BUGS functions

Function	Usage	Definition
Complementary	`cloglog(p)<-a+b*x`	$\log[-\log(1-p)] = a + bx$
log log	`y<-cloglog(p)`	$y = \log[-\log(1-p)]$
Logical equals	`y<-equals(x,z)`	$y = 1$ if $x = z$
		$y = 0$ if $x \neq z$
Exponential	`y<-exp(x)`	$y = e^x$
Inner product	`y<-inprod(a[],b[])`	$y = \sum_i a_i b_i$
Matrix inverse	`y[,]<-inverse(x[,])`	$y = x^{-1}$
		$y,\ x$ both $n \times n$ matrices
Natural logarithm	`log(lambda)<-a+b*x`	$\log(\lambda) = a + bx$
	`y<-log(x)`	$y = \log x$
Log determinant	`y<-logdet(x[,])`	$y = \log \lvert x \rvert$
		x is a $n \times n$ matrix
Log factorial	`y<-logfact(x)`	$y = \log(x!)$
Log(gamma function)	`y<-loggam(x)`	$y = \log[\Gamma(x)]$
Logit	`y<-logit(p)`	$y = \log[p/(1-p)]$
	`logit(p)<-a+b*x`	$\log[p/(1-p)] = a + bx$
Maximum	`c<-max(a,b)`	$c = \max(a, b)$
Mean	`x.bar<-mean(x[])`	$\bar{x} = \sum_i x_i / n$
Minimum	`c<-min(a,b)`	$c = \min(a, b)$
Standard Gaussian	`p<-phi(x)`	$p = \int_{-\infty}^{x} (2\pi)^{-1/2} e^{-t^2/2}\ dt$
distribution function		i.e. $p = \Phi(x)$
Power	`z<-pow(x,y)`	$z = x^y$
Probit	`y<-probit(p)`	$y = \Phi^{-1}(p)$
	`probit(p)<-a+b*x`	$\Phi^{-1}(p) = a + bx$
Standard deviation	`s<-sd(x[])`	$s = \sqrt{\sum_i (x_i - \bar{x})^2 / n}$
Square root	`sigma<-sqrt(tau)`	$\sigma = \sqrt{\tau}$
Unit step	`y<-step(x)`	$y = 0$ if $x < 0$
		$y = 1$ if $x \geq 0$
Sum	`x.sum<-sum(x[])`	$x_{\text{sum}} = \sum_i x_i$

BUGS distributions

Distribution	Usage	Definition
Bernoulli	`r~dbern(p)`	$f(r \mid p) = p^r(1-p)^{1-r}$; $r = 0, 1$
beta	`p~dbeta(a,b)`	$f(p \mid a, b) = \frac{\Gamma(a+b)}{\Gamma(a)\Gamma(b)} p^{a-1}(1-p)^{b-1}$; $0 < p < 1$
binomial	`r~dbin(p,n)`	$f(r \mid p, n) = \frac{n!}{r!(n-r)!} p^r(1-p)^{n-r}$; $r = 0, \ldots, n$
categorical	`r~dcat(p[])`	$f(r \mid p_1, \ldots, p_R) = p_r$; $r = 1, 2, \ldots, R$ where $R = \dim(\mathbf{p})$
chi-squared	`x~dchisq(k)`	$f(x \mid k) = 2^{-k/2} x^{k/2-1} e^{-x/2} / \Gamma(\frac{k}{2})$; $x > 0$
double exponential	`x~ddexp(mu,tau)`	$f(x \mid \mu, \tau) = \frac{\tau}{2} e^{-\tau\lvert x-\mu \rvert}$; $-\infty < x < \infty$
Dirichlet	`p[]~ddirch(alpha[])`	$f(\mathbf{p} \mid \alpha) = \frac{\Gamma(\sum_i \alpha_i)}{\prod_i \Gamma(\alpha_i)} \prod_i p_i^{\alpha_i - 1}$; $0 < p_i < 1, \ \sum_i p_i = 1$
exponential	`x~dexp(lambda)`	$f(x \mid \lambda) = \lambda e^{-\lambda x}$; $x > 0$
gamma	`x~dgamma(r,mu)`	$f(x \mid r, \mu) = \mu^r x^{r-1} e^{-\mu x} / \Gamma(r)$; $x > 0$
lognormal	`x~dlnorm(mu,tau)`	$f(x \mid \mu, \tau) = \sqrt{\frac{\tau}{2\pi}} x^{-1} \exp[-\frac{\tau}{2}(\log x - \mu)^2]; \quad x > 0$
logistic	`x~dlogis(mu,tau)`	$f(x \mid \mu, \tau) = \tau e^{\tau(x-\mu)} / (1 + e^{\tau(x-\mu)})^2; \quad -\infty < x < \infty$
multivariate normal	`x[]~dmnorm(mu[],T[,])`	$f(\mathbf{x} \mid \mu, \mathbf{T}) = (2\pi)^{-N/2} \lvert \mathbf{T} \rvert^{1/2} \exp[-\frac{1}{2}(\mathbf{x} - \mu)' \mathbf{T} (\mathbf{x} - \mu)]$; $-\infty < x_i < \infty$
multinomial	`x[]~dmulti(p[],N)` $0 < p_i < 1, \ \sum_i p_i = 1$	$f(\mathbf{x} \mid \mathbf{p}, N) = \frac{(\sum_i x_i)!}{\prod_i x_i!} \prod_i p_i^{x_i}$; $\sum_i x_i = N$
negative binomial	`x~dnegbin(p,r)`	$f(x \mid p, r) = \frac{(x+r-1)!}{x!(r-1)!} p^r (1-p)^x$; $x = 0, 1, 2, \ldots$
normal	`x~dnorm(mu,tau)`	$f(x \mid \mu, \tau) = \sqrt{\frac{\tau}{2\pi}} \exp[-\frac{\tau}{2}(x - \mu)^2]; \quad -\infty < x < \infty$
Pareto	`x~dpar(alpha,c)`	$f(x \mid \alpha, c) = \alpha c^\alpha x^{-(\alpha+1)}$; $x > c$

BUGS distributions continued

Distribution	Usage	Definition
Poisson	`r~dpois(lambda)`	$f(r \mid \lambda) = e^{-\lambda}\frac{\lambda^r}{r!}$; $r = 0, 1, \ldots$
Student's t	`x~dt(mu,tau,k)`	$f(x \mid \mu, \tau, k) = \frac{\Gamma([k+1]/2)}{\Gamma(k/2)}\sqrt{\frac{\tau}{k\pi}}[1 + \frac{\tau}{k}(x-\mu)^2]^{-(k+1)/2}$; $-\infty < x < \infty$
uniform	`x~dunif(a,b)`	$f(x \mid a, b) = 1/(b-a)$; $a < x < b$
Weibull	`x~dweib(v,lambda)`	$f(x \mid v, \lambda) = v\lambda x^{v-1}\exp(-\lambda x^v)$; $x > 0$
Wishart	`x[,]~dwish(R[,],k)`	$f(\mathbf{x} \mid \mathbf{R}, k) \propto \lvert\mathbf{R}\rvert^{k/2}\lvert\mathbf{x}\rvert^{(k-p-1)/2}\exp(-\frac{1}{2}\mathrm{tr}[\mathbf{Rx}])$; $\mathbf{x}$ symmetric and positive definite