1 Beta Distribution

1.1 Notation

$Beta(\alpha, \beta)$ where $\alpha, \beta > 0$ are the shape parameters.

1.2 Density Function

$f(x) = \frac{x^{\alpha-1}(1-x)^{\beta-1}}{B(\alpha,\beta)}$ where $B(\alpha, \beta) = \frac{\Gamma(\alpha)\Gamma(\beta)}{\Gamma(\alpha+\beta)}$, for $x \in [0, 1]$.

1.3 Mean and Variance

$E[X] = \frac{\alpha}{\alpha+\beta}$
$Var[X] = \frac{\alpha\beta}{(\alpha+\beta)^2(\alpha+\beta+1)}$

2 Uniform Distribution

2.1 Notation

$U(a, b)$ where $-\infty < a < b < \infty$.

2.2 Density Function

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

2.3 Mean and Variance

$E[X] = \frac{1}{2}(a + b)$
$Var[X] = \frac{1}{12}(b - a)^2$

3 Gamma Distribution

3.1 Notation

$Gamma(n, 1/\lambda)$

3.2 Density Function

$f(x) = (\frac{\lambda^n}{\Gamma(n)})x^{n-1}e^{-\lambda x}$, where $\Gamma(n) = \int_0^\infty x^{n-1}e^{-x}dx$.
Note that $(\frac{\lambda^n}{\Gamma(n)})$ is constant wrt to x.

3.3 Mean and Variance

$E[X] = \frac{n}{\lambda}$
$Var[X] = \frac{n}{\lambda^2}$

4 Normal Distribution

4.1 Notation

$N(\mu, \sigma^2)$ where μ is the mean, σ^2 is the variance

4.2 Density Function

$f(x) = \frac{1}{\sqrt{2\pi}\sigma}exp\{-\frac{((x-\mu)^2)}{2\sigma^2}\}$, $-\infty < x < \infty$.

5 Dirichlet Distribution

This is a multivariate generalisation of the beta distribution, hence it is also known as the multivariate beta distribution (MBD).

5.1 Notation

$Dir(\alpha_1, \alpha_2, .., \alpha_n)$ where $\alpha_i > 0$.

5.2 Density Function

$f(x) = \frac{\Pi_{i=1}^n x_i^{\alpha_i - 1}}{B(\alpha_1,\alpha_2,..,\alpha_n)}$ where $B(\alpha_1, \alpha_2, ..., \alpha_n) = \frac{\Gamma(\alpha_1)\Gamma(\alpha_2)...\Gamma(\alpha_n)}{\Gamma(\alpha_1+\alpha_2+...+\alpha_n)}$

5.3 Mean and Variance

$E[X_i] = \frac{\alpha_i}{\sum_{i=1}^n \alpha_i}$
$Var[X_i] = \frac{\tilde{\alpha}_i(1-\tilde{\alpha}_i)}{\alpha_0+1}$ where $\alpha_0 = \Sigma_{i=1}^n \alpha_i$ and $\tilde{\alpha}_i = \alpha_i/\alpha_0$

6 t distribution

TODO

7 Truncated Normal Distribution

TODO

8 Multinomial Distribution

TODO