Aid Sheet

Binomial	$f(x) = \binom{n}{x} p^x (1-p)^{n-x}$	E(X) = np	V(X) = np(1-p)
Geometric	$f(x) = (1-p)^x p$	$E(X) = \frac{1-p}{p}$	$V(X) = \frac{1-p}{p^2}$
Negative Binomial	$f(x) = {x+r-1 \choose r-1} p^r (1-p)^x$	$E(X) = \frac{r(1-p)}{p}$	$V(X) = \frac{r(1-p)}{p^2}$
Poisson	$f(x) = \frac{e^{-\lambda} \lambda^x}{x!}$	$E(X) = \lambda$	$V(X) = \lambda$
Uniform	$f(x) = \frac{1}{b-a}, \ a \le x \le b$	$E(X) = \frac{a+b}{2}$	$V(X) = \frac{(b-a)^2}{12}$
Exponential	$f(x) = \frac{1}{\theta}e^{-x/\theta} = \lambda e^{-x\lambda}, x > 0$	$E(X) = \theta = \frac{1}{\lambda}$	$V(X) = \theta^2 = \frac{1}{\lambda^2}$
Gamma	$f(x) = \frac{1}{\Gamma(\alpha)\beta^{\alpha}} x^{\alpha - 1} e^{-x/\beta}, \ x > 0$	$E(X) = \alpha \beta$	$V(X) = \alpha \beta^2$
Beta	$f(x) = \frac{\Gamma(\alpha + \beta)}{\Gamma(\alpha)\Gamma(\beta)} x^{\alpha - 1} (1 - x)^{\beta - 1}, \ 0 \le x \le 1$	$E(X) = \frac{\alpha}{\alpha + \beta}$	$V(X) = \frac{\alpha\beta}{(\alpha+\beta)^2(\alpha+\beta+1)}$
Normal	If $X \sim N(\mu, \sigma^2) \to \frac{X - \mu}{\sigma} \sim N(0, 1)$	$E(X) = \mu$	$V(X) = \sigma^2$

$P(A \cup B) = P(A) + P(B) - P(A \cap B)$	$P(A) = \sum_{i=1}^{k} P(A B_i)P(B_i)$	
	if B_1, B_k partitions the sample space	
Variance: $V(X) = E[(x - \mu)^2]$	Chebyshev's Inequality: $P(x - \mu < k\sigma) \ge 1 - \frac{1}{k^2}$	
Variance: $V(X + Y) = V(X) + V(X) + 2Cov(X, Y)$	$V(aX + bY) = a^{2}V(X) + b^{2}V(Y) + 2abCov(X, Y)$	
Covariance: $\sigma_{XY} = Cov(X, Y) = E[(X - \mu_X)(Y - \mu_Y)]$	Correlation: $\rho = \frac{\sigma_{XY}}{\sigma_X \sigma_Y}$	
$\sigma_{XY} = E(XY) - E(X)E(Y)$	$\rho = \frac{CovXY}{\sqrt{V(Y)V(Y)}}$	
Gamma Function: $\Gamma(\alpha) = \int_0^\infty x^{\alpha-1} e^{-x} dx$	Gamma Function Properties:	
	$\Gamma(\alpha) = (\alpha - 1) \Gamma(\alpha - 1)$	
	$\Gamma(1/2) = \sqrt{\pi}$	
Moment Generating Function: $M_X(t) = E(e^{tX})$	Transformation Method: $f_Y(y) = f_X(g^{-1}(y)) \left \frac{dg^{-1}(y)}{dy} \right $	