a	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990

Chapter1:	Independent Trials
$(A \cup B)^c = A^c \cap B^c$	$A \cap (B \cup C) = (A \cap B) \cup (A \cap B)$
$P(A-B) = P(A) - P(A \cap B)$	$P(A_1 \cup A_2 ..) = P(A_1) + P(A_2)..$
The probability A given B	$P(A\|B) = \frac{P(A \cap B)}{P(B)}$
A and B are disjoint:	$P(A\|B) = \frac{P(A \cap B)}{P(B)} = \frac{0}{P(B)} = 0.$
$A \subset B$	$P(A\|B) = \frac{P(A \cap B)}{P(B)} = \frac{P(A)}{P(B)}.$
$B \subset A$	$P(A\|B) = \frac{P(A \cap B)}{P(B)} = \frac{P(B)}{P(B)} = 1.$
$P(A \cup B) = P(A) + P(B) - P(A \cap B)$	Disjoint: $P[AB]=0$
$P[A^c] = 1 - P[A]$	lependent: $P(A \cap B) = P(A)\,P(B)$
$A - B = A \cap B^c$	اذا عملت اتحاد:partition واعطوني S ويكونو disjoint
$P(A) = \sum_{i=1}^{m} P(A\|B_i)P(B_i)$	Bayes' Rule: $P(B\|A) = \frac{P(A\|B)P(B)}{P(A)}$

$A_1, A_2, A_3, \cdots$ are disjoint events,

$$P(A_1 \cup A_2 \cup A_3 \cdots | B) = P(A_1|B) + P(A_2|B) + P(A_3|B) + \cdots$$

$\frac{P_{23}^{365}}{356^{23}}$ ➔ p of no two have the same birthday (from 23) on ch 2

Chapter2	$P(A) = \frac{\|A\|}{\|S\|} = \frac{M}{N}$
MultinomialCoefficient:	$\binom{n}{n_1, n_2, \ldots, n_r} = \frac{n!}{n_1! n_2! \ldots n_r!}.$
Binomial Formula:	$P(k) = \binom{n}{k} p^k (1-p)^{n-k}$
Independent Trials:	$P[E_{n_0,n_1}] = \binom{n}{n_1}(1-p)^{n-n_1} p^{n_1}$
	$P[E_{n_0,n_1}] = \binom{n}{n_0}(1-p)^{n_0} p^{n-n_0}.$

ordered sampling with replacement	n^k
ordered sampling without replacement	$P_k^n = \frac{n!}{(n-k)!}$
unordered sampling without replacement	$\binom{n}{k} = \frac{n!}{k!(n-k)!}$
unordered sampling with replacement	$\binom{n+k-1}{k}$

X		
Y	قوانينه	الي تحت
px		
Ey		

$$S_Y = \{g(x) | x \in S_X\} = \{g(x_1), g(x_2), \cdots\}.$$
$$P_Y(y_k) = P(Y = y_k) = P(g(X) = y_k).$$

Chapter3:Discrete	PMF
$\text{Range}(X) = S_X = \{x_1, x_2, x_3, \ldots\}$	$P_X(x_k) = P(X = x_k)$, for $k = 1, 2, 3,$
Bernoulli(p): E[X]= P	$P_X(x) = \begin{cases} p & \text{for } x = 1 \\ 1-p & \text{for } x = 0 \\ 0 & \text{otherwise} \end{cases}$ Range$(X) = \{0, 1\}$
Geometric(p): E[X]= 1/P	$P_X(k) = p(1-p)^{k-1}, \quad k = 1, 2, 3, \ldots$
Binomial(n,p): E[X]= nP	$P_X(k) = \binom{n}{k} p^k (1-p)^{n-k}, \quad k = 0, 1, 2, \cdots, n$
Pascal(k,p): E[X]= k/P	$P_X(k) = \binom{k-1}{m-1} p^m (1-p)^{k-m} \quad k = m, m+1, m+2,$
Uniform Random Variables(k,L) E[X]= (k+L)/2	$P_X(x_i) = \frac{1}{\|S_X\|}$
CDF: $F_X(x) = P(X \le x).$	$P(a < X \le b) = F_X(b) - F_X(a)$
$\sigma_X = \sqrt{\text{Var}(X)}.$	$\text{Var}(X) = E[X^2] - (E[X])^2.$
$\text{Var}(aX + b) = a^2\,\text{Var}(X)$	
Poisson : $\alpha = \lambda t$ E[X]= α	$P_X(k) = \frac{e^{-\alpha}\alpha^k}{k!}, k = 0, 1, 2, 3, ..$

$$P(X = k) = P_X(k) = \binom{n}{k} p^k (1-p)^{n-k} = \binom{n}{k} (\frac{\alpha}{n})^k (1 - \frac{\alpha}{n})^{n-k}$$

Chapter4 :Continuous	$F_X(x) = Prob\{X \le x\}$
Pdf: $f_X(x) = \frac{dF_X(x)}{dx}$	CDF: $F_X(x) = \int_{-\infty}^{x} f_X(\alpha)d\alpha.$
$P(a < X < b) = F_X(b) - F_X(a)$	$= \int_a^b f_X(\alpha)d\alpha.$
$\int_{-\infty}^{\infty} f_X(x)dx = 1.$	$\int u\,v\,dx = u\int v\,dx - \int u'\left(\int v\,dx\right)dx$
$E[X] = \int_{-\infty}^{\infty} x f_X(x)dx.$	$\mathrm{Var}(X) = E[X^2] - (E[X])^2.$
$E[Y^2] = \int_{-\infty}^{\infty} y^2 f_Y(y)\,dy$:	
Erlang(n, λ):	$f_X(x) = \begin{cases} \frac{\lambda^n x^{n-1} e^{-\lambda x}}{(n-1)!} & x \ge 0, \\ 0 & otherwise, \end{cases}$
$E[X] = \frac{n}{\lambda}.$	$\mathrm{Var}[X] = \frac{n}{\lambda^2}.$
Gaussian (μ, σ)	$f_X(x) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{-(x-\mu)^2/2\sigma^2},$
$Z \sim N(0,1)$	$f_Z(z) = \frac{1}{\sqrt{2\pi}} e^{-\frac{z^2}{2}},$
CDF **Gaussian:**	$\Phi(x) = P(X \le x) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{x} e^{-\frac{u^2}{2}} du.$
$F_X(x) = \Phi\left(\frac{x-\mu}{\sigma}\right)$	$P[a < X \le b] = \Phi\left(\frac{b-\mu}{\sigma}\right) - \Phi\left(\frac{a-\mu}{\sigma}\right)$
Complementary CDF:	$Q(z) = P[Z > z] = \frac{1}{\sqrt{2\pi}} \int_z^{\infty} e^{-u^2/2} du = 1 - \Phi(z).$

$$\mathrm{Prob}\{a \le X < b\} = \sum_{a \le x_k < b} P_X(x_k) \longrightarrow \int_a^b f_X(x)dx$$

discrete ↑ continuous ↑

Uniform Distribution:(a,b)	Exponential(λ):
$f_X(x) = \begin{cases} \frac{1}{b-a} & a < x < b \\ 0 & x < a \text{ or } x > b \end{cases}$	$f_X(x) = \begin{cases} \lambda e^{-\lambda x} & x \ge 0,\ \lambda > 0 \\ 0 & \text{else} \end{cases}$ $= \lambda e^{-\lambda x} u(x)$
$F_X(x) = \begin{cases} 0 & \text{for } x < a \\ \frac{x-a}{b-a} & \text{for } a \le x \le b \\ 1 & \text{for } x > b \end{cases}$	$u(x) = \begin{cases} 1 & x \ge 0 \\ 0 & \text{otherwise} \end{cases}$ $F_X(x) = (1 - e^{-\lambda x})u(x)$
$E[X] = \frac{a+b}{2},$	$E[X] = \frac{1}{\lambda}.$
$\mathrm{Var}(X) = E[X^2] - (E[X])^2 = \frac{(b-a)^2}{12}.$	$E[X^2] = \int_0^{\infty} x^2 \lambda e^{-\lambda x} dx = \frac{2}{\lambda^2}$ $\mathrm{Var}(X) = E[X^2] - (E[X])^2 = \frac{2}{\lambda^2} - \frac{1}{\lambda^2} = \frac{1}{\lambda^2}.$

Ch 03:

- Binomial trial: we have n trials and want to know the probability of k successes $p(k) = \binom{n}{k} P^k (1-P)^k$
- Geometric: # of trials until getting the first success
- Pascal random variable: the probability of # k trials until getting m successes. $p(k) = \binom{k-1}{m-1} P^m (1-P)^{k-m}$
- Poisson: $p(k) = \frac{e^{-\alpha}\alpha^k}{k!}$, $\alpha = \lambda T$ (بتتغير حسب الفترة المطلوبة), T: time in the question, λ: the average.
- The nth moment is $E[(X)^n]$, the nth central moment is $E[(X-\mu_x)^n]$
- $\int_{-\pi}^{\pi} \sin(a+x)\sin(b+x)\,dx$
-

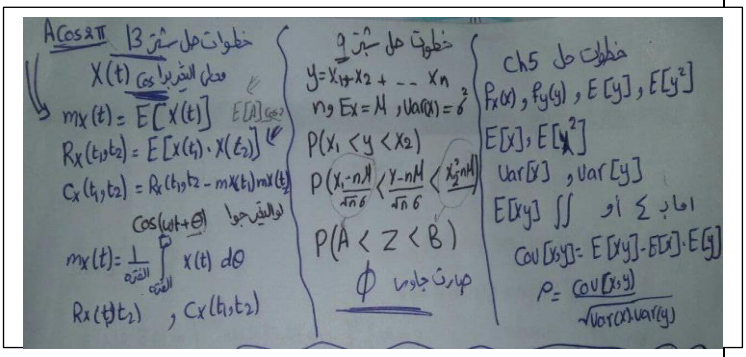
Chapter 5:joint	$f_{XY}(x,y) = \frac{\partial^2}{\partial x \partial y} F_{XY}(x,y).$
PMF(X,Y)	$P_{XY}(x_j, y_j) = P(X = x_k, Y = y_j)$
Marginal PMF discrete	$P_Y(y) = \sum_{x \in S_X} P_{X,Y}(x,y)$ $P_X(x) = \sum_{y \in S_Y} P_{X,Y}(x,y)$
CDF $F_{XY}(x,y) =$	$\int_{-\infty}^{y} \int_{-\infty}^{x} f_{XY}(u,v)dudv,$
$E[X+Y] = E[X] + E[Y].$	$\mathrm{Var}[X+Y] = \mathrm{Var}[X] + \mathrm{Var}[Y] + 2E[(X-\mu_X)(Y-\mu_Y)]$
Marginal PDFs: continuous	$f_X(x) = \int_{-\infty}^{\infty} f_{XY}(x,y)dy,$ for all x, $f_Y(y) = \int_{-\infty}^{\infty} f_{XY}(x,y)dx,$ for all y.
Independent CDF,PDF	$F_{XY}(x,y) = F_X(x)F_Y(y),$ $P_{XY}(x_i, y_j) = P_X(x_i)P_Y(y_j)$
Covariance :Cov(X,Y) X,Y inde. Cov(x,y)=0	$E[XY] - (E[X])(E[Y]).$
Correlation Coefficient:	$\rho(X,Y) = \frac{\mathrm{Cov}(X,Y)}{\sqrt{\mathrm{Var}(X)\ \mathrm{Var}(Y)}} = \frac{\mathrm{Cov}(X,Y)}{\sigma_X \sigma_Y}$

The correlation of X and Y is $r_{X,Y} = E[XY]$

Random variables X and Y are orthogonal if $r_{X,Y} = 0$.

Random variables X and Y are uncorrelated if $\mathrm{Cov}[X,Y] = 0$.

For independent random variables X and Y
(a) E[g(X)h(Y)] = E[g(X)] E[h(Y)],
(b) rx,y = E[XY] = E[X] E[Y],
(c) Cov[X, Y] = ρ X,Y = 0,
(d) Var[X+Y] = Var[X] + Var[Y]

Ch 05, 09, 13:.

- $Cov[x,x] = Var(x)$, $Cov(ax,y) = aCov(x,y)$, $Cov(x + cons, y) = Cov(x,y)$, $Cov(X+Y,Z) = Cov(X,Z) + Cov(Y,Z)$
- $-1 \le \rho \le 1$, $\rho(aX+b, cY+d) = \rho(X,Y)$, $\rho_{X,Y} = 1$,if $X = aX + c$,and a>0, and -1 if a<0
- Correlation: $R_x(t_1,t_2) = E[X(t_1)X(t_2)]$,
- Covariance: $Cov(t_1,t_2) = Cov(X(t_1), X(t_2)) = R_x(t_1,t_2) - \mu_{X(t_1)}\mu_{X(t_2)}$