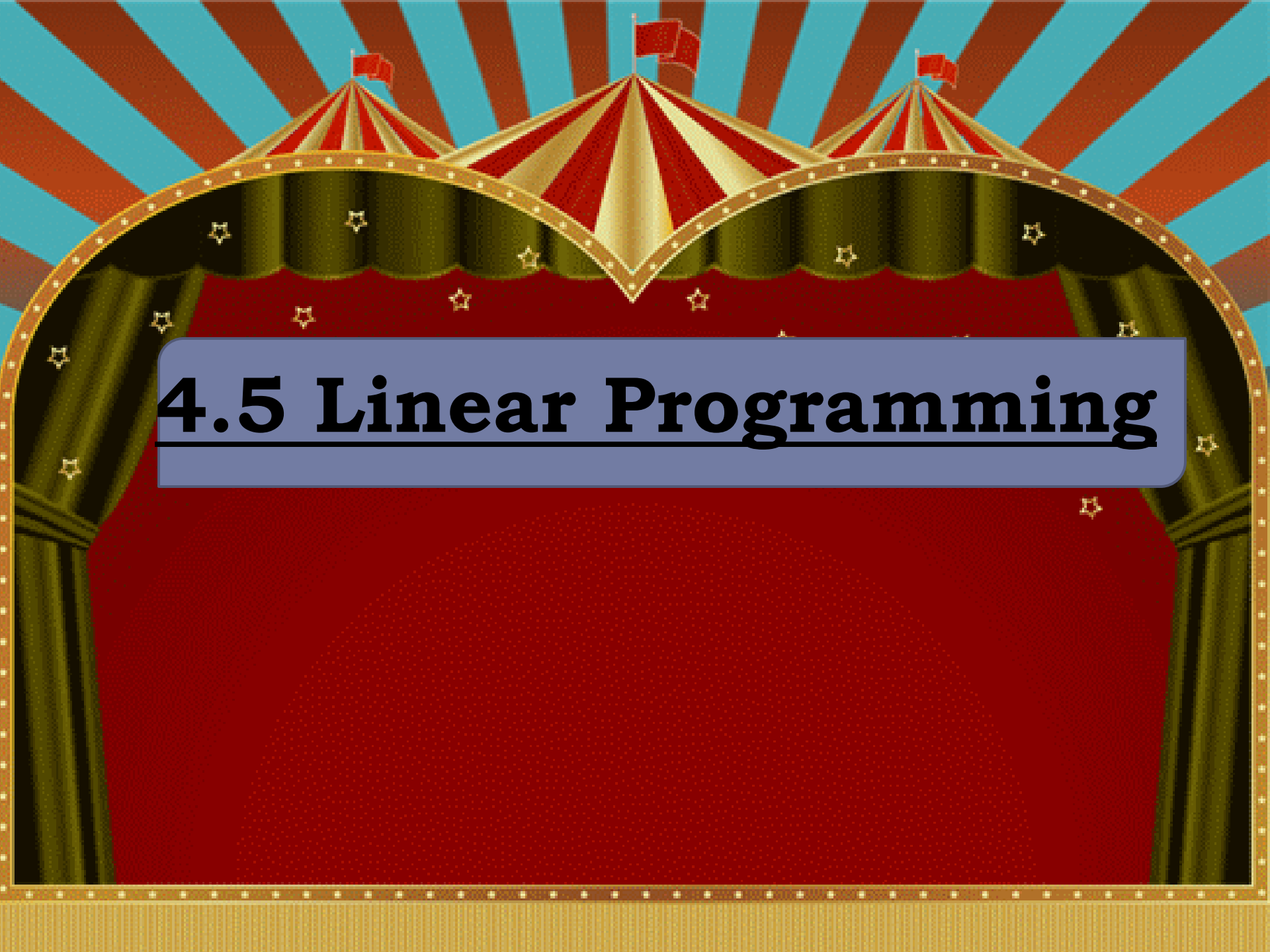
4.5 Linear Programming

Goals

- Write inequalities for business constraints
- Graph inequalities
- Find points of intersection
- Test points to maximize/minimize profits

Profit

- Inventory – goods left on hand

- Efficient
  - Working well
  - Producing a product with a minimum *amount* of energy, expense, and waste

Constraints

- Constraints are :
  - Conditions that must be met by a business
    - (written as linear inequalities)

    - Examples:
      - Money available for investment
      - Time available
      - Materials available
      - Demand for product or service

Constraints

- **Linear Programming**:
  - a method for planning within given constraints

- We use linear programming to maximize and minimize factors in a business situation.

- Maximize = find the greatest value within constraints
- Minimize = find the least value within the constraints

- Example:
  - Businesses wish to maximize profit and minimize cost

Skill 1

- Joe and Brett are planning a road trip to the World Series.
  - A. They are leaving at 10:00 am and do not want to drive after dark. They only have 9 hrs to drive
  - B. They want to travel at least 400 miles.
  - C. They want to stay within the speed limit of 50 miles/hr
- We want to graph the constraints as inequalities and show the different possible ways to make the trip.

- Assign variables
  - Let x = hours

    y = miles
- Write inequalities for each constraint
  - A. The trip is no more than 9 hrs

    $x \leq 9$

    $x \geq 0$
  - B. The distance must be at least 400 miles

    $y \geq 400$
  - C. speed limit of 50 (Distance = rate * time)

    $y \leq 50x$
- Graph the system of inequalities

- After we graph the inequalities we find the corner points of the shaded region by solving the equations that intersect at the given point.

  - Point A

$y = 400$

$y = 50x$

$50x = 400$

$x = 8$

$y = 400$

A (8,400)

What does this point represent?

- After we graph the inequalities we find the corner points of the shaded region by solving the equations that intersect at the given point.

  - Point B

  $y = 400$

  $x = 9$

  $B\ (9, 400)$

  What does this point represent?

- Point C

$x = 9$

$y = 50x$

$y = 50x$

$y = 50(9)$

$y = 450$

C (9,450)

- What does this point represent?

SKILL 2

- Nick, Pavel, and Henrick have begun selling bobble heads and souvenir pucks. They purchase the bobble heads for $4.50 and the pucks for $2.50. There are some constraints that affect their business.
  - To satisfy demand, they must produce at least 30 items per week.
  - The supplier can supply them no more than 20 pucks per week.
  - Because of free puck night at the Joe they must be ready to sell at least as many pucks as bobble heads.

- Assign variables
- Express the constraints as inequalities:
  - They must sell a total more than 30 items.
    - $x + y \geq 30$
      - In slope intercept : $y \geq -x + 30$
  - They can obtain no more than 20 pucks
    - $y \leq 20$
  - They will sell at least as many pucks as bobble heads.
    - $y \geq x$
  - Graph

- We want to find the lowest costs within the given constraints.
  - We need to choose a quantity that we want to maximize or minimize and write an equation for that quantity. **OBJECTIVE FUNCTION**
  - Identify the constraints
    - We want to minimize total cost. Cost is expressed by the following equation:
      - C = 4.50x + 2.50y where c = the cost
        x = the number of bobble heads
        y = the number of souvenir pucks

- Substitute vertices in the objective function $c = 4.50x + 2.50y$.
- Where is the lowest cost achieved?