Bayesian Statistical Methods – Common distributions

For each distribution, x is the random quantity and the other symbols are parameters.

Discrete distributions

Distribution	Probability mass function	Range of parameters and variates	Mean	Variance
Binomial	$\binom{n}{x} q^x(1-q)^{n-x}$	$0 \leq q \leq 1$ $x = 0, 1, \ldots, n$	nq	$nq(1-q)$
Poisson	$\frac{\lambda^x e^{-\lambda}}{x!}$	$\lambda > 0$ $x = 0, 1, 2, \ldots$	λ	λ
Geometric	$q(1-q)^x$	$0 < q \leq 1$ $x = 0, 1, 2, \ldots$	$\frac{(1-q)}{q}$	$\frac{(1-q)}{q^2}$
Negative binomial	$\binom{r+x-1}{x} q^r(1-q)^x$	$0 < q \leq 1$, $r > 0$ $x = 0, 1, 2, \ldots$	$\frac{r(1-q)}{q}$	$\frac{r(1-q)}{q^2}$

Continuous distributions

Distribution	Probability density function	Range of parameters and variates	Mean	Variance
Uniform	$\frac{1}{b-a}$	$-\infty < a < b < \infty$ $a < x < b$	$\frac{a+b}{2}$	$\frac{(b-a)^2}{12}$
Normal $N(\mu, \sigma^2)$	$\frac{1}{\sqrt{2\pi\sigma^2}} \exp\left(-\frac{(x-\mu)^2}{2\sigma^2}\right)$	$-\infty < \mu < \infty, \sigma > 0$ $-\infty < x < \infty$	μ	σ^2

The 95th and 97.5th percentiles of the standard $N(0, 1)$ distribution are 1.64 and 1.96, respectively.

Distribution	Probability density function	Range of parameters and variates	Mean	Variance
Exponential	$\lambda e^{-\lambda x}$	$\lambda > 0$ $x > 0$	$\frac{1}{\lambda}$	$\frac{1}{\lambda^2}$
Gamma	$\frac{\beta^\alpha x^{\alpha-1} e^{-\beta x}}{\Gamma(\alpha)}$	$\alpha > 0, \beta > 0$ $x > 0$	$\frac{\alpha}{\beta}$	$\frac{\alpha}{\beta^2}$
Beta	$\frac{\Gamma(\alpha+\beta)}{\Gamma(\alpha)\Gamma(\beta)} x^{\alpha-1}(1-x)^{\beta-1}$	$\alpha > 0, \beta > 0$ $0 < x < 1$	$\frac{\alpha}{\alpha+\beta}$	$\frac{\alpha\beta}{(\alpha+\beta)^2(\alpha+\beta+1)}$