

normal() — Cumulatives, reverse cumulatives, and densities

Syntax Diagnostics	Description Also see	Remarks and examples	Conformability
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Syntax

Gaussian normal

```

d = normalden(z)
d = normalden(x, sd)
d = normalden(x, mean, sd)
p = normal(z)
z = invnormal(p)
ln(d) = lnnormalden(z)
ln(d) = lnnormalden(x, sd)
ln(d) = lnnormalden(x, mean, sd)
ln(p) = lnnormal(z)

```

Binormal

```
p = binormal(z1, z2, rho)
```

Beta

```

d = betaden(a, b, x)
p = ibeta(a, b, x)
q = ibetatail(a, b, x)
x = invibeta(a, b, p)
x = invibetatail(a, b, q)

```

Binomial

```

pk = binomialp(n, k, pi)
p = binomial(n, k, pi)
q = binomialtail(n, k, pi)
pi = invbinomial(n, k, p)
pi = invbinomialtail(n, k, q)

```

Chi-squared

```

p = chi2(df, x)
d = chi2den(df, x)
q = chi2tail(df, x)
x = invchi2(df, p)
x = invchi2tail(df, q)

```

Dunnett's multiple range

```

p = dunnettprob(k, df, x)
x = invdunnettprob(k, df, p)

```

F

```
d = Fden(df1, df2, f)
p = F(df1, df2, f)
q = Ftail(df1, df2, f)
f = invF(df1, df2, p)
f = invFtail(df1, df2, q)
```

Gamma

```
d = gammaden(a, b, g, x)
p = gammap(a, x)
q = gammaptail(a, x)
x = invgammap(a, p)
x = invgammaptail(a, q)
dg/da = dgammapda(a, x)
dg/dx = dgammapdx(a, x)
d2g/da2 = dgammapdada(a, x)
d2g/dadx = dgammapdadx(a, x)
d2g/dx2 = dgammapdxdx(a, x)
```

Hypergeometric

```
pk = hypergeometricp(N, K, n, k)
p = hypergeometric(N, K, n, k)
```

Negative binomial

```
pk = nbinomialp(n, k, pi)
p = nbinomial(n, k, pi)
q = nbinomialtail(n, k, pi)
pi = invnbinomial(n, k, p)
pi = invnbinomialtail(n, k, q)
```

Noncentral beta

```
d = nbetaden(a, b, np, x)
p = nibeta(a, b, np, x)
x = invnibeta(a, b, np, p)
```

Noncentral chi-squared

```
p = nchi2(df, np, x)
d = nchi2den(df, np, x)
q = nchi2tail(df, np, x)
x = invnchi2(df, np, p)
x = invnchi2tail(df, np, q)
np = npnchi2(df, x, p)
```

Noncentral F

$$\begin{aligned}
 p &= \text{nF}(df_1, df_2, np, f) \\
 d &= \text{nFden}(df_1, df_2, np, f) \\
 q &= \text{nFtail}(df_1, df_2, np, f) \\
 f &= \text{invnFtail}(df_1, df_2, np, q) \\
 np &= \text{npnF}(df_1, df_2, f, q)
 \end{aligned}$$

Noncentral Student's t

$$\begin{aligned}
 p &= \text{nt}(df, np, t) \\
 d &= \text{ntden}(df, np, t) \\
 q &= \text{nttail}(df, np, t) \\
 t &= \text{invnttail}(df, np, q) \\
 np &= \text{npnt}(df, t, p)
 \end{aligned}$$

Poisson

$$\begin{aligned}
 pk &= \text{poissonp}(mean, k) \\
 p &= \text{poisson}(mean, k) \\
 q &= \text{poisontail}(mean, k) \\
 m &= \text{invpoisson}(k, p) \\
 m &= \text{invpoisontail}(k, q)
 \end{aligned}$$

Student's t

$$\begin{aligned}
 p &= \text{t}(df, t) \\
 d &= \text{tden}(df, t) \\
 q &= \text{ttail}(df, t) \\
 t &= \text{invt}(df, p) \\
 t &= \text{invttail}(df, q)
 \end{aligned}$$

Tukey's Studentized range

$$\begin{aligned}
 p &= \text{tukeyprob}(k, df, x) \\
 x &= \text{invtukeyprob}(k, df, p)
 \end{aligned}$$

where

1. All functions return real and all arguments are real.
2. The left-hand-side notation is used to assist in interpreting the meaning of the returned value:

$$\begin{aligned}
 d &= \text{density value} \\
 pk &= \text{probability of discrete outcome } K = \Pr(K = k) \\
 p &= \text{left cumulative} \\
 &= \Pr(-\text{infinity} < \text{statistic} \leq x) \text{ (continuous)} \\
 &= \Pr(0 \leq K \leq k) \text{ (discrete)} \\
 q &= \text{right cumulative} \\
 &= 1 - p \text{ (continuous)} \\
 &= \Pr(K \geq k) = 1 - p + pk \text{ (discrete)} \\
 np &= \text{noncentrality parameter}
 \end{aligned}$$

3. Hypergeometric distribution:

N = number of objects in the population

K = number of objects in the population with the characteristic of interest,

$$K < N$$

n = sample size, $n < N$

k = number of objects in the sample with the characteristic of interest,

$$\max(0, n - N + K) \leq k \leq \min(K, n)$$

4. Negative binomial distribution: $n > 0$ and may be nonintegral.

Description

The above functions return density values, cumulatives, reverse cumulatives, and in one case, derivatives of the indicated probability density function. These functions mirror the Stata functions of the same name and in fact are the Stata functions.

See *Probability distributions and density functions* in [D] **functions** for function details. In the syntax diagram above, some arguments have been renamed in hope of aiding understanding, but the function arguments match one to one with the underlying Stata functions.

Remarks and examples

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Remarks are presented under the following headings:

R-conformability

A note concerning `invbinomial()` and `invbinomialtail()`

A note concerning `ibeta()`

A note concerning `gammap()`

R-conformability

The above functions are usually used with scalar arguments and then return a scalar result:

```
: x = chi2(10, 12)
: x
.7149434997
```

The arguments may, however, be vectors or matrices. For instance,

```

: x = chi2((10,11,12), 12)
: x
      1          2          3
1  .7149434997  .6363567795  .5543203586

: x = chi2(10, (12,12.5,13))
: x
      1          2          3
1  .7149434997  .7470146767  .7763281832

: x = chi2((10,11,12), (12,12.5,13))
: x
      1          2          3
1  .7149434997  .6727441644  .6309593164

```

In the last example, the numbers correspond to `chi2(10,12)`, `chi2(11,12.5)`, and `chi2(12,13)`.

Arguments are required to be *r-conformable* (see [M-6] [Glossary](#)), and thus,

```

: x = chi2((10\11\12), (12,12.5,13))
: x
      1          2          3
1  .7149434997  .7470146767  .7763281832
2  .6363567795  .6727441644  .7066745906
3  .5543203586  .593595966   .6309593164

```

which corresponds to

```

      1          2          3
1  chi2(10,12) chi2(10,12.5)  chi2(10,13)
2  chi2(11,12) chi2(11,12.5)  chi2(11,13)
3  chi2(12,12) chi2(12,12.5)  chi2(12,13)

```

A note concerning `invbinomial()` and `invbinomialtail()`

`invbinomial(n, k, p)` `invbinomialtail(n, k, q)` are useful for calculating confidence intervals for p_i , the probability of a success. `invbinomial()` returns the probability p_i such that the probability of observing k or fewer successes in n trials is p . `invbinomialtail()` returns the probability p_i such that the probability of observing k or more successes in n trials is q .

A note concerning `ibeta()`

`ibeta(a, b, x)` is known as the cumulative beta distribution, and it is known as the incomplete beta function $I_x(a, b)$.

A note concerning `gammap()`

`gammap(a , x)` is known as the cumulative gamma distribution, and it is known as the incomplete gamma function $P(a, x)$.

Conformability

All functions require that arguments be r-conformable; see [R-conformability](#) above. Returned is matrix of `max(argument rows)` rows and `max(argument columns)` columns containing element-by-element calculated results.

Diagnostics

All functions return missing when arguments are out of range.

Also see

[M-4] [statistical](#) — Statistical functions