Economists have a variety of terms for these level sets. Let's compare:

1. **Maximize** the Top of a Hill
2. **MV** between y and x
3. **Tradeoff Ratio**
4. **Y** on the balloon

**Exercise Goals** (color-coded to Four Tasks)
- The overarching goal is to provide an intuitive introduction to the tradeoffs inherent in marginal analysis. The goal is to identify, z, represents utility, profit, or output produced while x and y are inputs or outputs, depending on economic situation under analysis.
- To visualize marginal value of x as slope in the x direction.
- To visualize marginal value of y as slope in the y direction.
- To find a point where y is twice as valuable as x using tradeoff ratios (TR = MV_y/MV_x, the slope of the level set).
- To find a point where y equals the slope of the balloon and on the graph as tangency between constraint and level set.
- To relate tangency to marginal values and Equal Bar (+) for the bucket rule.

**Building the Balloon Model**

The algebraic counterpart requires solving two equations in two variables. I.e.,

\[ \begin{align*}
    x + 2y &= 18 \\
    2x + y &= 20
\end{align*} \]

At (C) = (8, 5), the MV_y = 2860 & MV_x = 1200.

**4.1 Estimating Δz in Any Direction**

Task 1. Visualizing z Slope in the x Direction
- **Marginal value of x, MV_x** is 9 - 13/9 * 0.001 = 9 - 0.0014 = 8.9986
- **Marginal value of y, MV_y** is 40 - 4 * 0.001 = 40 - 0.004 = 39.996

The slope in the y direction at any value of y, MV_y, depends on the specific value of x that is being held fixed (x). It was the case that when visualizing the graph paper provided. Make sure to include the isocontours. This exercise works best if the geometric and algebraic analyses are interwoven.

**4.2 Level Sets and Tradeoff Ratios**

Task 2. Visualizing z Slope in the y Direction
- **Marginal Value of x, MV_x** is 25 + 40 - 0.001 = 25 + 0.0012 = 25.0012
- **Marginal Value of y, MV_y** is 2 y + 40 - 0.001 = 2 y + 0.0008 = 2 y + 0.001
- The surface of the balloon z(x, y) can represent a number of economic concepts including profits and losses. For example, the purple line indicates the profit hill using the graph paper provided. Make sure to include the isocontours. This exercise works best if the geometric and algebraic analyses are interwoven.

**4.3 Using MV to find the Top of a Hill**

Building the Model

- Each Group needs the following Materials (slide deck) and instructions.

**4.4 The Constrained Optimality is the Tangency between Balloon and Constraint**

Looking at the balloon from overhead, hold the balloon horizontally so that the front of the balloon is touching the paper and lower the balloon until the balloon at the 0 point in the graph and upper the balloon until the balloon is in the goal point. The profit at (0, 0) is $200. Solve for the balloon, MV_x = MV_y = 0.

The algebraic counterpart requires solving two equations in two unknowns: a) constraint function & b) Tradeoff ratio = price ratio x = 25 - 2x + 40 - 2y = 65 - 2x - 2y

-Solve for x in (a): x = 18 - 2
-Cross-multiplying (b) to obtain: 50 - 4x + 2y = 40 - 2y = 0
-The simplified system is:
-Substitute for x and solve for y: x = 10 - 5y
-Solve x in (a) to get 40 - 4y = 0
-A = (8, 5), the MV_x = 2860 & MV_y = 1200.

This exercise works best if the geometric and algebraic analyses are interwoven.

**How to Create an Oval Balloon from a Round Balloon**

- Round balloons are readily available, but not desirable, as it is more difficult to represent economic models correctly. The balloon should be held approximately 10 inches above the table so that it will not grow from the sides with your fingers.

**Positioning your Balloon on the Base**

- Place your balloon on a 40 x 25 sheet of graph paper to begin.

**Exercise 1:**

- Draw a dashed line between (8, 5) and (10, 10).
- Use your ruler to draw a dashed line between y(x) and the given x = 10.

**Exercise 2:**

- Substitute for x and solve for y:

- The algebraic counterpart requires solving two equations in two unknowns: a) constraint function & b) Tradeoff ratio = price ratio x = 25 - 2x + 40 - 2y = 65 - 2x - 2y

-Solve for x in (a): x = 18 - 2
-Cross-multiplying (b) to obtain: 50 - 4x + 2y = 40 - 2y = 0
-The simplified system is:
-Substitute for x and solve for y: x = 10 - 5y
-A = (8, 5), the MV_x = 2860 & MV_y = 1200.

This exercise works best if the geometric and algebraic analyses are interwoven.

**Exercise 3:**

- The surface of the balloon z(x, y) can represent a number of economic concepts including profits and losses. For example, the purple line indicates the profit hill using the graph paper provided. Make sure to include the isocontours. This exercise works best if the geometric and algebraic analyses are interwoven.