STAT 5700 formulas

Chapter 2

$(A \cup B)' = A' \cap B'$

$(A \cap B)' = A' \cup B'$

$P(A) = 1 - P(A')$

$P(A \cup B) = P(A) + P(B) - P(A \cap B)$

${}_nP_r = \frac{n!}{(n-r)!}$

$\binom{n}{r} =_n C_r = \frac{{}_nP_r}{r!} = \frac{n!}{(n-r)!r!}$

$\binom{n}{n_1 \quad n_2 \cdots \quad n_k} = \frac{n!}{n_1!n_2!\cdots n_k!}$

$P(B|A) = \frac{P(A \cap B)}{P(A)}$

$P(B'|A) = 1 - P(B|A)$

Bayes Rule: $P(A|B) = \frac{P(B|A)P(A)}{P(B)}$

Distribution	Probability Function	Mean	Variance
Bernoulli	$p^y(1-p)^{1-y}$	p	$p(1-p)$
Binomial	$\binom{n}{y}p^y(1-p)^{n-y}$	np	$np(1-p)$
Geometric	$p(1-p)^{y-1}$	$\frac{1}{p}$	$\frac{1-p}{p^2}$
Hypergeometric	$\frac{\binom{r}{y}\binom{N-r}{n-y}}{\binom{N}{n}}$	$\frac{nr}{N}$	$n\left(\frac{r}{N}\right)\left(\frac{N-r}{N}\right)\left(\frac{N-n}{N-1}\right)$
Poisson	$\frac{\lambda^y e^{-\lambda}}{y!}$	λ	λ
Negative Binomial	$\binom{y-1}{r-1}p^r(1-p)^{y-r}$	$\frac{r}{p}$	$\frac{r(1-p)}{p^2}$

Definition	Discrete	Continuous
$\mu = E(Y)$	$\sum_{y\in S} yp(y)$	$\int_S yf(y)dy$
$\sigma^2 = V(Y) = E[(Y-\mu)^2]$	$\sum_{y\in S}(y-\mu)^2p(y)$	$\int_S(y-\mu)^2f(y)dy$
k^{th} moment $=E(Y^k)$	$\sum_{y\in S} y^kp(y)$	$\int_S y^kf(y)dy$
$m(t) = E(e^{tY})$	$\sum_{y\in S} e^{ty}p(y)$	$\int_S e^{ty}f(y)dy$
$E(g(Y))$	$\sum_{y\in S} g(y)p(y)$	$\int_S g(y)f(y)dy$

Distribution	Probability Density Function (pdf)	Mean	Variance
Uniform	$\frac{1}{\theta_2-\theta_1}, \quad \theta_1 \le y \le \theta_2$	$\frac{\theta_1+\theta_2}{2}$	$\frac{(\theta_2-\theta_1)^2}{12}$
Normal	$\frac{1}{\sigma\sqrt{2\pi}}e^{-(y-\mu)^2/(2\sigma^2)}$	μ	σ^2
Eyponential	$\frac{1}{\beta}e^{-y/\beta}, \quad y \ge 0$	β	β^2
Gamma	$\frac{1}{\beta^\alpha\Gamma(\alpha)}y^{\alpha-1}e^{-y/\beta}, \quad y \ge 0$	$\alpha\beta$	$\alpha\beta^2$
Chi-square	$\frac{1}{2^{\nu/2}\Gamma(\nu/2)}y^{\nu/2-1}e^{-y/2}, \quad y \ge 0$	ν	2ν
Beta	$\frac{\Gamma(\alpha+\beta)}{\Gamma(\alpha)\Gamma(\beta)}y^{\alpha-1}(1-y)^{\beta-1}, \quad 0 \le y \le 1$	$\frac{\alpha}{\alpha+\beta}$	$\frac{\alpha\beta}{(\alpha+\beta)^2(\alpha+\beta+1)}$

Geometric series: $\sum_{n=0}^{\infty} ar^n = \frac{a}{1-r}$

For geometric random variable, $P(Y > k) = (1-p)^k$

Maclaurin series expansion: $e^x = \sum_{n=0}^{\infty} \frac{x^n}{n!}$

Binomial expansion: $(a+b)^n = \sum_{y=0}^{n} \binom{n}{y} a^y b^{n-y}$