JOHNS HOPKINS BLOOMBERG SCHOOL *of* PUBLIC HEALTH

Describing Data: Part II

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Lecture Topics

- The normal distribution
- Means, variability, and the normal distribution
- Calculating normal (z) scores
- Means, variability and z-scores for non-normal distributions

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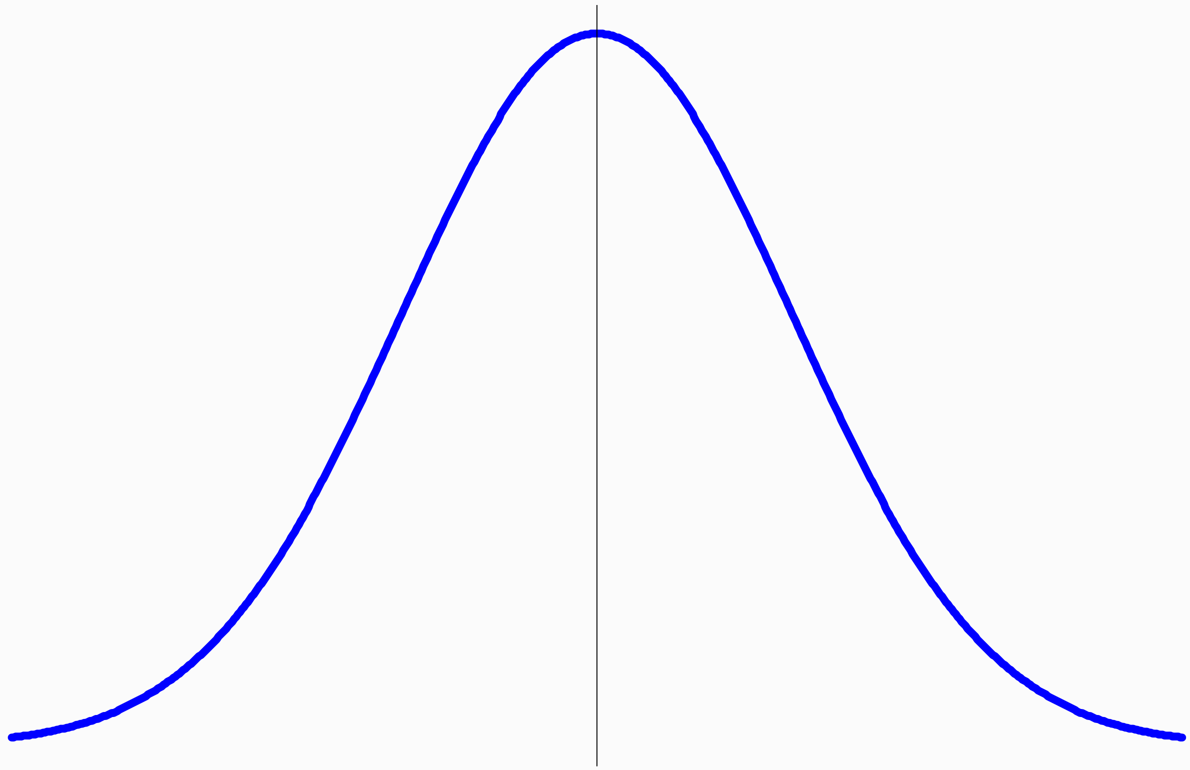
Section A

The Normal Distribution

The Normal Distribution

- The **normal distribution** is a theoretical probability distribution that is perfectly symmetric about its mean (and median and mode), and had a “bell” like shape



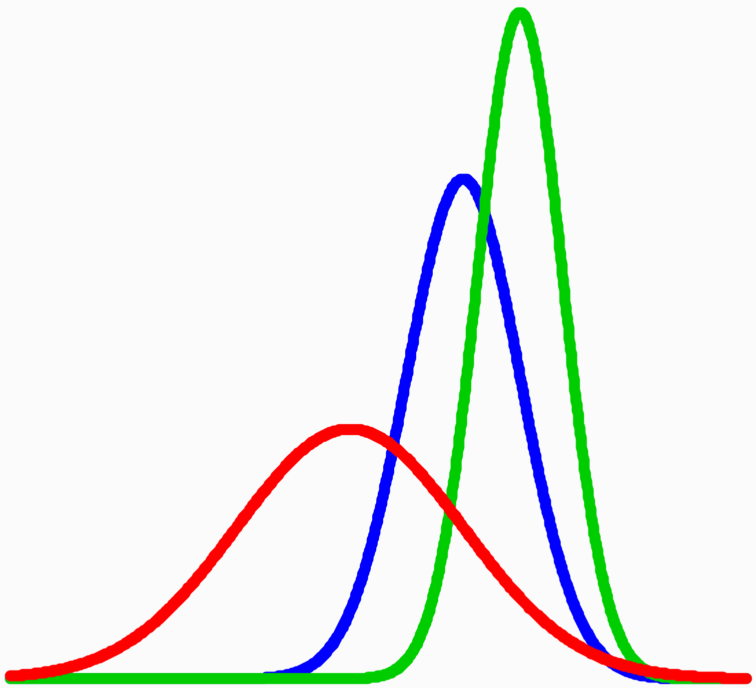
The Normal Distribution

- The normal distribution is also called the “Gaussian distribution” in honor of its inventor Carl Friedrich Gauss

The Normal Distribution

- Normal distributions are uniquely defined by two quantities: a mean (μ), and standard deviation (σ)

- There are literally an infinite number of possible normal curves, for every possible combination of (μ) and (σ)



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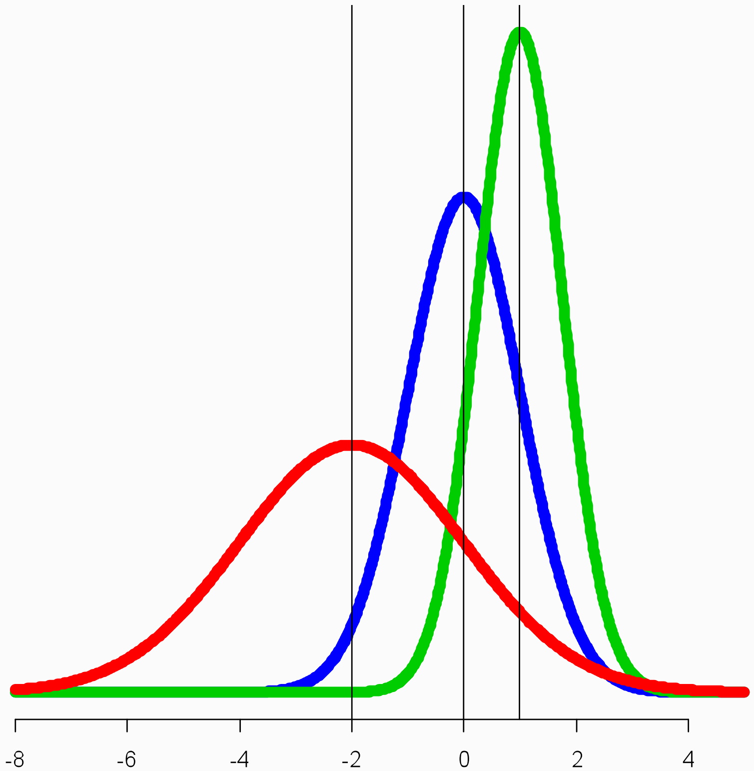

The Normal Distribution

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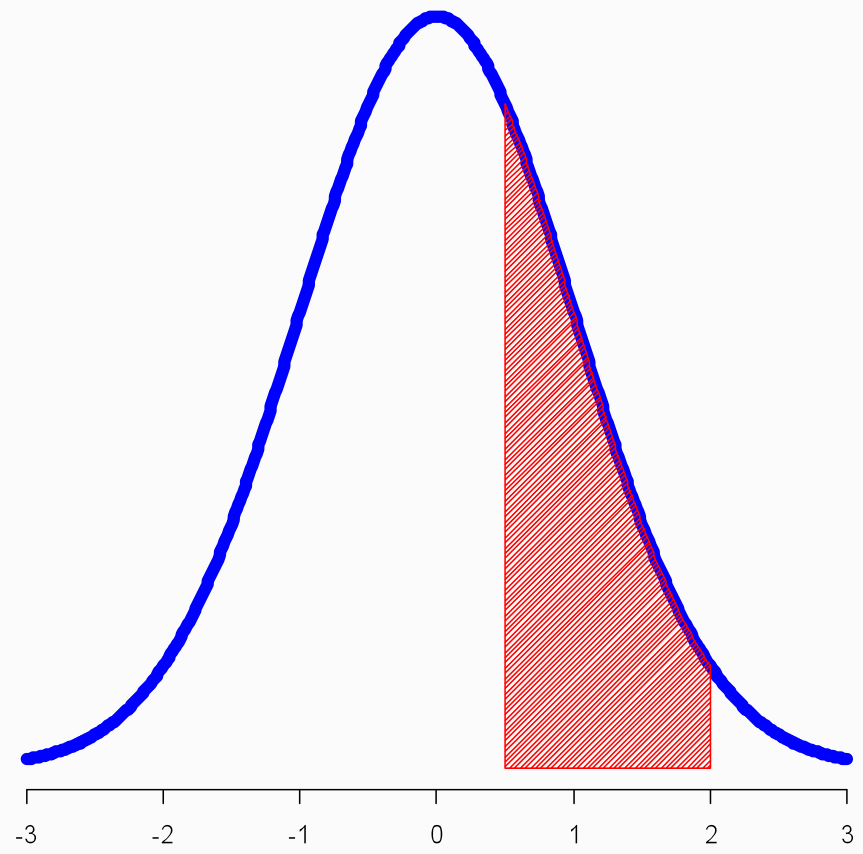
- There are literally an infinite number of possible normal curves, for every possible combination of (μ) and (σ)

- This function defines the normal curve for any given (μ) and (σ)

$$\frac{1}{\sqrt{2\pi\sigma}} e^{\frac{-(x-\mu)^2}{2\sigma^2}}$$

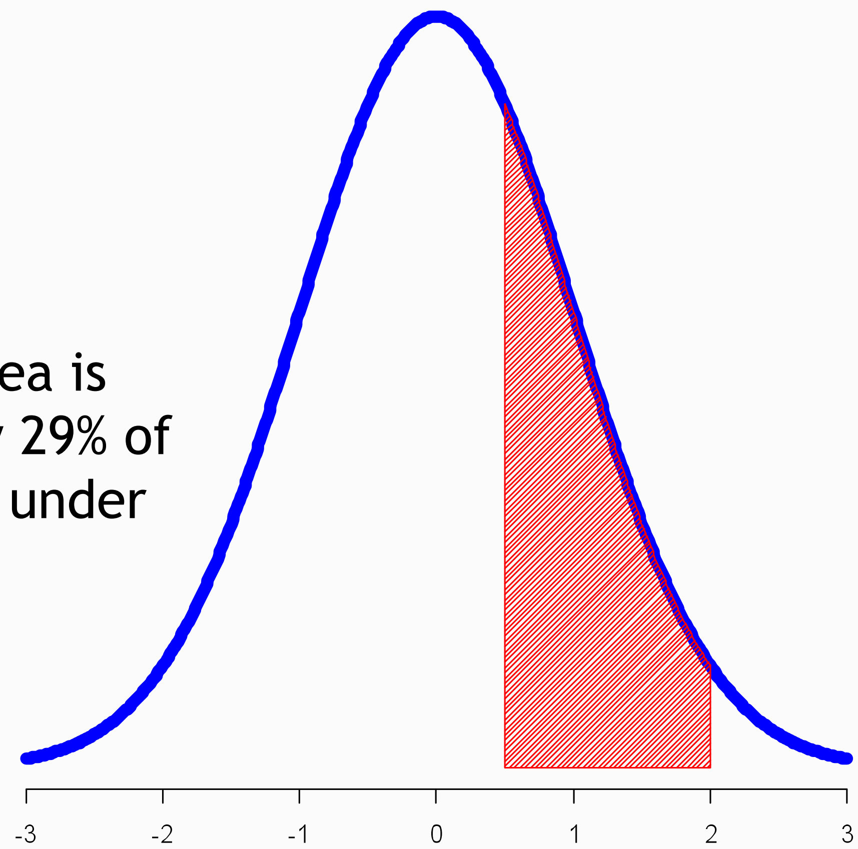
Normal Distribution

- Areas under a normal curve represent the proportion of total values described by the curve that fall in that range



Normal Distribution

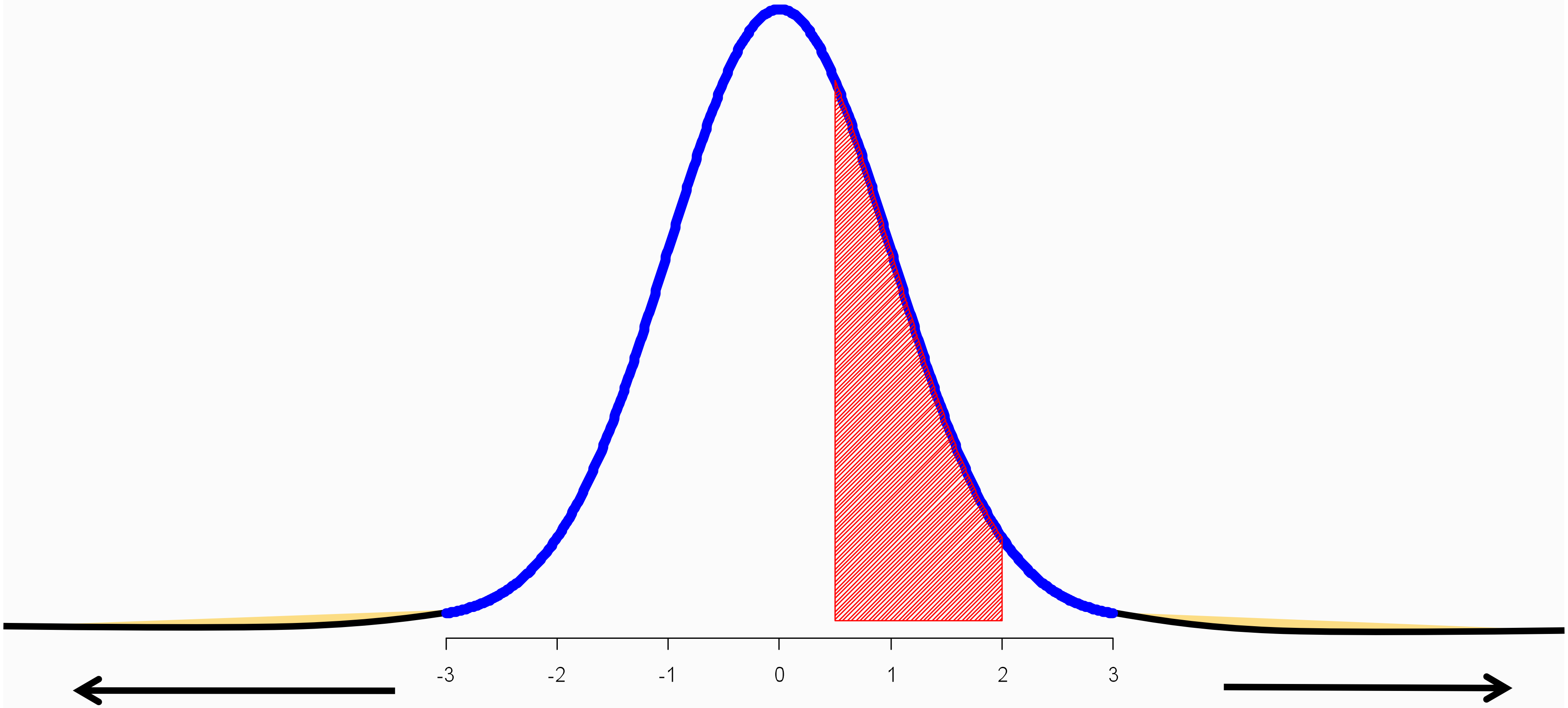
- This shaded area represents the proportion of values (observations) between 0 and 1 following a normal distribution with $\mu = 0$ and $\sigma = 1$



- The shaded area is approximately 29% of the total area under the curve

Normal Distribution

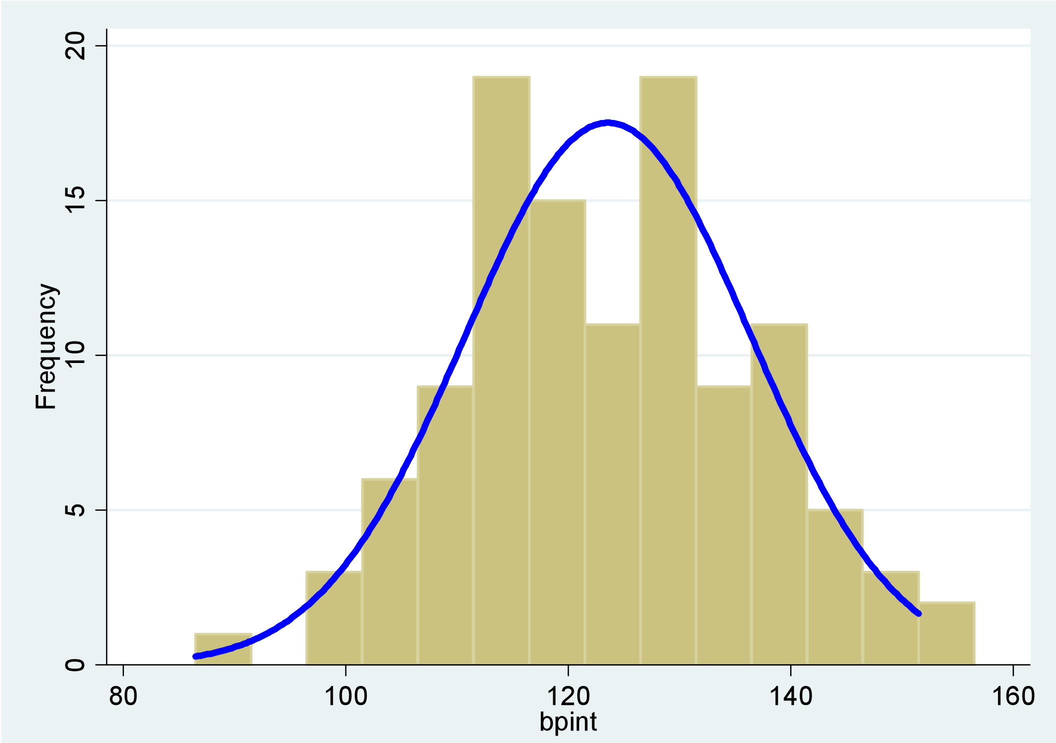
- The normal distribution is a theoretical distribution: no real data will truly be normally distributed (at the sample or population level)
  - For example: the tails of the normal curve are “infinite”



Normal Distribution

- BUT: some data approximates a normal curve pretty well

- Here is a histogram of the BP of the 113 men with a normal curve superimposed (normal curve has same mean and SD as sample of 113 men)
  - Mean 123.6 mmHG, SD 12.9 mmHg



Normal Distribution

- Other data, does not approximate a normal distribution

- Here is a histogram of the hospital length of stay of the 500 patients with a normal curve superimposed (normal curve has same mean and SD as sample of 500 patients)
  - Mean 5.1 days, SD 6.4 days