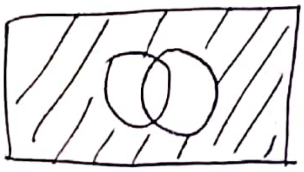
⟹

$$\overline{A \cup B} = A' \cap B'$$



$$1 - P(A \cup B) = P(A' \cap B')$$

$$1 - \left(P(A) + P(B) - P(A \cap B)\right) = P(A' \cap B')$$

$$P(\bar{A})P(\bar{B}) = P(\bar{A} \cap \bar{B})$$

⟹ Continuous Probability Function

$f(x)$

$$\boxed{\int_{-\infty}^{\infty} f(x)\,dx = 1}$$

⟹ $P(a < x < b) = \int_a^b f(x)\,dx$

⟹ $F(x) = P(X \le x) = \int_{-\infty}^{x} f(t)\,dt$

$$\boxed{F'(x) = f(x)}$$

⟹ Expectation

$$\mu = E(x) = \sum_{\forall x} x\,p(x)$$

⟹ Variance

$$\sigma^2 = E\left[(X - \mu)^2\right]$$

$$= E[X^2] - (E[X])^2$$

$\Rightarrow$ $Var(c) = 0$

$var(cx) = c^2 \, var(x)$

$\Rightarrow$ rth moment about origin

$$\mu_r' = E[X^r] = \sum x^r p(x)$$
$$= \int_{-\infty}^{\infty} x^r f(x)\,dx$$

$\Rightarrow$ Moment generation function

$$M_x(t) = E[e^{tx}]$$
$$= \int_{-\infty}^{\infty} e^{tx} f(x)\,dx$$

$\Rightarrow$ Mean deviation abt mean

$$MD = \sum_{\forall x} |x - \mu| \, p_x$$

$$= \int_{-\infty}^{\infty} |x - \mu| \, f(x)\,dx$$

$\Rightarrow$ characterstic function

$$\phi_x(t) = E[e^{itx}]$$

$\Rightarrow$ Bernoulli

$$p(x) = p^x q^{1-x}$$

$E(X) = p$ $\quad$ $M_x(t) = q + pe^t$

$V(X) = pq$

$\Rightarrow$ Binomial

$$P(X=x) = {}^nC_x \, p^x q^{n-x}$$

$$E(X) = np \qquad M(X) = (q + pe^t)^n$$

$$V(X) = npq$$

$$E(x) = \sum_{\forall x} x p(x)$$

$$= \sum_{x=0}^{n} x \, {}^nC_x \, p^x q^{n-x}$$

$$= \sum x \frac{n!}{x!(n-x)!} p^x q^{n-x}$$

$$= np \sum \underbrace{\frac{x(n-1)!}{x!(n-x)!} p^{x-1} q^{n-x}}_{(q+p)^{n-1}}$$

$$= np$$

For variance

$$n(n-1)p^2 (q+p)^{n-2} + np$$

$$= np(1-p)$$

$\Rightarrow$ Skewness $= \dfrac{1-2p}{\sqrt{npq}}$

$\Rightarrow$ Geometric distribution

$$P(X=x) = p\,q^{x-1}$$
$$= q^{x-1}\,p^{1}$$

$$E(x) = \frac{1}{p} \qquad var(x) = \frac{q}{p^2}$$

$\Rightarrow$ Poisson Distribution

$$P(\lambda) = \frac{e^{-\lambda}\lambda^{x}}{x!} \qquad x = 0, 1, 2 \text{ - - - -}$$

$$\boxed{E(x) = V(x) = \lambda}$$

$$\boxed{M_x(t) = e^{\lambda(e^t-1)}}$$

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Covariance

$$\text{cov}(X, Y) = E\left[(X - \mu_x)(Y - \mu_y)\right]$$

$$E[X] = \mu_x \qquad E[Y] = \mu_y$$

$$\boxed{\text{cov}(X, Y) = E[XY] - E[X]E[Y]}$$

$$\Rightarrow \boxed{\text{Var}(X + Y) = \text{var}(X) + \text{Var}(Y) + 2\,\text{cov}(X, Y)}$$

Conditional Distribution

$$P(X = x \mid Y = y) = \frac{P[X = x \,\&\, Y = y]}{P[Y = y]}$$

$$E[Y/x] = \sum y\, f_{Y|X}(y)$$

$$\Rightarrow M_x(t) = e^{\mu t + \frac{1}{2}\sigma^2 t^2}$$

$$\Rightarrow \text{Correlation} \quad \rho = \frac{\text{cov}(X, Y)}{\sqrt{\text{var}(X)\,\text{var}(Y)}}$$

$$\rho = \frac{n\Sigma xy - \Sigma x \Sigma y}{\left(\left[n\Sigma x^2 - (\Sigma x)^2\right]\left[n\Sigma y^2 - (\Sigma y)^2\right]\right)^{1/2}}$$

Chi square Distribution

$$\sum_{i=1}^{n} \frac{(X_i - \mu_i)^2}{\sigma_i^2}$$

$$E[X] = n$$

$$var[X] = 2n$$

$$\boxed{\chi^2 = \sum_{i=1}^{n} \frac{(O_i - e_i)^2}{e_i}}$$

Student t distribution

$$\boxed{S^2 = \frac{1}{n-1} \Sigma (x_i - \bar{x})^2}$$

$$\boxed{t = \frac{\bar{x} - \mu_0}{s / \sqrt{n}}}$$

F- Distribution

$$F = \frac{X/\nu_1}{Y/\nu_2}$$

$$\boxed{F = \frac{Sx^2}{Sy^2}}$$

Hyper geometric dist

$$\frac{{}^{r}C_{x} \; {}^{n-r}C_{n-x}}{{}^{n}C_{x}}$$

$\Rightarrow$ Uniform Distribution

$$f(x) = \frac{1}{b-a} \quad a \leq x \leq b.$$

$$\boxed{\begin{aligned} E[X] &= \frac{b+a}{2} \\ \sigma^2 &= \frac{(b-a)^2}{12} \end{aligned}}$$

$\Rightarrow$ Gamma Distribution

$$\mu = \frac{r}{\lambda}$$

$$\sigma^2 = \lambda$$

$\Rightarrow$ Normal Distribution

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

mean deviation $\frac{\sqrt{2}}{\pi}$

$\Rightarrow$ Standard Normal Variable $\left(\frac{X-\mu}{\sigma} = z\right)$

$$F(-z) = 1 - F(z)$$

Chebyshev

$$P\left[|X-\mu| < k\sigma\right] \geq 1 - \frac{1}{k^2}$$