

Exploring Graphs of Systems of Linear Inequalities

YOU WILL NEED

- graphing technology OR graph paper, ruler, and coloured pencils

GOAL

Explore graphs of situations that can be modelled by systems of two linear inequalities in two variables.



EXPLORE the Math

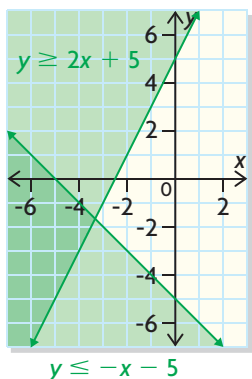
A nursery school serves morning and afternoon snacks to its students. The morning snacks are fruits, vegetables, and juice, and the afternoon snacks are cheese and milk.

- The school can accommodate 50 students or fewer altogether. Students can attend for just the morning or for a full day.
- The morning snack costs \$1 per student per week, and the afternoon snack costs \$2 per student per week.
- The weekly snack budget is \$120 or less.

- ❓ What combinations of morning and full-day students can the school accommodate and stay within the weekly snack budget?

system of linear inequalities

A set of two or more linear inequalities that are graphed on the same coordinate plane; the intersection of their solution regions represents the solution set for the system.



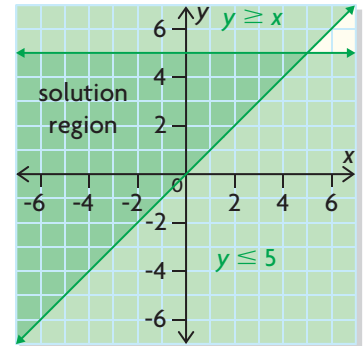
Reflecting

- In a small group, compare the strategies that could be used to solve the problem. Would each strategy allow you to identify all the possible solutions to the problem? Explain.
- How could a **system of linear inequalities** represent all the possible solutions?
- Suggest a possible combination of morning and full-day students that would solve the problem. Explain your choice.
- How would the graph of the system of inequalities change in each situation?
 - The snack budget is \$126 per week.
 - The school accommodates 30 or fewer students.
 - The school has 50 or more students, and the weekly snack budget is no more than \$48.

In Summary

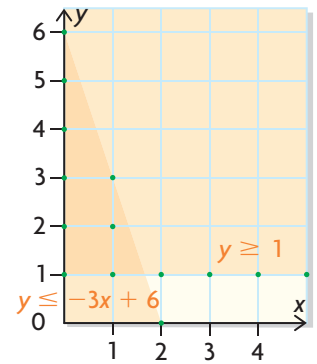
Key Ideas

- Some contextual situations can be modelled by a system of two or more linear inequalities.
- All of the inequalities in a system of linear inequalities are graphed on the same coordinate plane. The region where their solution regions intersect or overlap represents the solution set to the system. For example, this graph shows the solution region to this system:
 $\{(x, y) \mid y \geq x, x \in \mathbb{R}, y \in \mathbb{R}\}$
 $\{(x, y) \mid y \leq 5, x \in \mathbb{R}, y \in \mathbb{R}\}$



Need to Know

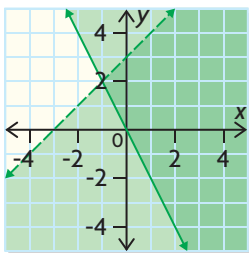
- As with the solution region for a single linear inequality, the solution region for a system of linear inequalities can be discrete or continuous and can be restricted to certain quadrants. For example, the graph to the right shows the system described below:
 $\{(x, y) \mid y \geq 1, x \in \mathbb{W}, y \in \mathbb{W}\}$
 $\{(x, y) \mid y \leq -3x + 6, x \in \mathbb{W}, y \in \mathbb{W}\}$
 Its solution region is restricted to discrete points with whole-number coordinates in the first quadrant.
- If the solution regions for the linear inequalities in the system do not overlap, there is no solution.



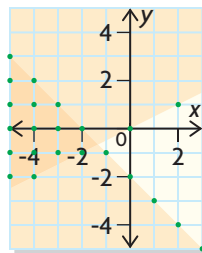
FURTHER Your Understanding

1. Three systems of linear inequalities have been graphed below. For each system, describe what you can infer from the graph about the restrictions on the domain and range.

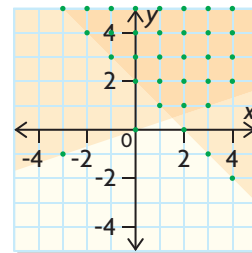
a) $y \geq -2x$
 $-3 < x - y$



b) $x + 3y \geq 0$
 $x + y \geq 2$



c) $x + y \leq -2$
 $2y \geq x$



2. Graph each system of linear inequalities. Justify your representation of the solution set.

a) $\{(x, y) \mid -x + 2y \geq -4, x \in \mathbb{R}, y \in \mathbb{R}\}$ b) $\{(x, y) \mid 2x + 3y \leq 9, x \in \mathbb{I}, y \in \mathbb{I}\}$
 $\{(x, y) \mid y \geq x, x \in \mathbb{R}, y \in \mathbb{R}\}$ $\{(x, y) \mid y - 6x \geq 1, x \in \mathbb{I}, y \in \mathbb{I}\}$