Breaking Down Base Rates

Thinking Probabilistically

ALLIANCE FOR DECISION EDUCATION

Grade Level

6th-8th

Suggested Timing

55-65 minutes

Focus Standard

TP.4 - Use probabilistic thinking when making predictions and evaluating real-world contexts involving uncertainty

Supporting Standards

TP.2 - Strategically apply appropriate numeracy and probability techniques

CB.8 - Recognize and actively resist the tendency to ignore measures of likelihoods and relevant data when making judgments

Resources

Grid worksheets

Subject

Mathematics

Impact

Understanding base rates helps us to calibrate our thinking and make informed decisions. In this lesson, students explore the concept of a base rate and how it can support their decision-making.

Objectives

- Students will use known base rates to solve a problem.
- Students will identify ways that base rates can support their decision-making.

Optional Teaching Strategies

- Split your students into small groups during the scenario portion of the lesson.
- You can extend the taxi problem (below) to a 20x20 grid and ask the students to consider larger percentages. This will showcase that ratios can be used to anticipate large numbers given that the conditions are the same.

Differentiation

- Provide multiple examples of base rate fallacy/neglect to demonstrate how it applies in different contexts.
- Create a checklist for students who are struggling to break down the steps of the taxi problem.

What To Look and Listen For

- Are students able to accurately represent the base rates using the grid?
- What conclusions are students able to draw based on their visual representations of the problem?
- Are students able to transfer the application of base rates to other scenarios?

Engage (10 minutes)

Introduce the concept of base rates to your students in two parts: Please visit our teaching resource, *Understanding Base Rates,* for details about these concepts.

1. **Base rate:** A number, usually a percentage, that represents the prevalence of a characteristic in a population. It gives you information on how frequent or likely an event might be.
2. **Base rate neglect**: the tendency to ignore base rates.

Suggested Questions:

- Why are base rates important?
- Why do you think there is a tendency to ignore base rates? How could that be harmful?

Apply (30-40 minutes)

Introduce the famous taxi problem created by Amos Tversky and Daniel Kahneman with your students:

> Suppose you were told that a taxi was involved in a hit-and-run accident one night. Of the taxis in the city, 85% belonged to the green company, and 15% to the blue company. You are then asked to estimate the likelihood that the hit-and-run accident involved a green taxi (all else being equal). You would probably say that there is an 85% chance, since 85% of the taxis are green. However, suppose you were then told that an eyewitness had identified the taxi as a blue taxi. But when the individual's ability to identify taxis under appropriate visibility conditions was tested, the individual was wrong 20% of the time. You now have to decide the probability that the taxi involved in the accident was blue.
> **Which taxi company is likely responsible, blue or green?**

Collect students' initial responses in a quick poll. Then, assign small groups to discuss and solve the problem, introducing the 10x10 grid sheet or the 20x20 grid sheet and using different colors to represent their thinking about the taxi problem.

Suggested Prompts and Questions:

Assume a sample population of 100 taxis. Each box in the grid represents one taxi.

- On a 10x10 grid sheet, outline the number of blue taxis and green taxis if 100 taxis were operating.
- Shade in the number of taxis identified as blue in the portion that is outlined in blue. This will represent the number of taxis correctly identified as blue. [Example Solution: here]
- Recall that 20% of green taxis will be identified as blue. Shade in the number of taxis identified as blue that are green in the portion outlined as green. This will represent the number of taxis incorrectly identified as blue.
- How many taxis were identified as blue? [29]
- How many of these taxis are actually green? [17]
- What is the likelihood of the taxi being blue? [blue taxis identified : 29-17=12, therefore likelihood of blue is 12/29 = 41.4%]
- Based on the grid examples above, who do you **NOW** think is responsible for the hit and run? Why?

Repeat the exercise above with different base rates to explore how the base rate affects likelihoods.

Suggested Follow-up Question:

- Ask your students to predict what would happen if 70% were green taxis and 30% were blue? 60% green? 40% green?

Reflect (15 minutes)

Have your students revisit the questions they answered prior to the exercise. What have they learned and how might they modify their responses?

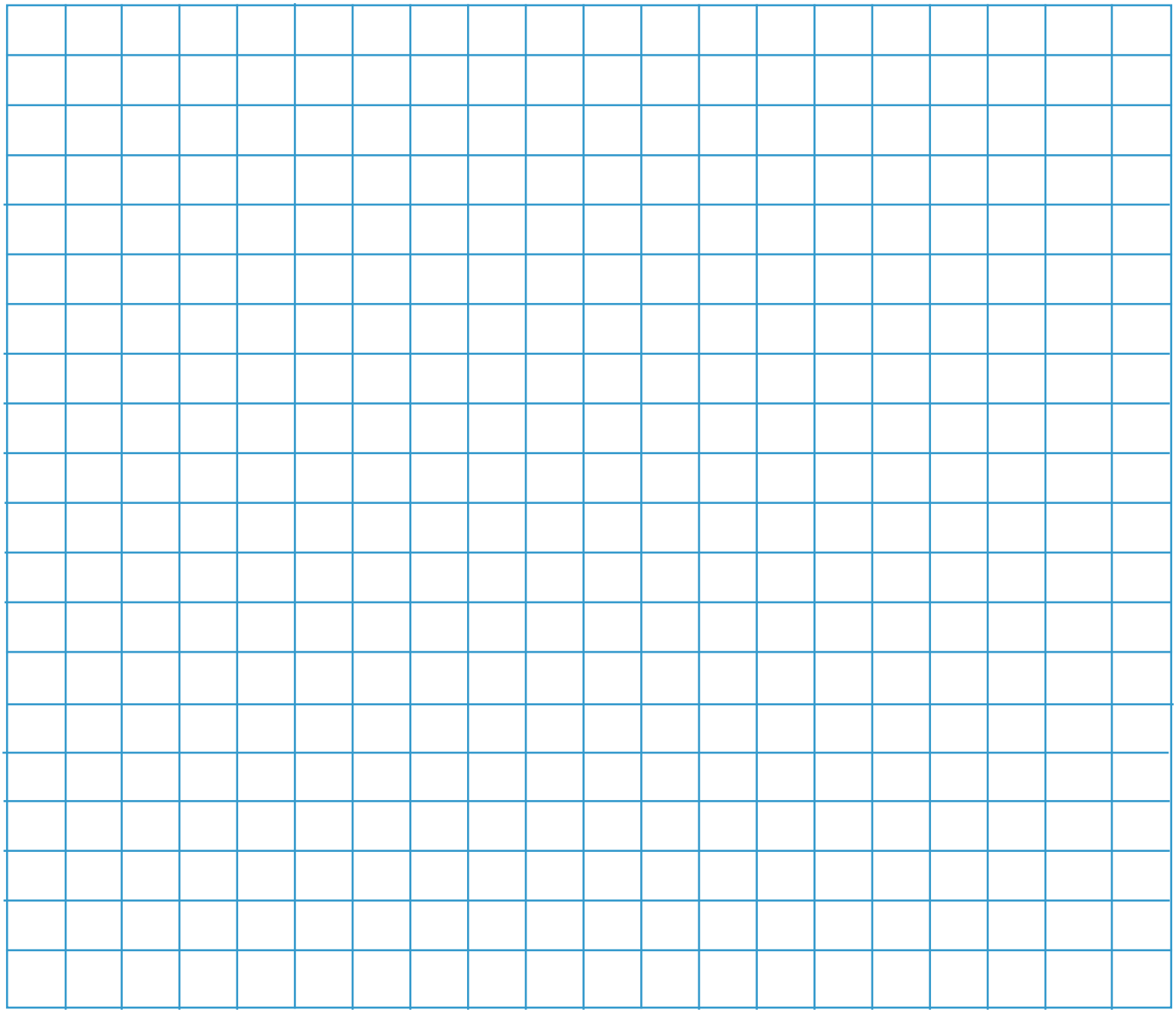
- Why are base rates important?
- Why do you think there is a tendency to ignore base rates? How could that be harmful?

Lead a discussion about the practical application of base rates by identifying scenarios that your students can incorporate this thinking into their decision-making.

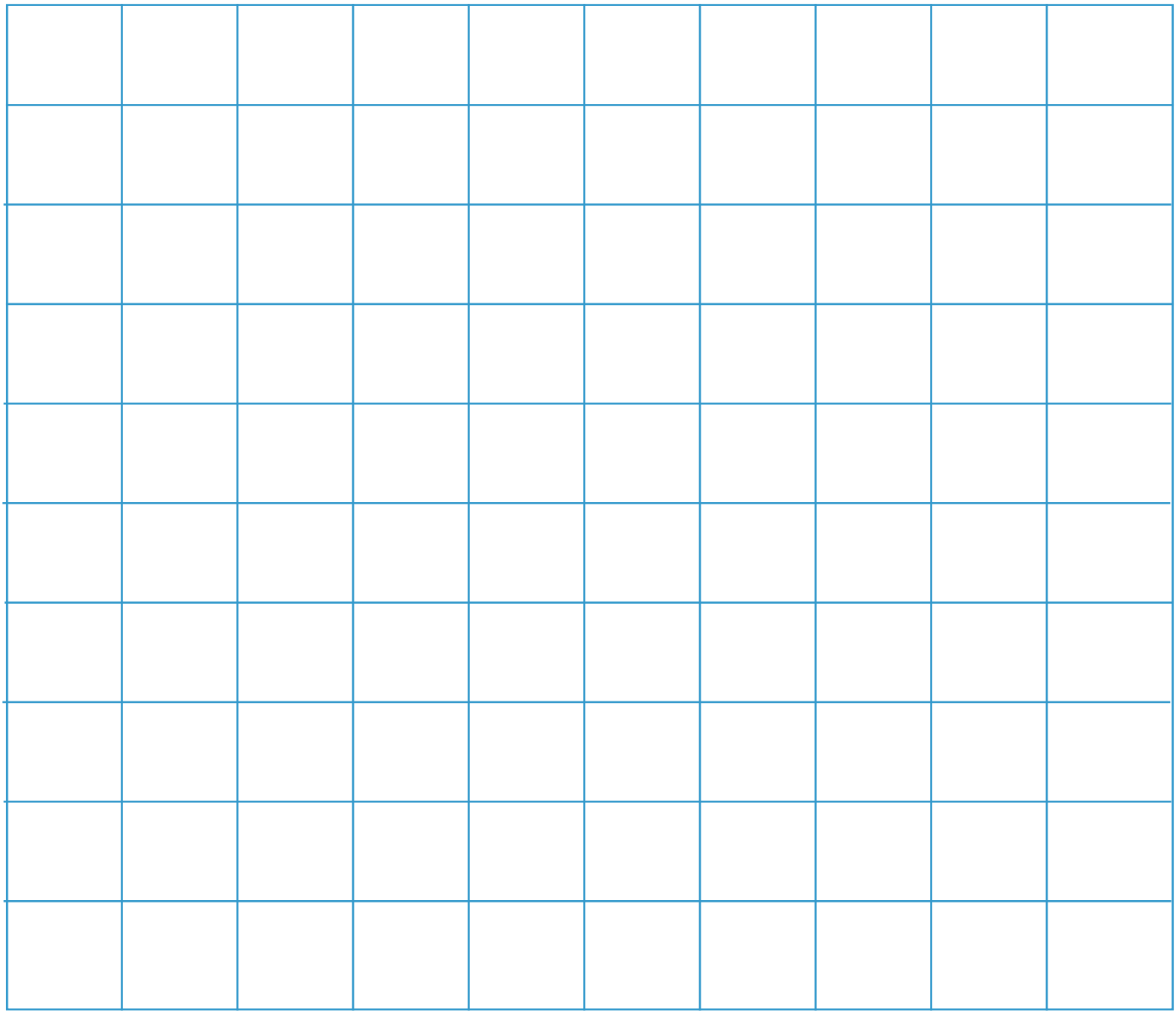
Suggested Questions:

- How did using a base rate shift your thinking about the taxi problem?
- What are some scenarios where using a base rate could help you make a more informed decision?

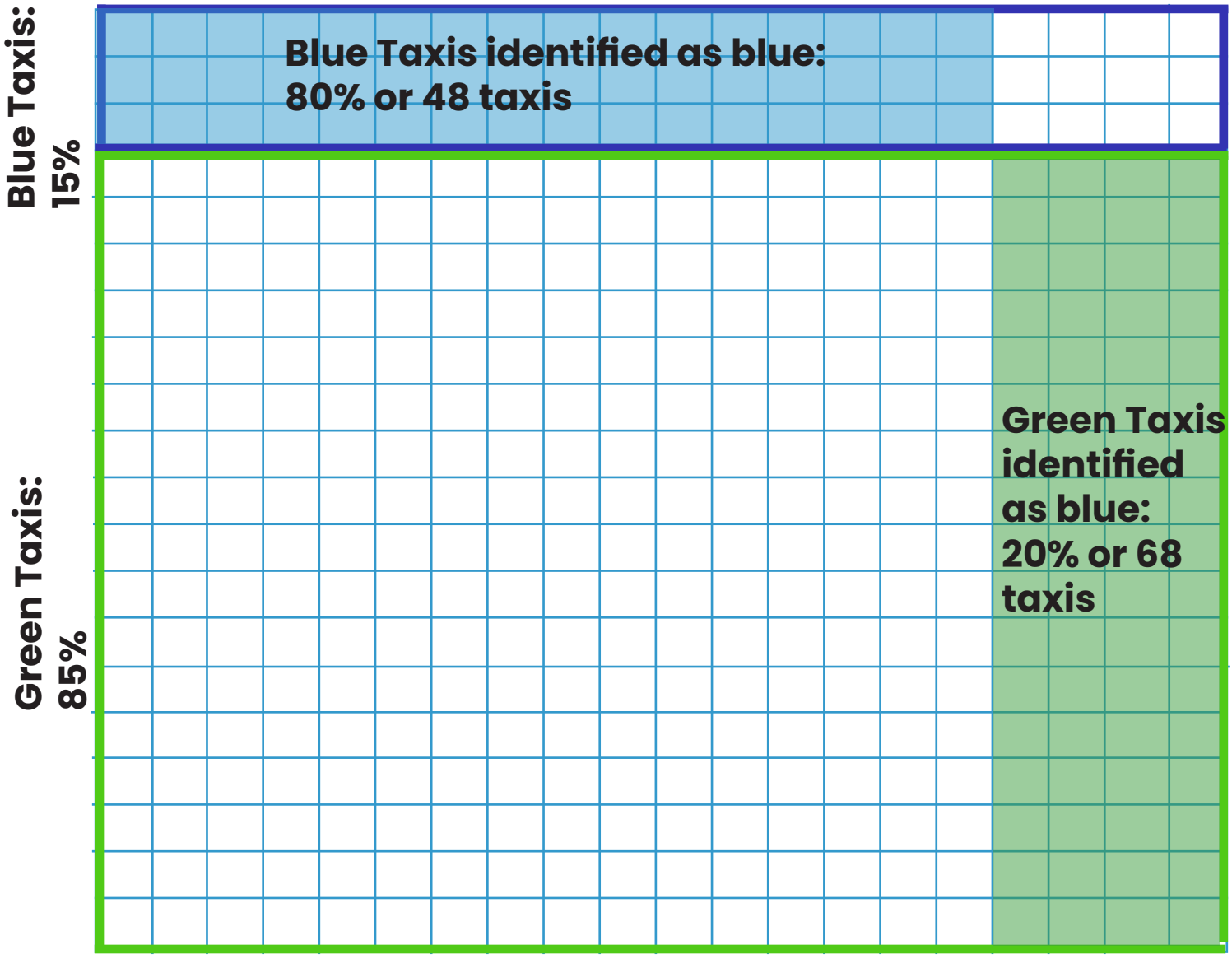
20 x 20 grid sheet



10 x 10 grid sheet

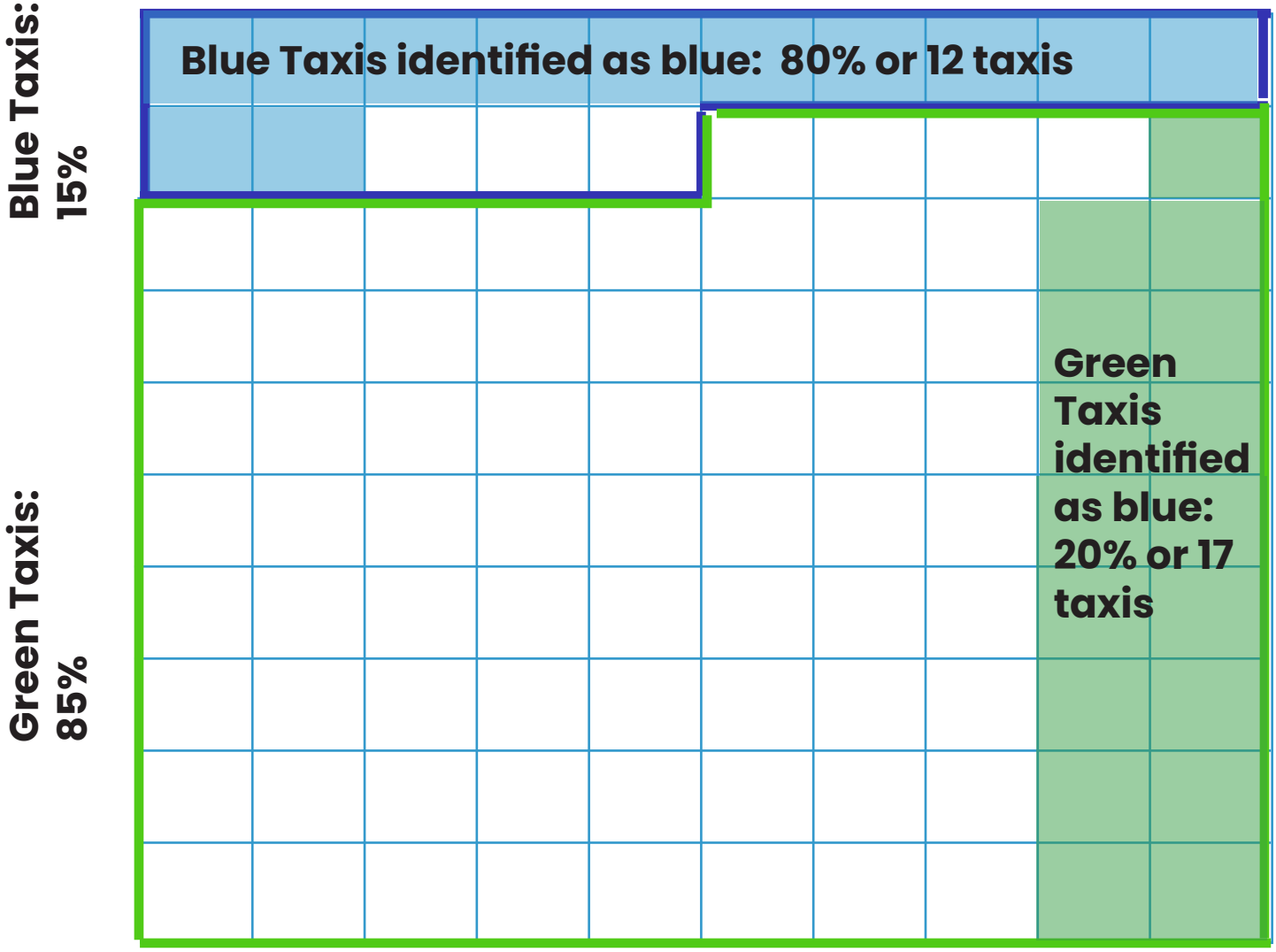


Solution with a 20x20 grid



Taxis identified as blue that are blue: 48
Taxis identified as blue that are green: 68
Total Taxis identified as Blue: 48+68 = 116
Likelihood Taxi is blue: 48/116 or 41.4%

Solution with a 10x10 grid



Taxis identified as blue that are blue: 12
Taxis identified as blue that are green: 17
Total Taxis identified as Blue: 12+17 = 29
Likelihood Taxi is blue: 12/29 or 41.4%