

Part 2: Odds and odds ratios

A key thing to understand with logistic regression!

Odds and odds ratios

- An odds ratio is one of the most important outcomes of logistic regression
- Odds ratio = Change in odds resulting from a unit change in the predictor
- Measure of association between a predictor and an outcome
- But what are odds...?

$$\text{Odds} = \frac{\text{Probability event occurs}}{\text{Probability event does not occur}}$$

Our example



	Happy - No	Happy - yes	Total
Hamster - no	12	8	20
Hamster - yes	8	25	33

Odds in the no hamster group

$$Odds = \frac{\text{Probability event occurs}}{\text{Probability event does not occur}}$$

$$Odds = \frac{\text{Probability happy}}{\text{Probability not happy}}$$

	Happy - No	Happy - Yes	Total
Hamster - No	12	8	20

What's the probability they **are** happy?
 $8/20 = 0.4$

What's the probability they **are NOT** happy?
 $12/20 = 0.6$

$$Odds = \frac{0.4}{0.6} = 0.667$$

Odds in the hamster group

$$Odds = \frac{\text{Probability event occurs}}{\text{Probability event does not occur}}$$

$$Odds = \frac{\text{Probability happy}}{\text{Probability not happy}}$$

	Happy - No	Happy - Yes	Total
Hamster - Yes	8	25	33

What's the probability they **are** happy?
 $25/33 = 0.75757576$

What's the probability they are **NOT** happy?
 $8/33 = 0.24242424$

$$Odds = \frac{0.75757576}{0.24242424} = 3.125$$

Change in odds (or odds ratio)

$$\text{Odds ratio} = \frac{\text{Odds after a unit change in the predictor}}{\text{Original odds}}$$

No hamster:

Odds = 0.6667

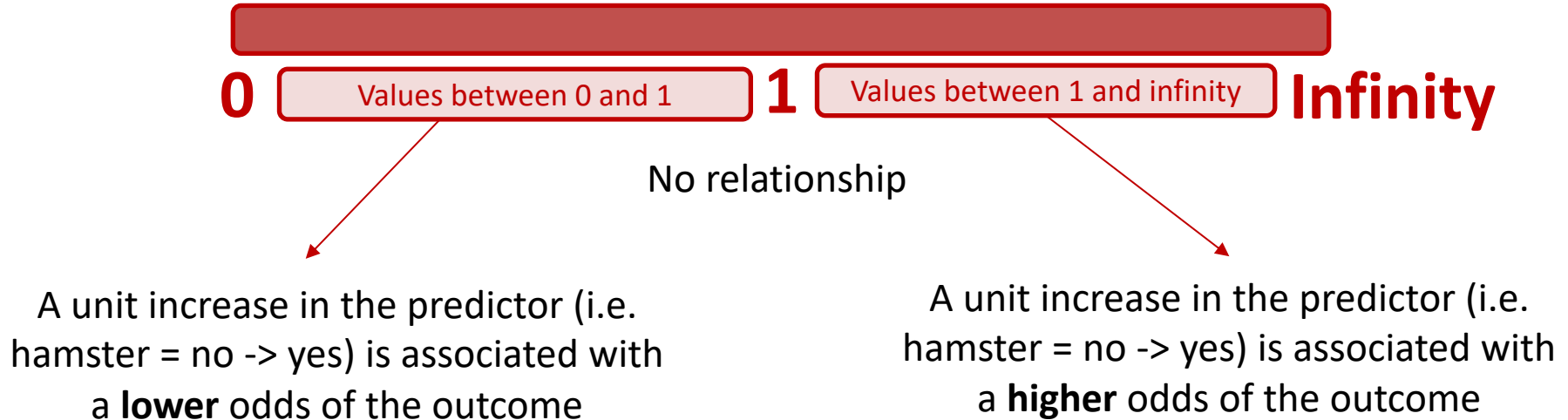
Hamster:

Odds = 3.125

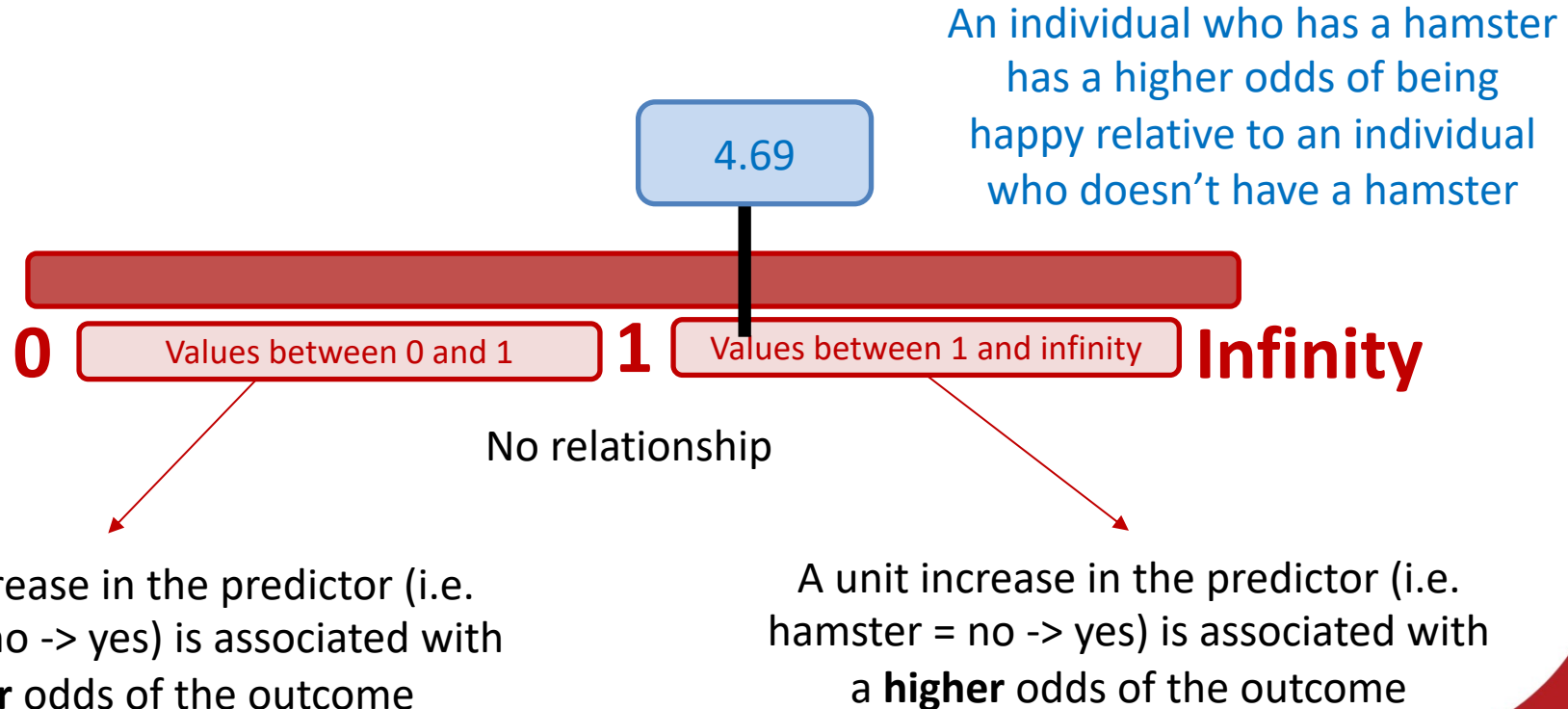
$$\text{Odds ratio} = \frac{3.125}{0.6667} = 4.69$$

Interpreting the odds ratio

Can range from 0 to infinity:



Where does our hamster and happiness example fit?



What does the odds ratio number mean?

- Individuals who have a hamster have 4.69x higher odds being happy relative to individuals who do not have a hamster
- You must use the word ‘odds’ when referring to odds ratios
- A common mistake...

~~Individuals who have a hamster
are 4.69x more likely to be happy
relative to individuals who do not
have a hamster~~

“More likely” – Likely is a term
used to describe probability. It
shouldn’t be used when referring
to odds