

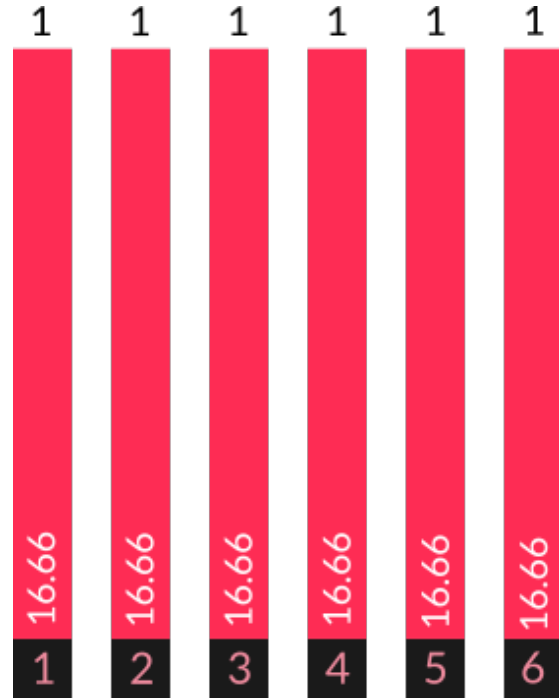


Mathematics and Problem Solving

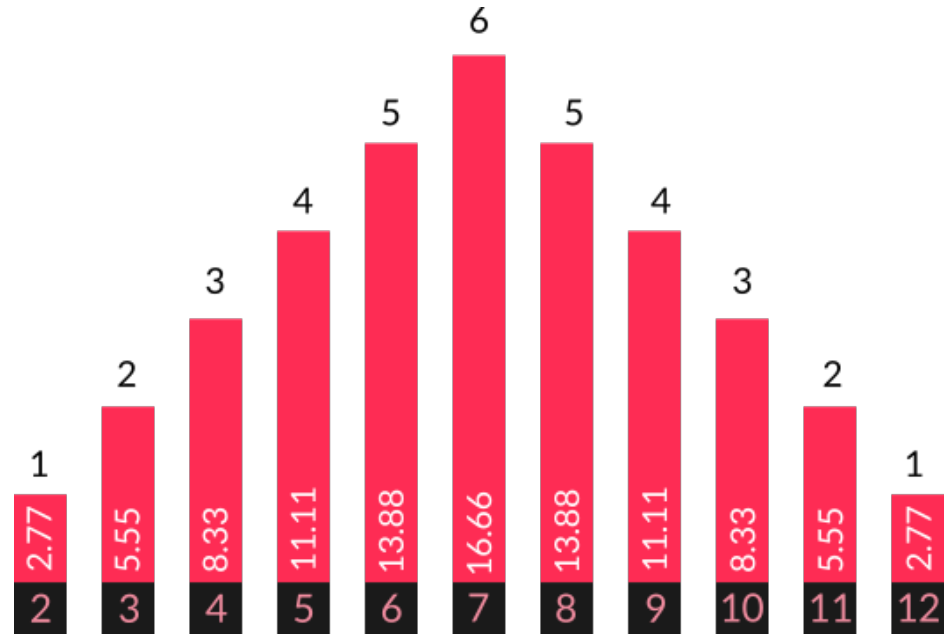
Lecture 11.3

Probability Distributions

- Roll one dice
 - The **probability** of getting each number is **the same**



- Roll two dice and add them together
 - The **probability** differs for each number

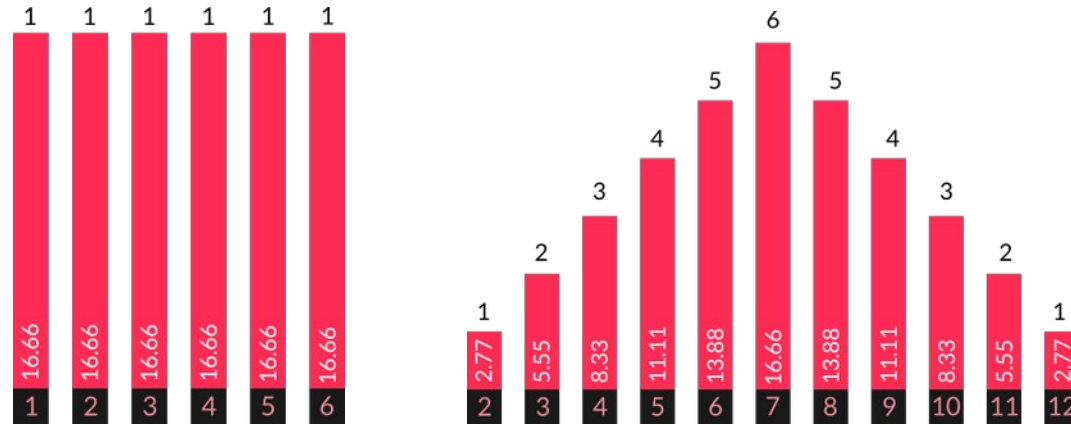


- What's the probability of rolling 7?

$$6/36 = 1/6 = 16.66$$

$$\begin{aligned} & P(1) * P(6) \\ & + P(2) * P(5) \\ & + P(3) * P(4) \\ & + P(4) * P(3) \\ & + P(5) * P(2) \\ & + P(6) * P(1) \end{aligned}$$

- These are two different **probability distributions**



Discrete Distribution

- Discrete
 - Countable $D_1 \dots D_n$
- **Probability mass function** = list of values and their probabilities
 - Sum to 1



Discrete Uniform Distribution

- Discrete
 - Countable $D_1 \dots D_n$
- Uniform
 - All same probability



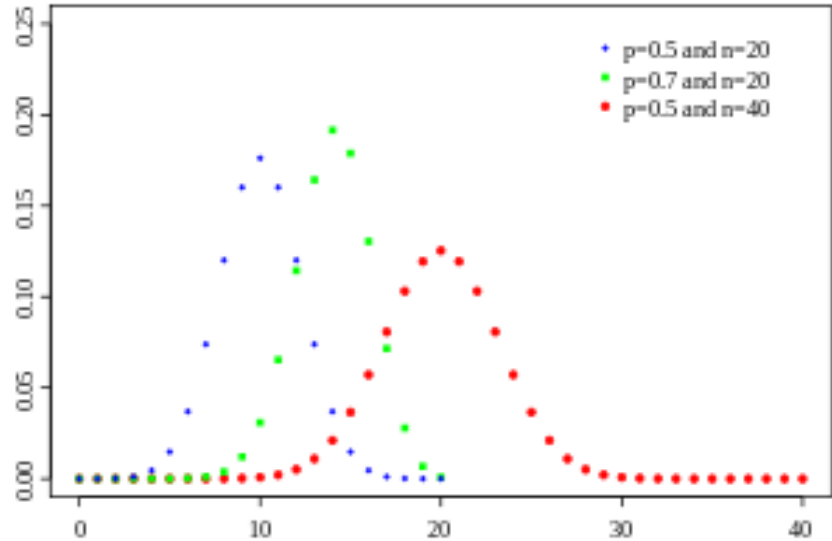
Binomial Distribution

- Flip a coin, twice
 - Probability of success constant = 0.5
 - Independant trials
 - Variable = number of heads

Number of Heads	Probability
0	0.25
1	0.5
2	0.25

Binomial Distribution

- Number of successes in a sequence of yes/no questions
 - e.g. flip a coin 10 times, count the number of heads
- Defined by
 - n (number of questions) and
 - p (probability of a “yes”)



Binomial Distribution

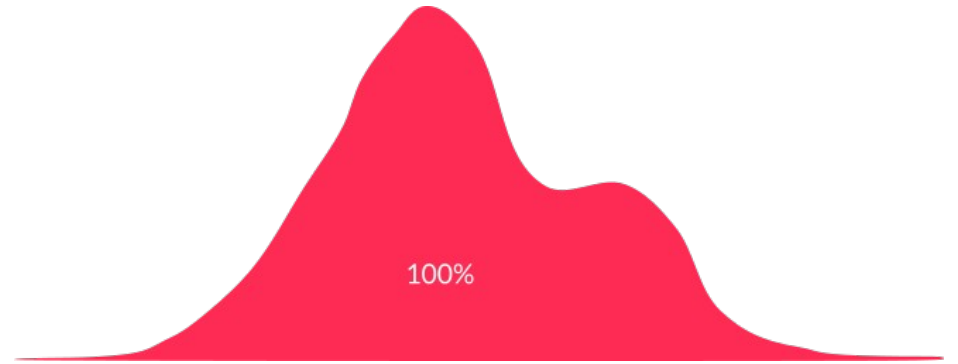
- Binomial formula
 - Probability of x successes

The diagram shows the binomial probability formula $P(X = x) = {}^n C_x \cdot p^x \cdot (1 - p)^{(n-x)}$ with callouts explaining its parts:

- No. of successes**: Points to the variable x in the binomial coefficient.
- Combination of x successes from n trials**: Points to the binomial coefficient ${}^n C_x$.
- number of failures**: Points to the exponent $(n-x)$ in the failure probability term.
- random variable X** : Points to the variable X in the probability function.
- probability of success**: Points to the variable p in the success probability term.
- probability of failure**: Points to the variable $(1-p)$ in the failure probability term.

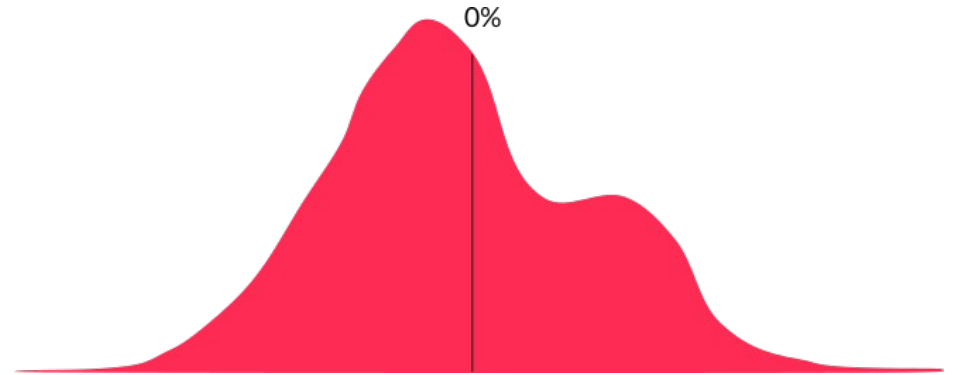
Continuous Distribution

- Probability density function represents a curve
 - Area under curve **adds up to 1**



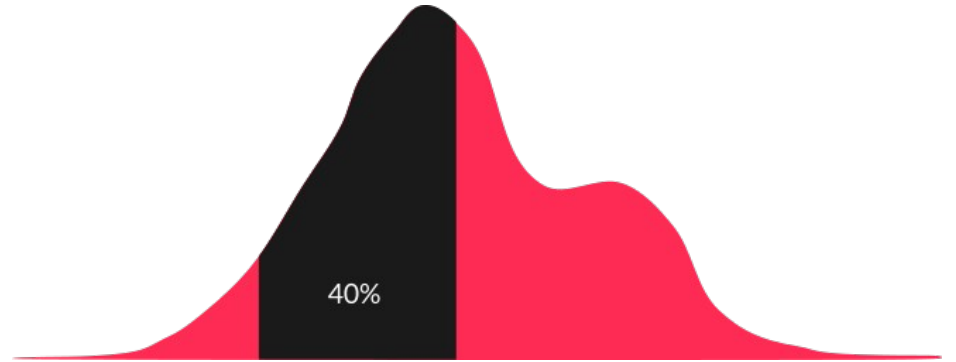
Continuous Distribution

- Probability density function represents a curve
 - Probability of **single value** = 0



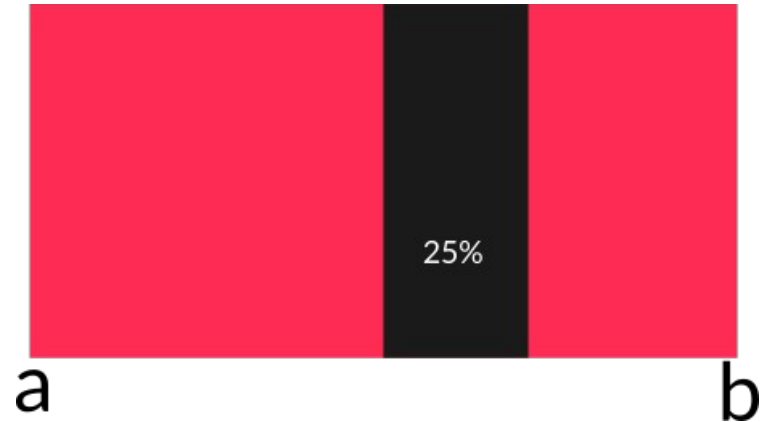
Continuous Distribution

- Probability density function represents a curve
 - **Area under the curve** is probability of **range** of values



Continuous Uniform Distribution

- Continuous
 - Range $a \rightarrow b$
- Uniform
 - All same probability



Normal Distribution

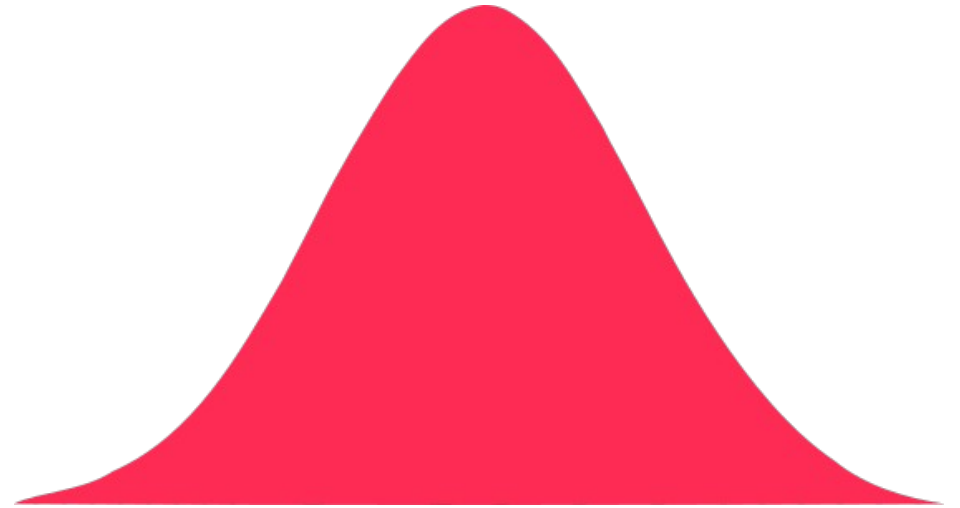
- Measure height of everyone in a class

1.56 1.37 1.14 1.38

1.09 1.18 1.68 1.22

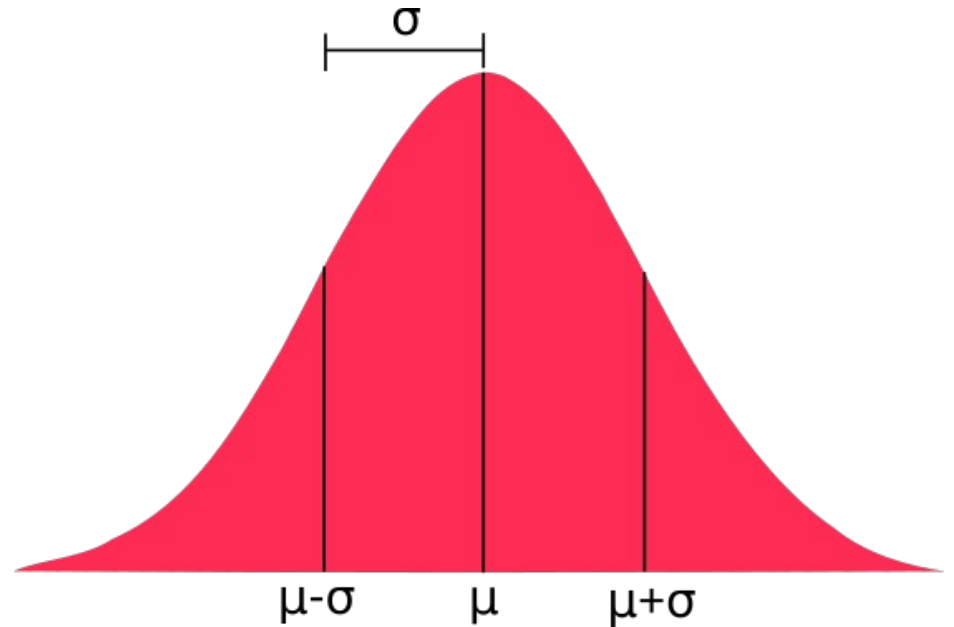
1.15 1.43 1.58 1.59

1.02 ...

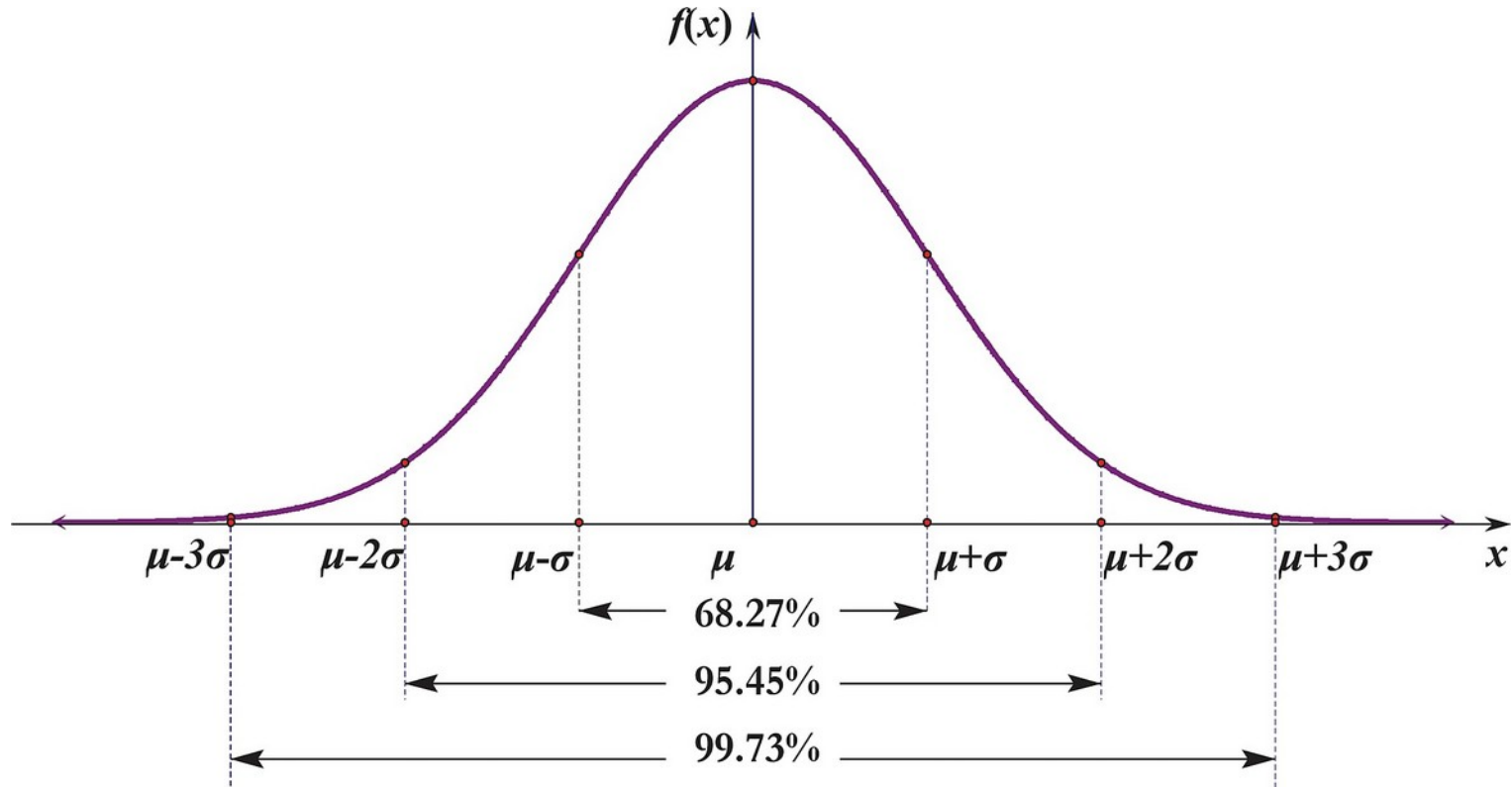


Normal Distribution

- Defined by:
 - **mean** (μ)
 - **standard deviation** (σ)
- Used a lot in inferential statistics

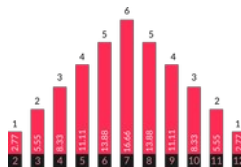


Normal Distribution



Summary

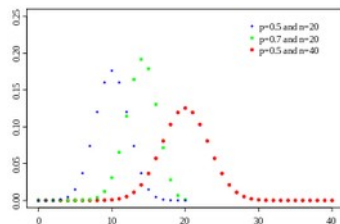
- Discrete vs. Continuous



- Uniform



- Binomial



- Normal

