

SPINOFFS

Spinoffs are relatively short learning modules inspired by the LTAs. They can be easily implemented to support student learning in courses ranging from prealgebra through calculus. The Spinoffs typically give students an opportunity to use mathematics in a real world context.

LTA - SPINOFF 2A

Cost Analysis for the NASA Aquatics Lab

LTA - SPINOFF 2B

NASA Aquatics Lab Loading

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SPINOFF 2A

Cost Analysis for the NASA Aquatics Lab

Background Information

Governments and industries from around the world buy Shuttle space so that scientists can carry out experiments in a weightless environment. French and German scientists used space aboard the Shuttle Columbia for the August, 1997 launch and for several subsequent launches of other Shuttle flights. Their experiment studied the effects of weightlessness on fish and snails. When in orbit aboard a Shuttle craft, the animals are contained in a flexible spherical aquarium, and due to weightlessness, air forms in a pocket at the center of the aquarium.

An aquatics lab was built at Kennedy Space Center to perform preliminary experiments in preparation for the launch. Unused office space on the second floor of an existing building was modified to house racks of 30 and 50 gallon aquaria.

Technical Information

Capacity: The scientists were flexible on the number of 30 and 50 gallon aquaria, but they required at least 4,200 gallons total capacity.

Space: There was an area of 720 square feet available in the remodeled space for the aquaria. The aquaria were installed in racks stacked 3 high above the floor with another aquarium placed on the floor beneath the ones on the rack. Each rack of 30 gallon aquaria required 24 square feet of space and each rack of 50 gallon aquaria required 30 square feet of space.

Load: The second floor of the remodeled space had a load capacity of 200 pounds per square foot. Water weighs 8.34 pounds per gallon. Each metal rack for the 30 gallon aquaria adds an additional 200 pounds while each metal rack for the 50 gallon aquaria adds an additional 250 pounds to the weight of the water.

Cost: The cost of materials and installation of each 30 gallon rack was quoted as \$2,600. Each 50 gallon rack was \$4,500.

Student Task

Use linear programming techniques to do a cost analysis and determine the number of racks of 30 and 50 gallon aquaria which satisfy all the criteria and minimizes the cost.

Worksheet

Let x represent the number of 30 gallon racks used.

Let y represent the number of 50 gallon racks used.

- 1) Write a linear inequality in x and y which limits the total weight of all the racks and aquaria.

- 2) Write a linear inequality in x and y which describes the total space requirements and limitations.

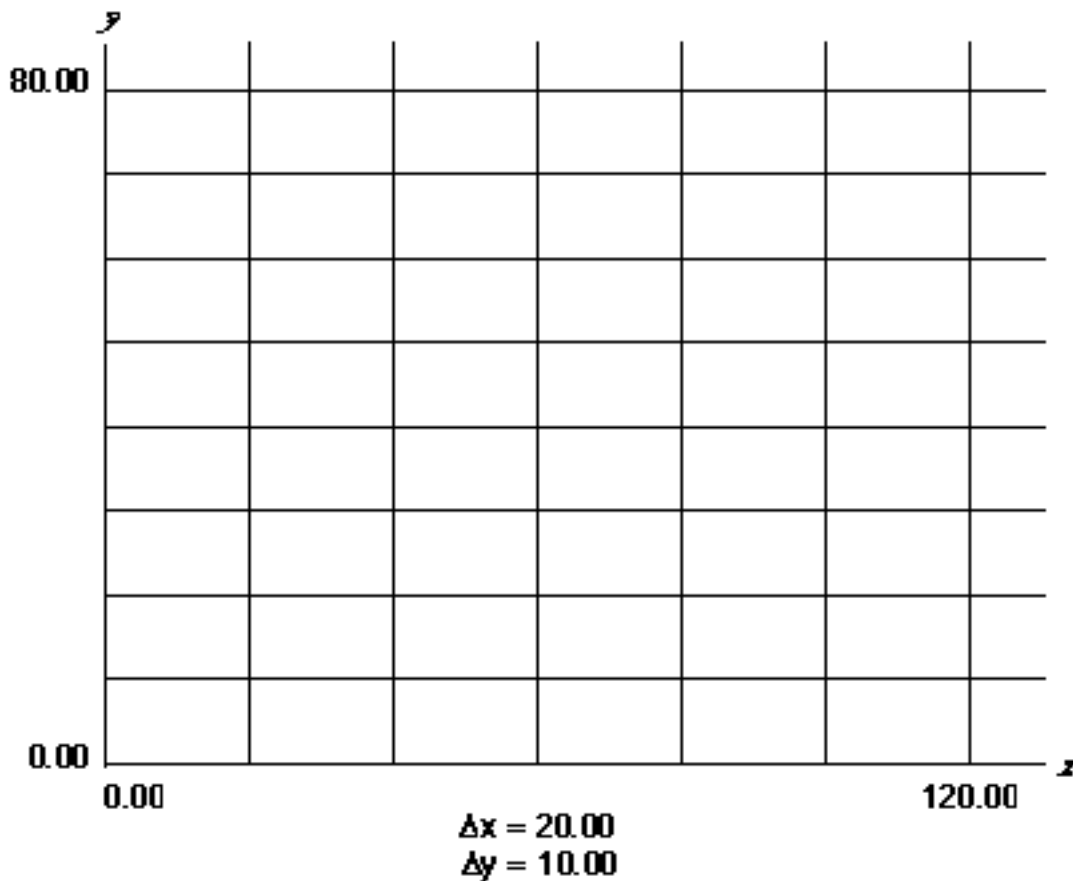
- 3) Write a linear inequality in x and y which assures the total capacity needs are met.

- 4) Write a linear function in x and y which describes the total cost of materials and installation.

- 5) Sketch a graph of the system of inequalities defined in Exercises 1-3 above. First, construct the graphs on the coordinate system in Figure 1 and then construct the graphs on the smaller scale system in Figure 2. Be sure to clearly label each boundary line and shade the final region which satisfies all conditions. Also, label each vertex of the region of compatibility with an ordered pair of coordinates.

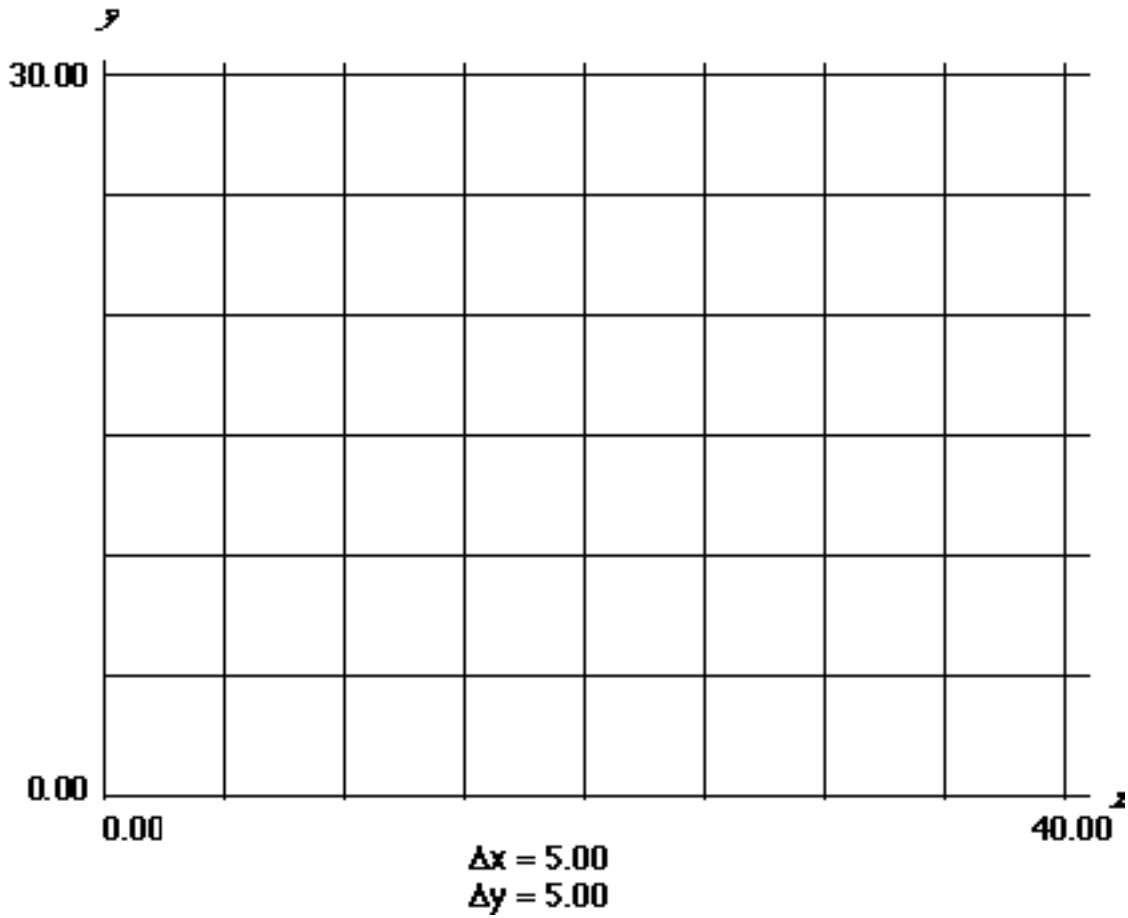
a)

Figure 1



b)

Figure 2



- 6) Evaluate the cost function defined in Exercise 4 above at each vertex of the compatibility region.

- 7) Use complete sentences to state your conclusion as to when the minimum cost is achieved.