Three data types: continuous, counts and coin flips

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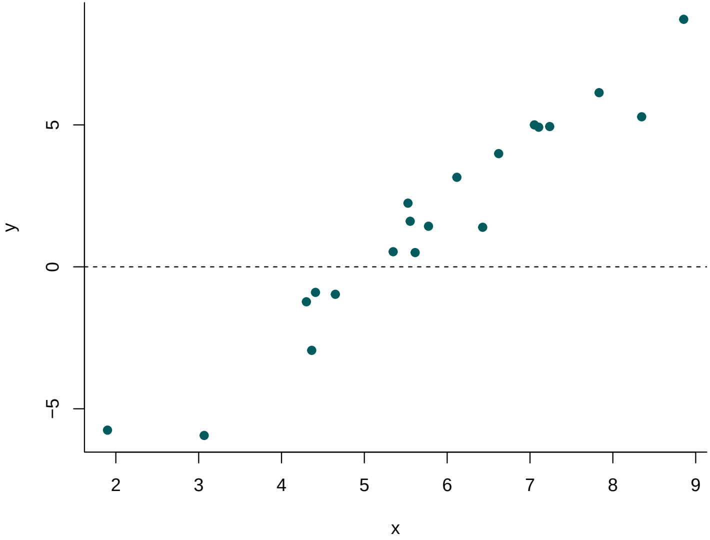
Outline

Describe some features of the response data y

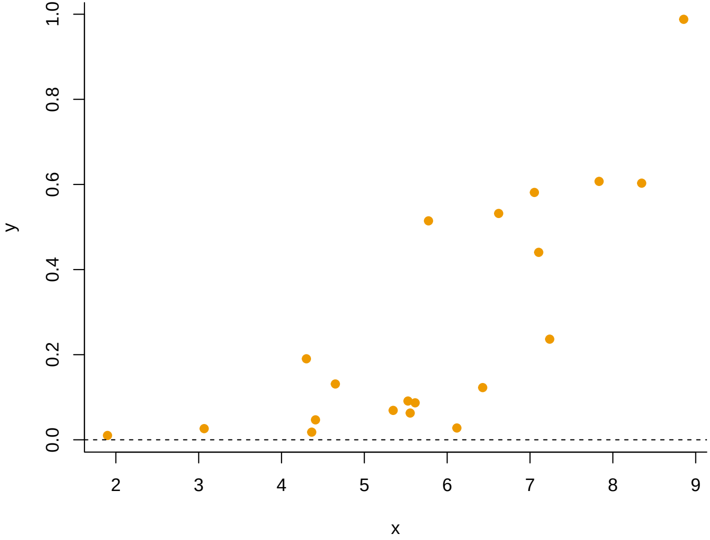


Describe some features of the response data y

Continuous data

- Response y is continuous, e.g., $y = 1.25$ possible
- Response can be positive or negative (on the real line)
- Apparent positive linear relationship with continuous variable x
- **Example** y could be a change in water height

Describe some features of the response data y

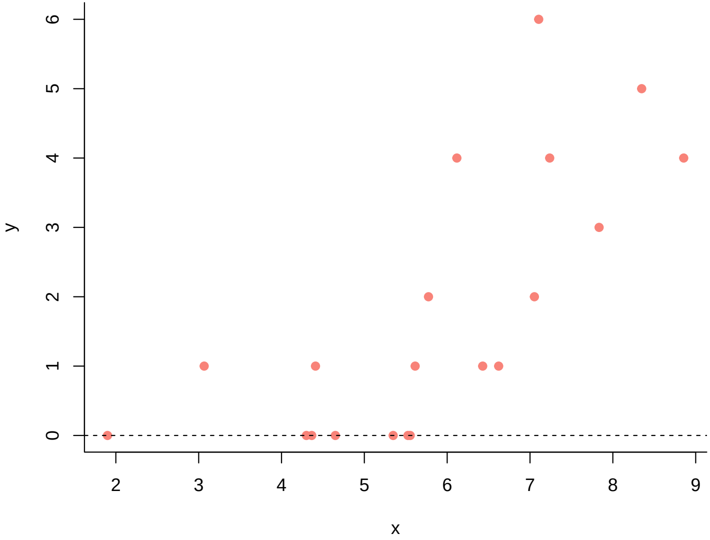


Describe some features of the response data y

Positive continuous data

- Response y is also continuous, e.g., $y = 0.25$ possible
- Response can only be positive (on the positive real line)
- Apparent positive non-linear relationship with continuous variable x
- **Example** y could be mass of individuals
  - Discuss what values mass/weight of a fish could be

Describe some features of the response data y

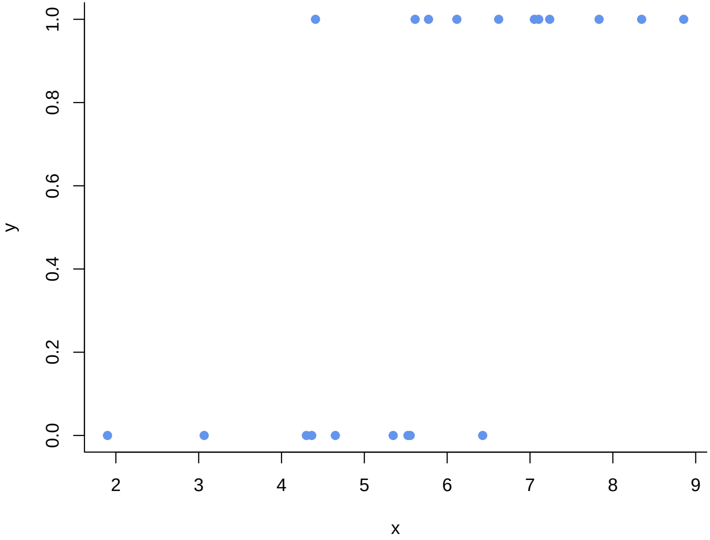


Describe some features of the response data y

Count data

- Response y is a count (discrete), e.g., $y = 1.25$ impossible
- Response can be zero or a positive integer
- Apparent positive non-linear relationship with continuous variable x
- **Example** y could be an organism count per unit area (abundance)
    - Discuss what values of abundance are possible

Describe some features of the response data y



Describe some features of the response data y

Binary data

- Response y can be either a 1 or a 0 (or other binary categories, e.g., on/off)
  - Often it is a sum of positives out of a given number of trials, e.g., total number of heads in 10 coin flips
  - Key thing is that for any one flip there can only be 2 outcomes
- Apparent positive non-linear relationship with continuous variable x
- **Example** y could be maturity status (mature/immature) for an organism
  - Discuss other binary data examples

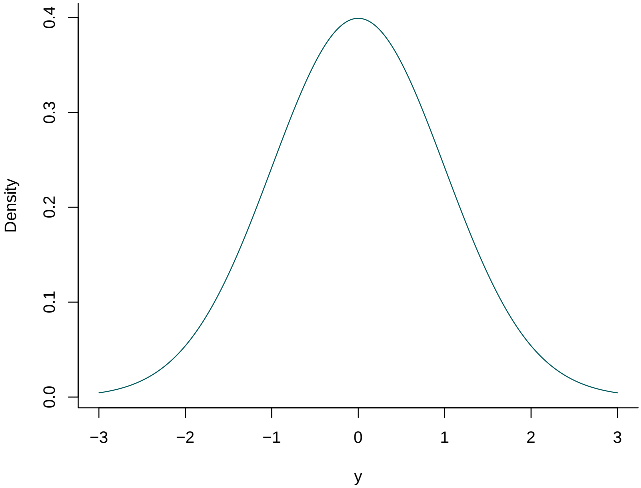
Outline

Probability distribution

A function that describes the probabilities associated with possible outcomes for an experiment (think of the response y)

Continuous probability distributions

Normal distribution



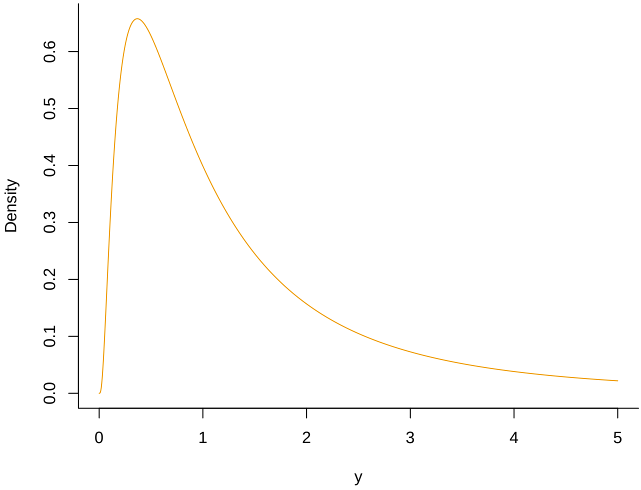
Continuous probability distributions

Normal distribution

- Distribution is continuous, e.g., $y = 1.25$ possible
- Positive or negative values possible (on the real line)
- Governed by two parameters: mean μ and variance σ^2
- Write: $y \sim \mathrm{N}(\mu, \sigma^2)$

Positive continuous probability distributions

Lognormal distribution

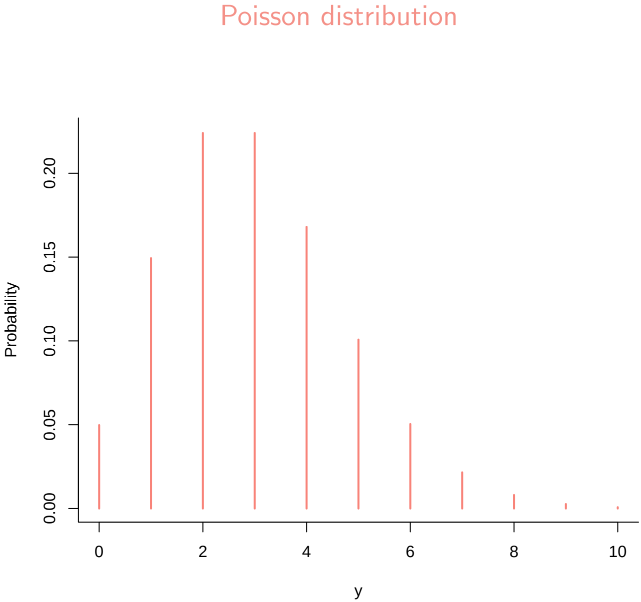


Positive continuous probability distributions

Lognormal distribution

- Distribution is continuous, e.g., $y = 1.25$ possible
- Only positive values possible (on the positive real line)
- Governed by two parameters: mean μ and standard deviation σ (both on log scale)
- Write: $y \sim \text{Lognormal}(\mu, \sigma)$

Count probability distributions



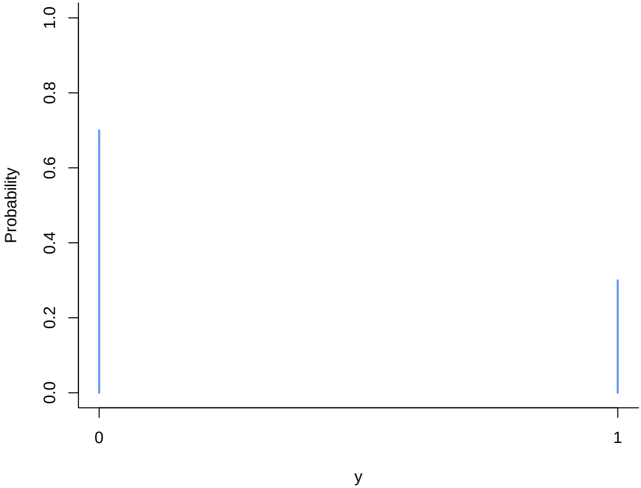
Count probability distributions

Poisson distribution

- Distribution is discrete, e.g., $y = 1.25$ impossible
- Distribution is only positive at zero and positive integers
- Governed by one parameter: rate λ (e.g., density)
  - Discuss rates in relation to counts
- Write: $y \sim \text{Pois}(\lambda)$

Binary probability distribution

Binary (Bernoulli) distribution

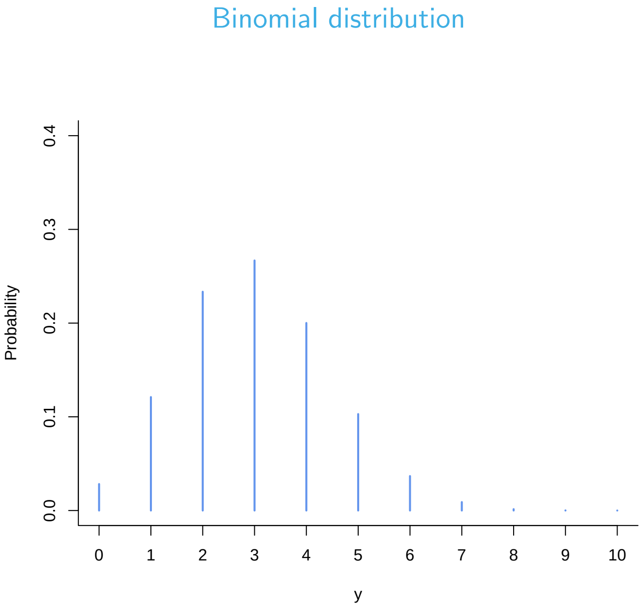


Binary probability distribution

Binary (Bernoulli) distribution

- Distribution over 0 or 1 (or other binary categories) only
- Governed by parameter: probability of success p (e.g., probability of being mature)
- Think: coin flip but coin not necessarily fair
- Write $y \sim \text{Bernoulli}(p)$

Binomial probability distribution



Binomial probability distribution

Binomial distribution

- Distribution over $\{0, 1, \ldots, n\}$ only
- Governed by 2 parameters: number of trials n (think: number coin flips) and probability of success p on any trial
- Write $y \sim \text{Bin}(n, p)$

Note: Binomial is the sum of Bernoulli trials

Outline

Explanatory variables[1]

Often a goal of an experiment or observational study is to relate observed response values to explanatory variables, e.g.,

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- Does behavioural response depend on time-of-day?

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- Does abundance relate to environment, e.g., temperature?
- Does behavioural response depend on time-of-day?
- ...

We would like to explore/model the relationships between the response and explanatory variables

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