CODING WITH R

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PROBABILITY DISTRIBUTIONS

One convenient use of R is to provide a comprehensive set of statistical tables.

Functions are provided

- to evaluate the cumulative distribution function P(X x), the probability density

Function;

- to evaluate the quantile function (given q, the smallest x such that $P(X \leq x) > q$);

-to simulate from the distribution.

PROBABILITY DISTRIBUTIONS

For normal distribution:

dnorm(x,mean,sd,…) ### calculate the pdf of normal distribution at the point x.

pnorm(x,mean,sd,…) ### calculate the cdf of normal distribution at the point x.

qnorm(p,mean,sd,…) ### calculate the point x at which P[X≤x] > p

rnorm(n,mean,sd,…) ### draw random sample of size n from a normal distribution.

Ex.

pnorm(1.66,1,2) ## calculate the pdf of normal distribution with mean = 1, sd = 2, at the point 1.66.

qnorm(0.85,1,2) ## calculate the point x at which P[X≤x] > 0.85 for normal(1,2) distribution.

dnorm(3,1,2) ## calculate the pdf of normal distribution with mean = 1, sd = 2, at the point 3.

rnorm(1000,1,2) ## draw random sample of size 1000 from a normal distribution with mean = 1, sd=2.

PROBABILITY DISTRIBUTIONS

For uniform distribution:

dunif(x,min,max) ### calculate the pdf of uniform distribution at the point x.

punif(x, min,max) ### calculate the cdf of uniform distribution at the point x.

qunif(p, min,max) ### calculate the point x at which P[X≤x] > p

runif(n, min,max) ### draw random sample of size n from a uniform distribution.

Ex.

punif(1.3,1,2) ## calculate the pdf of uniform distribution with min = 1, max = 2, at the point x.

qunif(0.85,1,2) ## calculate the point x at which P[X≤x] > 0.85 for uniform distribution.

dunif(1.87,1,2) ## calculate the pdf of uniform distribution with min = 1, max = 2, at the point 1.87.

runif(1000,1,2) ## draw random sample of size 1000 from a normal distribution with min = 1, max=2.

PROBABILITY DISTRIBUTIONS

For gamma distribution:

dgamma(x,shape,rate) ### calculate the pdf of gamma distribution at the point x.

pgamma(x, shape,rate) ### calculate the cdf of gamma distribution at the point x.

qgamma(p, shape, rate) ### calculate the point x at which $P[X \leq x] > p$

rgamma(n, shape, rate) ### draw random sample of size n from a gamma distribution.

Ex.

pgamma(1.3,1,2) ## calculate the pdf of gamma distribution with shape = 1, rate = 2, at the point x.

qgamma(0.85,1,2) ## calculate the point x at which $P[X \leq x] > 0.85$ for gamma distribution.

dgamma(1.87,1,2) ## calculate the pdf of gamma distribution with shape = 1, rate = 2, at the point 1.87.

rgamma(1000,1,2) ## draw random sample of size 1000 from a gamma distribution with shape = 1, rate=2.

PROBABILITY DISTRIBUTIONS

For beta distribution:

dgamma(x,shape,rate) ### calculate the pdf of gamma distribution at the point x.

pgamma(x, shape,rate) ### calculate the cdf of gamma distribution at the point x.

qgamma(p, shape, rate) ### calculate the point x at which $P[X \leq x] > p$

rgamma(n, shape, rate) ### draw random sample of size n from a gamma distribution.

Ex.

pgamma(1.3,1,2) ## calculate the pdf of gamma distribution with shape = 1, rate = 2, at the point x.

qgamma(0.85,1,2) ## calculate the point x at which $P[X \leq x] > 0.85$ for gamma distribution.

dgamma(1.87,1,2) ## calculate the pdf of gamma distribution with shape = 1, rate = 2, at the point 1.87.

rgamma(1000,1,2) ## draw random sample of size 1000 from a gamma distribution with shape = 1, rate=2.

PROBABILITY DISTRIBUTIONS

For beta distribution:

dbeta(x,shape1, shape2) ### calculate the pdf of beta distribution at the point x.

pbeta(x, shape1, shape2) ### calculate the cdf of beta distribution at the point x.

qbeta(p, shape1, shape2) ### calculate the point x at which $P[X \leq x] > p$

rbeta(n, shape1, shape2) ### draw random sample of size n from a beta distribution.

Ex.

pbeta(0.77,1,2) ## calculate the pdf of beta distribution with shape1 = 1, shape2 = 2, at the point x.

qbeta(0.85,1,2) ## calculate the point x at which $P[X \leq x] > 0.85$ for beta distribution.

dbeta (0.87,1,2) ## calculate the pdf of beta distribution with shape1 = 1, shape2 = 2, at the point 0.87.

rbeta(1000,1,2) ## draw random sample of size 1000 from a beta distribution with shape1 = 1, shape2=2.

You can also specify 'ncp' (non-centrality parameter) values if needed.

PROBABILITY DISTRIBUTIONS

For student’s t distribution:

dt(x,df) ### calculate the pdf of student’s t distribution at the point x. df = degrees of freedom.

pt(x, df) ### calculate the cdf of student’s t distribution at the point x.

qt(p, df) ### calculate the point x at which P[X≤x] > p

rt(n, df) ### draw random sample of size n from a student’s t distribution.

Ex.

pt(0.77,2) ## calculate the pdf of student’s t distribution with df = 2, at the point x.

qt(0.85,2) ## calculate the point x at which P[X≤x] > 0.85 for student’s t distribution.

dt(0.87,2) ## calculate the pdf of student’s t distribution with df = 2, at the point 0.87.

rt(1000,2) ## draw random sample of size 1000 from a student’s t distribution with df =2.

PROBABILITY DISTRIBUTIONS

For F distribution:

df(x,df1,df2) ### calculate the pdf of F distribution at the point x. df1 and df2 = degrees of freedoms.

pf(x, df1,df2) ### calculate the cdf of F distribution at the point x.

qf(p, df1,df2) ### calculate the point x at which P[X≤x] > p

rf(n, df1,df2) ### draw random sample of size n from a F distribution.

Ex.

pf(0.77,3,2) ## calculate the pdf of F distribution with df1 =3, df2 = 2, at the point x.

qf(0.85,3,2) ## calculate the point x at which P[X≤x] > 0.85 for F distribution.

df(0.87,3,2) ## calculate the pdf of F distribution with df1 =3, df2 = 2, at the point 0.87.

rf(1000,3,2) ## draw random sample of size 1000 from a F distribution with df1 =3, df2 = 2.

PROBABILITY DISTRIBUTIONS

For Cauchy distribution:

dcauchy(x,location,scale) ### calculate the pdf of Cauchy distribution at the point x.

pcauchy(x, location,scale) ### calculate the cdf of Cauchy distribution at the point x.

qcauchy(p, location,scale) ### calculate the point x at which $P[X \leq x] > p$

rcauchy(n, location,scale) ### draw random sample of size n from a Cauchy distribution.

Ex.

pcauchy(0.77,3,2) ## calculate the pdf of Cauchy distribution with location =3, scale = 2, at the point x.

qcauchy(0.85,3,2) ## calculate the point x at which $P[X \leq x] > 0.85$ for Cauchy distribution.

dcauchy(0.87,3,2) ## calculate the pdf of Cauchy distribution with location =3, scale = 2, at the point 0.87.

rcauchy(1000,3,2) ## draw random sample of size 1000 from a Cauchy distribution with location =3, scale = 2.

PROBABILITY DISTRIBUTIONS

For log-normal distribution:

dlnorm(x,meanlog,sdlog) ### calculate the pdf of log-normal distribution at the point x.

plnorm(x, meanlog,sdlog) ### calculate the cdf of log-normal distribution at the point x.

qlnorm(p, meanlog,sdlog) ### calculate the point x at which $P[X \leq x] > p$

rlnorm(n, meanlog,sdlog) ### draw random sample of size n from a log-normal distribution.

Ex.

plnorm(0.77,3,2) ## calculate the pdf of log-normal distribution with mean =3, sd = 2, at the point x.

qlnorm(0.85,3,2) ## calculate the point x at which $P[X \leq x] > 0.85$ for log-normal distribution.

dlnorm(0.87,3,2) ## calculate the pdf of log-normal distribution with mean =3, sd = 2, at the point 0.87.

rlnorm(1000,3,2) ## draw random sample of size 1000 from a log-normal distribution with mean =3, sd = 2.

PROBABILITY DISTRIBUTIONS

For binomial distribution:

dbinom(x,size,prob) ### calculate the pdf of binomial distribution at the point x.

pbinom(x, size,prob) ### calculate the cdf of binomial distribution at the point x.

qbinom(p, size,prob) ### calculate the point x at which $P[X \leq x] > p$

rbinom(n, size,prob) ### draw random sample of size n from a binomial distribution.

Ex.

pbinom(7,10,0.7) ## calculate the pdf of binomial distribution with size =10, prob = 0.7, at the point x.

qbinom(0.85,10,0.7) ## calculate the point x at which $P[X \leq x] > 0.85$ for binomial distribution.

dbinom(7,10,0.7) ## calculate the pdf of binomial distribution with size =10, prob = 0.7, at the point 7.

rbinom(1000,10,0.7) ## draw random sample of size 1000 from a binomial distribution with size =10, prob = 0.7.

PROBABILITY DISTRIBUTIONS

For Poisson distribution:

dpois(x,lambda) ### calculate the pdf of Poisson distribution at the point x.

ppois(x, lambda) ### calculate the cdf of Poisson distribution at the point x.

qpois(p, lambda) ### calculate the point x at which P[X≤x] > p

rpois(n, lambda) ### draw random sample of size n from a Poisson distribution.

Ex.

ppois(7, 3) ## calculate the pdf of Poisson distribution with lambda = 3, at the point x.

qpois(0.85,3) ## calculate the point x at which P[X≤x] > 0.85 for Poisson distribution.

dpois(7,3) ## calculate the pdf of Poisson distribution with lambda = 3, at the point 7.

rpois(1000,3) ## draw random sample of size 1000 from a Poisson distribution with lambda = 3.

PROBABILITY DISTRIBUTIONS

Install the package ‘e1071’. (mind the letter-case ‘e’.)

library(e1071) ### call the package

a = rf(100,3,2) ### draw 100 random samples from a F distribution.

skewness(a)

kurtosis(a)

** More distributions are available in ‘SuppDists’ package.

link: https://cran.r-project.org/web/packages/SuppDists/index.html

Also, you can search in google as ‘SuppDists package in R’.

PROBABILITY DISTRIBUTIONS

Alternatively,

```
### install and call the following packages
library(timeDate)
library(fBasics)

a  = rf(100,3,2) ### draw random sample from some distribution (not necessarily F)
skewness(a)
kurtosis(a)
```

PROBABILITY DISTRIBUTIONS

Remember:

- ‘p’ for ‘probability’, the cdf of a distribution.
- ‘q’ for ‘quantile’, the inverse cdf.
- ‘d’ for ‘density’, the density function (pdf or pmf)
- ‘r’ for ‘random’, random sample from the specified distribution.

PROBABILITY DISTRIBUTIONS

1. What is $P(X = 1)$ when X has the $\text{Bin}(25, 0.005)$ distribution?

2. What are the 10th, 20th, and so forth quantiles of the $\text{Bin}(10, 1/3)$ distribution?

3. Suppose widgits produced at Acme Widgit Works have probability 0.005 of being defective. Suppose widgits are shipped in cartons containing 25 widgits. What is the probability that a randomly chosen carton contains no more than one defective widgit?