

# Learning Objectives - Bayes' Rule

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The following questions will help you review what you learned in the Bayes' Rule lesson.

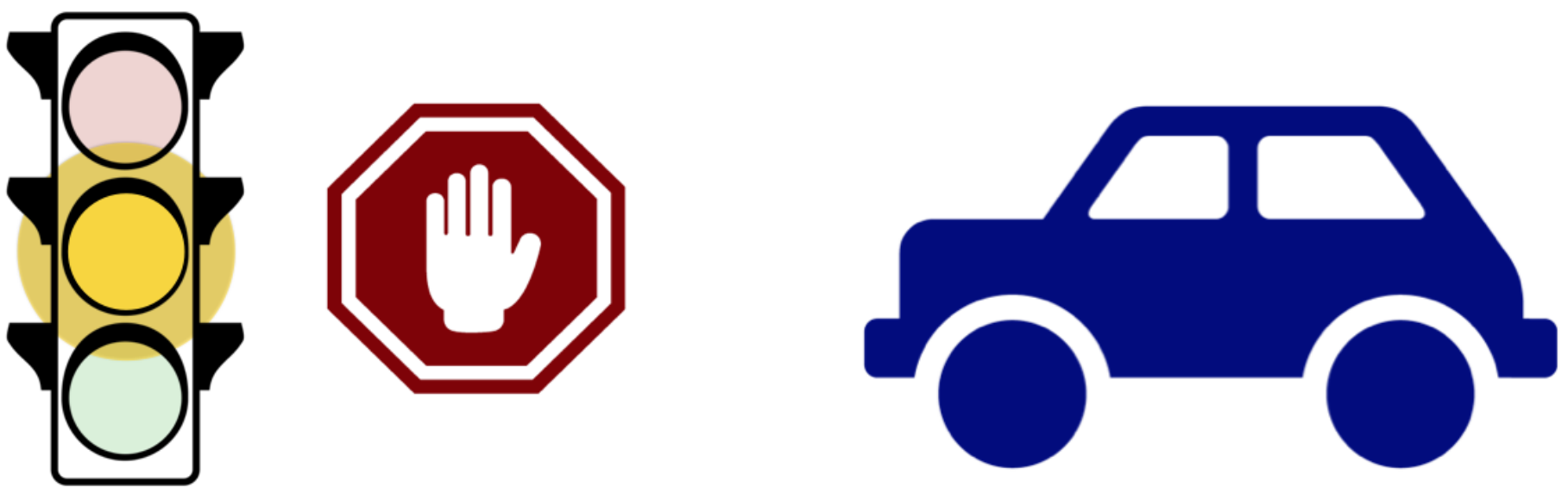
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## Prior knowledge

**For questions 1-3, assume you already have the following knowledge:**

You're interested in finding out the probability of a car stopping if it sees a *yellow* traffic light.

- Past data tells you that the probability of a car stopping at a traffic light intersection is  $P(S) = 0.40$ .
  - You also know that the past probability of a traffic light being yellow (as opposed to red or green) is  $P(Y) = 0.10$ .
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Car stopping at a yellow light

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## Traffic Light q1

When a car is stopped at an intersection, data shows that 12% of the time the light is yellow. So if we know a car is stopped, there's a 12% chance the light is yellow. This is called a *conditional probability*.

Given  $P(S)$  and  $P(Y)$  above, how would you represent this conditional probability in notation?

☐  $P(S|Y) = 0.12$

☐  $P(S) = 0.12$

☒  $P(Y|S) = 0.12$

☐  $P(Y,S) = 0.12$

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## Traffic Light q2

Using what you know from question 1, answer the following: if the traffic light is yellow, what is the chance that the car will stop?

☐ 0.04

☐ 0.33

☐ 0.40

☒ 0.48

☐ 0.50

☐ 0.52

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## Traffic Light q3

Knowing that a car stopping at an intersection and the presence of a yellow traffic light are related events, what are  $P(S)$  and  $P(Y)$  known as?

☐ Posterior probabilities

☐ Past probabilities

☒ Prior probabilities

☐ Total probabilities

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Questions 4 and 5 are different scenarios.

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#### Prior knowledge for question 4:

On a four-lane highway, cars are either going fast or not fast. Faster cars should go in the leftmost lanes.

- At any given time, 20% of cars are in the left-most lane.
  - Overall, 40% of cars on the highway are classified as going fast.
  - Out of all the cars in the leftmost lane, 90% are going fast.
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### Bayes q2

Given the above information, if a car is going fast, what is the probability that it will be in the leftmost lane?

☐ 0.125

☐ 0.25

☒ 0.45

☐ 0.55

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Bayes' rule is not only used to incorporate sensor data into an estimate; it's also often used to incorporate test data into a medical diagnosis.

#### Prior knowledge for question 5:

- 1% of all people have cancer.
  - 90% of people who have cancer test positive when given a cancer-detecting blood test, meaning the test detects cancer 90% of the time.
  - 5% of people will have false positives, meaning that 5% of the time, this test will produce a positive result when people *do not* have cancer.
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### Bayes q3

Given the above data, what is the probability that a person has cancer if they have a positive cancer-test result? (Note: answers are rounded to the nearest 4th decimal place).

☐ 0.1125

☒ 0.1538

☐ 0.2687

☐ 0.8924

