$N(\mu,\sigma^2)$	$f(x)=\frac{1}{\sqrt{2\pi}\sigma}e^{\frac{-(x-\mu)^2}{2\sigma^2}}\quad \forall x\in\mathbb{R}$	$Z=\frac{X-\mu}{\sigma}$	$\Phi(z)=P(X\le x)=P(\frac{X-\mu}{\sigma}\le\frac{x-\mu}{\sigma})=P(Z\le z)$

Distribution	Formula	$\boldsymbol{E(X)}$, $\boldsymbol{V(X)}$	Special Notes
Exponential	$f(x)=\lambda e^{-\lambda x},\ x\in(0,\infty)$	$\mu=\frac{1}{\lambda},\ \sigma^2=\frac{1}{\lambda^2}$	λ is *Scale Parameter* that controls shape and location.
Gamma	$f(x)=\frac{\lambda^r x^{r-1}e^{-\lambda x}}{\Gamma(r)},\quad \Gamma(r)=(r-1)!$	$\mu=\frac{r}{\lambda},\ \sigma^2=\frac{r}{\lambda^2}$	r (skew→sym), λ (scale), Γ(Gamma fun.) model fail rate; $r\to 1$ tends to exp. dist.
Weibull	$f(x)=\frac{\beta}{\delta}\left[\frac{x}{\delta}\right]^{\beta-1}e^{-\left[\frac{x}{\delta}\right]^{\beta}},\quad x\in(0,\infty)$ $F(x)=1-\exp\left[-\left(\frac{x}{\delta}\right)^{\beta}\right]\quad\forall x\in\mathbb{R}^+$	$\mu=\delta\Gamma(1+\frac{1}{\beta})$ $\sigma^2=\delta^2\Gamma\left(1+\frac{2}{\beta}\right)-\delta^2\left[\Gamma\left(1+\frac{1}{\beta}\right)\right]^2$	β(shape: skew to sym), δ(scale: narrow to wide); models time dependent fail rate
Lognormal	$F(x)=\Phi\left(\frac{\ln(x)-\theta}{\omega}\right)$ $f(x)=\frac{1}{\sqrt{2\pi}\omega x}\exp\left[-\frac{(\ln(x)-\theta)^2}{2\omega^2}\right]$	$\mu=e^{\theta+\omega^2/2}$ $\sigma^2=e^{2\theta+\omega^2}(e^{\omega^2}-1)$	Let W be normal rv. with mean θ and variance ω^2, let $X=e^W$. $F(x)=P(X\le x)=P(W\le\ln(x))$ $=P(Z\le(\ln(x)-\theta)/\omega)$
Binomial	$f(x)=\binom{n}{x}\cdot p^x\cdot(1-p)^{n-x},\quad\binom{n}{r}=\frac{n!}{r!\,(n-r)!}$	$\mu=np$ $\sigma^2=np(1-p)$	n is # trials, x is # success, p is the probability of a success on each trial
Poisson	$f(x)=\frac{\lambda^x e^{-\lambda}}{x!}$	$\mu=\lambda$ $\sigma^2=\lambda$	Poisson dist. is Bernoulli Trial at infinitesimal segment ($p_{seg}=\lambda\Delta t/T, n=T/\Delta t$)

	$E(X)$	$V(x)$
Sample	$\overline{x}=\frac{1}{n}\sum_{i=1}^{n}x_i$	$s^2=\frac{1}{n-1}\sum_{i=1}^{n}(x_i-\overline{x})^2=\frac{1}{n-1}\left[\sum_{i=1}^{n}x_i^2-\frac{1}{n}\left(\sum_{i=1}^{n}x_i\right)^2\right]$
Population	$\mu=\frac{1}{N}\sum_{i=1}^{N}x_i$	$\sigma^2=\frac{1}{N}\sum_{i=1}^{N}(x_i-\mu)^2$
Continuous RV	$\mu=\int_{-\infty}^{\infty}x\cdot f(x)dx$	$\sigma^2=\int_{-\infty}^{\infty}(x-\mu)^2 f(x)dx$
Discrete RV	$\mu=\sum_{i=1}^{n}x_i\cdot f(x_i)$	$\sigma^2=\sum_{i=1}^{n}(x_i-\mu)^2\cdot f(x_i)=\left[\sum_{i=1}^{n}x_i^2\cdot f(x_i)\right]-\mu^2$

Central Limit Theorem		**Student t**	
Let $X_1,\dots,X_n$ be a random sample of size n taken from a population with mean μ and variance σ^2. $\overline{X}$ is sample mean:		$t=\frac{\overline{x}-\mu}{s/\sqrt{n}}$	μ is population mean, $\overline{x}$ is sample mean, s is sample st. deviation, and n is sample size.
$Z=\frac{\overline{X}-\mu}{\sigma/\sqrt{n}}$	μ and σ should be given. If σ unknown, $n>30\Rightarrow\sigma\approx s$.	Like st. norm. dist., except shape of curve changes depends on the degree of freedom $k=n-1$	
$n\ge 4$ works for normally distributed data $n\ge 30$ works for all distributions		$t_{a,k}$: α is given and is the probability in range ($t_{a,k}$ $+\infty$), k again is degree of freedom.	

Confidence Interval is the percentage $(1-\alpha)\%$, where heads and tail both share $\alpha/2$ probability.

	Normal Approximation	**Explanation**
Binomial	$Z=\frac{X-np}{\sqrt{np(1-p)}}$	when $np>5\wedge n(1-p)>5$ the norm. approx. is good enough
Poisson	$Z=\frac{X-\lambda}{\sqrt{\lambda}}$	when $\lambda>5$, the norm. approx. is good enough

Continuity Correction

A correction factor to improve approx. accuracy:
Let X be a discrete rv., Y be a continuous rv.:

$$P(X=x_i)=P(x_i-0.5<Y<x_i+0.5)$$
$$P(X\le x_i)=P(Y<x_i+0.5)$$

Quartiles: q_1 interpolate to $(n+1)/4$ pos.
Percentiles: interpolate to $k(n+1)$ pos, k is a percentage.
Inter-Quartile Range (IQR): $IQR=q_3-q_1$
Whiskers: smallest/biggest within 1.5 IQR from q_1/q_3
Outliers: points beyond whiskers within 3 IQR from q_1/q_3.
Extreme Outlier: a point more than 3 IQR from q_1/q_3.
Box Plot: boxes bound by q_1, q_2, q_3; line extends to whiskers; outliers plotted as dots.

Probability Plotting: Plot data points for $n\le 20$, sort data in ascending order, for each point calculate cumulative freq.

$\frac{j-0.5}{n}=P(Z\le z_j)=\Phi(z_j)$ where j is # pt. after sorting, n is sample size.

Plot cumulative freq. histogram for $n\ge 20$, choose bin size, add prev. bin height to current, divide by n → relative freq.

Fit data from the center of the graph, NOT at the limits.
Big variation at small, large end means sample not normal.