Name	When to Use	Formula (PMF/PDF)	Characteristics	Example 1	Example 2
Bernoulli	When there are only two possible outcomes (yes/no)	$P(X = x) = p^x(1-p)^{1-x}$, $x \in \{0, 1\}$	Mean: p, Var: $p(1-p)$, Binary outcome, p: success prob	If the chance of rain today is 30% ($p = 0.3$), what is the probability it won't rain?	If historically 75% of people respond to your texts ($p = 0.75$), what is the probability of getting a response from your crush?
Binomial	When counting successes in multiple attempts	$P(X = k) = \binom{n}{k}p^k(1-p)^{n-k}$	Mean: np, Var: $np(1-p)$, Independent trials, Parameters: n, p	On a 10-question true/false quiz, if you have a 60% chance of getting each question right ($p = 0.6$), what's the probability of getting exactly 7 correct?	If each houseplant has a 70% chance of surviving when you're away ($p = 0.7$), what's the probability exactly 4 of your 5 plants will survive?
Geometric	When counting attempts until first success	$P(X = k) = (1-p)^{k-1}p$	Memoryless, Mean: $1/p$, Var: $(1-p)/p^2$, Parameter: p	If your chance of getting a match on a dating app is 15% ($p = 0.15$), what's the probability you'll get your first match on the 4th swipe?	If each lottery ticket has a 5% chance of winning ($p = 0.05$), what's the probability you'll need to buy exactly 3 tickets before winning?
Negative Binomial	When counting attempts until several successes	$P(X = k) = \binom{k-1}{r-1}p^r(1-p)^{k-r}$	Mean: r/p, Var: $r(1-p)/p^2$, Parameters: r, p	If each job application has a 20% chance of getting an interview ($p = 0.2$), what's the probability you'll need exactly 10 applications to get 3 interviews?	If you like 25% of restaurants you try ($p = 0.25$), what's the probability you'll need to visit exactly 15 restaurants to find 5 you really like?
Poisson	When counting random events in a fixed interval	$P(X = k) = \frac{\lambda^k e^{-\lambda}}{k!}$	Mean = Var = λ, memoryless, Parameter: λ	If you receive an average of 8 emails per hour ($\lambda = 8$), what's the probability of receiving exactly 5 emails in the next hour?	If an average of 12 cars pass your house every 10 minutes ($\lambda = 12$), what's the probability that exactly 15 cars will pass in the next 10 minutes?
Hypergeometric	When sampling without replacement	$P(X = k) = \frac{\binom{K}{k}\binom{N-K}{n-k}}{\binom{N}{n}}$	Sampling without replacement, Var ¡ Binomial, Parameters: N, K, n	If your playlist has 10 favorite songs out of 50 total songs ($N = 50, K = 10$), what's the probability of getting exactly 2 favorites when shuffling and playing 5 songs ($n = 5$)?	In a group of 15 men and 10 women ($N = 25, K = 10$), what's the probability of randomly selecting exactly 3 women when choosing 6 people ($n = 6$)?
Multinomial	When each trial can result in more than two outcomes and you count how often each occurs	$\frac{n!}{x_1!\ldots x_k!}p_1^{x_1}\ldots p_k^{x_k}$	Extends Binomial to multiple categories, Parameters: n, p_i	If breakfast preferences in your family are cereal (30%), toast (25%), eggs (35%), and other (10%), what's the probability that out of 20 family members, exactly 7 choose cereal, 5 choose toast, 6 choose eggs, and 2 choose other?	In a class of 30 students, if grade probabilities are A (15%), B (30%), C (35%), D (15%), and F (5%), what's the probability of having exactly 5 A's, 9 B's, 10 C's, 5 D's, and 1 F?
Uniform (Discrete)	When each value in a finite set has equal chance of occurring	$P(X = x) = 1/n$	Equal probability, Mean: $(n+1)/2$, Var: $(n^2-1)/12$	What's the probability your birthday falls on a weekend?	What's the probability of rolling a number greater than 4 on a fair die?

Name	When to Use	Formula (PMF/PDF)	Characteristics	Example 1	Example 2
Uniform (Continuous)	When any value in a continuous range is equally likely	$f(x) = \frac{1}{b-a}$, $x \in [a, b]$	Flat density, Mean: $(a+b)/2$, Var: $(b-a)^2/12$	If your friend says they'll arrive between 1:00 and 2:00 PM, what's the probability they'll arrive between 1:15 and 1:30?	If your dog stops randomly along a 100-foot path, what's the probability they'll stop within 10 feet of the start?
Normal	When data is symmetrically spread around the average, common in nature	$f(x) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$	Bell-shaped, Parameters: μ, σ, 68-95-99.7 rule	If heights of your friends follow a normal distribution with mean 5'8" (68 inches) and standard deviation 3 inches, what's the probability a randomly selected friend is taller than 6 feet?	If your commute time is normally distributed with mean 25 minutes and standard deviation 4 minutes, what's the probability your commute takes between 20 and 30 minutes?
Exponential	When modeling time between random, independent events occurring at a constant rate	$f(x) = \lambda e^{-\lambda x}, x \geq 0$	Memoryless, Mean: $1/\lambda$, Skewed right	If you receive text messages at a rate of 4 per hour ($\lambda = 4$), what's the probability you'll wait more than 20 minutes for the next text?	If customers enter a coffee shop at a rate of 12 per hour ($\lambda = 12$), what's the probability that the next customer arrives within 2 minutes of you?
Gamma	When modeling time until multiple events in a Poisson process occur	$f(x) = \frac{\lambda^\alpha x^{\alpha-1} e^{-\lambda x}}{\Gamma(\alpha)}$	Generalizes Exponential, Mean: α/λ, Flexible shapes	If Uber rides arrive at a rate of 8 per hour ($\lambda = 8$) and you need 3 rides today ($\alpha = 3$), what's the probability it takes less than 30 minutes to get all 3 rides?	If you find four-leaf clovers at a rate of 2 per hour ($\lambda = 2$), what's the probability it takes between 1 and 2 hours to find 4 clovers ($\alpha = 4$)?
Beta	When modeling random probabilities and proportions between 0 and 1	$f(x) = \frac{x^{\alpha-1}(1-x)^{\beta-1}}{B(\alpha,\beta)}$	Bounded [0,1], Many shapes possible, Used in Bayesian stats	Based on your past behavior ($\alpha = 2, \beta = 3$), what's the probability you'll save between 30% and 50% of your budget this month?	If your Netflix watching pattern follows $\alpha = 3, \beta = 7$, what's the probability you'll watch more than 40% of your watchlist?
Chi-Square	When testing independence or comparing observed vs expected frequencies	$f(x) = \frac{1}{2^{k/2}\Gamma(k/2)} x^{k/2-1} e^{-x/2}$	Skewed right, Used in hypothesis tests, Parameter: k (df)	You believe your music app's shuffle isn't truly random. After noting the genres of 100 songs played, you calculate a chi-square statistic of 15.2 with 9 degrees of freedom. What is the p-value and what can you conclude?	You wonder if births in your family are evenly distributed across months. For 36 family birthdays, you calculate a chi-square value of 23.6 with 11 degrees of freedom. What is the p-value and what can you conclude?
Student's t	When estimating means with small samples and unknown variance	$f(x) = \frac{\Gamma((\nu+1)/2)}{\sqrt{\nu\pi}\Gamma(\nu/2)} \left(1 + \frac{x^2}{\nu}\right)^{-(\nu+1)/2}$	Like normal, but heavier tails, Parameter: ν (df)	From your last 8 grocery trips, you spent a mean of \$85 with standard deviation \$12. Calculate a 95% confidence interval for your true average grocery bill.	You walked route A 6 times (mean 18.2 minutes, SD 2.1) and route B 6 times (mean 16.8 minutes, SD 1.9). Test if route B is significantly faster at the 0.05 level.

Name	When to Use	Formula (PMF/PDF)	Characteristics	Example 1	Example 2
F-distribution	When comparing variability between two or more groups (ANOVA, regression)	Complex PDF	Right-skewed, Non-negative, Parameters: d_1, d_2 (df)	You track your weight loss with exercise routine A (10 measurements, variance 4.2) and routine B (8 measurements, variance 9.6). Test if routine B has significantly more variable results at the 0.05 level.	You timed how long 5 people took to make a recipe with two different instructions. Method 1 had variance 12.6 and method 2 had variance 3.4. Test if method 1 produces significantly more variable cooking times at the 0.05 level.
Log-Normal	When data is positively skewed and values can't be negative	$f(x) = \frac{1}{x\sigma\sqrt{2\pi}} e^{-\frac{(\ln x - \mu)^2}{2\sigma^2}}$	Skewed right, log of data is normal, Parameters: μ, σ	If house prices in your neighborhood follow a log-normal distribution with parameters $\mu = 12.8$ and $\sigma = 0.4$, what's the probability a randomly selected house costs less than \$400,000?	If daily social media usage (in minutes) follows a log-normal distribution with parameters $\mu = 4.1$ and $\sigma = 0.8$, what's the probability someone uses social media for more than 120 minutes (2 hours) per day?