Sept. 30, 2013 Oct. 2, 2014 Sept. 30, 2015 **Feb. 11, 2020**

5.4 Optimization Problems I: Creating the Model

New Vocabulary/Symbols
- optimization problem
- constraint
- objective function
- feasible region

An __optimization__ problem is a problem in which we find the greatest or least value of functions. The method used to solve such problems is called **linear programming** and consists of two parts:

1. An __objection__ **function** tells us the quantity we want to maximize or minimize.

2. The system of constraints consists of linear __inequalities__ whose overlapping areas create the __feasible__ **region**. The solution is contained in this region.

A **constraint** is a limiting condition of the optimization problem being modeled, represented by a linear inequality.

INVESTIGATE the Math

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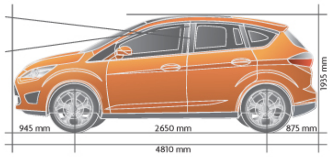
A toy company manufactures two types of toy vehicles: racing cars and sport-utility vehicles.

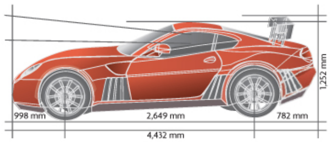
- Because the supply of materials is limited, no more than 40 racing cars and 60 sport-utility vehicles can be made each day.
- However, the company can make 70 or more vehicles, in total, each day.
- It costs \$8 to make a racing car and \$12 to make a sport-utility vehicle.

objective function

Pull for Lesson Notes

There are many possible combinations of racing cars and sport-utility vehicles that could be made. The company wants to know what combinations will result in the minimum and maximum costs, and what those costs will be.





? How can this situation be modelled?

A. What are the two variables in this situation?

B. Write a system of three linear inequalities to represent these conditions:
- the total number of racing cars that can be made
- the total number of sport-utility vehicles that can be made
- the total number of vehicles that can be made

C. What do you know about the restrictions on the domain and range of the variables? Explain.

D. Graph the system. Choose at least two points in the solution region that are possible solutions to the system.

E. What quantity in this situation needs to be minimized and maximized? Write an equation to represent how the two variables relate to this quantity.

Answers

x y

A. number of sports utility vehicles and number of racing cars

B. Let s represent the number of sports utility vehicles, and let r represent the number of racing cars.

Total number of racing cars: $r \leq 40$ $y \leq 40$

Total number of sports utility vehicles: $s \leq 60$ $x \leq 60$

Total number of vehicles: $r + s \geq 70$ $y+x \geq 70$

$\boxed{x+y \leq 100}$

C. The restrictions are $s \in W$ and $r \in W$, because only whole numbers of vehicles make sense.

D. e.g., (50, 20) and (40, 35)

$r \leq 40$ $y \leq 40$

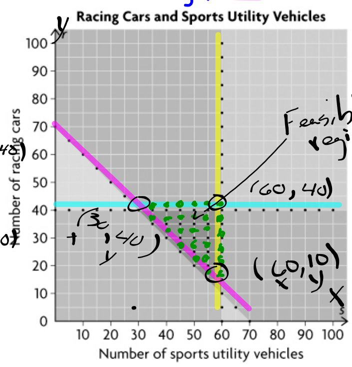
$s \leq 60$ $x \leq 60$

$r + s \geq 70$ $y+x \geq 70$

$x+y \leq 100$

$12(60)+8(40)$
$C=\$1040$

$12(30)+8(40)$
$C=\$680$



$C=12(60)+8(10)$
$C=\$800$

E. The total cost of producing the two types of toys, C, must be optimized:

$C = 8r + 12s$

$C=8y+12x \rightarrow C=8(40)+12(60)$

$C=320+720$

$C=\$1040$

Attachments

6Ws4e1.mp4

6Ws4e2.mp4