0,\ x \leq 9,\ y \leq 12,\ z \leq 60,\ 2.5x + 3y + 4z \leq 70$
is the correct answer.

E. None of the above