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	$f(x) = \binom{x+r-1}{r-1} p^r (1-p)^x$	$E(X) = \frac{r(1-p)}{p}$	$V(X) = \frac{r(1-p)}{p^2}$
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 $X \sim N(\mu, \sigma^2) \rightarrow \frac{X-\mu}{\sigma} \sim N(0,1)$	$E(X) = \mu$	$V(X) = \sigma^2$

$P(A \cup B) = P(A) + P(B) - P(A \cap B)$	$P(A) = \sum_{i=1}^{k} P(A\vert B_i)P(B_i)$ if $B_1, ...B_k$ partitions the sample space
Variance: $V(X) = E[(x-\mu)^2]$	**Chebyshev's Inequality**: $P(\vert x-\mu\vert < k\sigma) \ge 1 - \frac{1}{k^2}$
Variance: $V(X+Y) = V(X) + V(X) + 2Cov(X,Y)$	$V(aX+bY) = a^2V(X) + b^2V(Y) + 2abCov(X,Y)$
Covariance: $\sigma_{XY} = Cov(X,Y) = E[(X-\mu_X)(Y-\mu_Y)]$ $\sigma_{XY} = E(XY) - E(X)E(Y)$	**Correlation:** $\rho = \frac{\sigma_{XY}}{\sigma_X \sigma_Y}$ $\rho = \frac{CovXY}{\sqrt{V(Y)V(Y)}}$
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:** $f_Y(y) = f_X(g^{-1}(y)) \left\vert \frac{dg^{-1}(y)}{dy} \right\vert$