stats (version 3.6.2)

FDist: The F Distribution

Description

Density, distribution function, quantile function and random generation for the F distribution with `df1` and `df2` degrees of freedom (and optional non-centrality parameter `ncp`).

Usage

```
df(x, df1, df2, ncp, log = FALSE)
pf(q, df1, df2, ncp, lower.tail = TRUE, log.p = FALSE)
qf(p, df1, df2, ncp, lower.tail = TRUE, log.p = FALSE)
rf(n, df1, df2, ncp)
```

Arguments

x, q	vector of quantiles.
p	vector of probabilities.
n	number of observations. If `length(n) > 1`, the length is taken to be the number required.
df1, df2	degrees of freedom. `Inf` is allowed.
ncp	non-centrality parameter. If omitted the central F is assumed.
log, log.p	logical; if TRUE, probabilities p are given as log(p).

`lower.tail`	logical; if TRUE (default), probabilities are $P[X \le x]$, otherwise, $P[X > x]$.

Value

`df` gives the density, `pf` gives the distribution function `qf` gives the quantile function, and `rf` generates random deviates.

Invalid arguments will result in return value `NaN`, with a warning.

The length of the result is determined by `n` for `rf`, and is the maximum of the lengths of the numerical arguments for the other functions.

The numerical arguments other than `n` are recycled to the length of the result. Only the first elements of the logical arguments are used.

Details

The F distribution with `df1 =` n_1 and `df2 =` n_2 degrees of freedom has density $$f(x) = \frac{\Gamma(n_1/2 + n_2/2)}{\Gamma(n_1/2)\Gamma(n_2/2)} \left(\frac{n_1}{n_2}\right)^{n_1/2} x^{n_1/2 -1} \left(1 + \frac{n_1 x}{n_2}\right)^{-(n_1 + n_2) / 2}%$$ for $x > 0$.

It is the distribution of the ratio of the mean squares of n_1 and n_2 independent standard normals, and hence of the ratio of two independent chi-squared variates each divided by its degrees of freedom. Since the ratio of a normal and the root mean-square of m independent normals has a Student's t_m distribution, the square of a t_m variate has a F distribution on 1 and m degrees of freedom.

The non-central F distribution is again the ratio of mean squares of independent normals of unit variance, but those in the numerator are allowed to have non-zero means and `ncp` is the sum of squares of the means. See Chisquare for further details on non-central distributions.

References

Becker, R. A., Chambers, J. M. and Wilks, A. R. (1988) *The New S Language*. Wadsworth & Brooks/Cole.

Johnson, N. L., Kotz, S. and Balakrishnan, N. (1995) *Continuous Univariate Distributions*, volume

2, chapters 27 and 30. Wiley, New York.

See Also

Distributions for other standard distributions, including `dchisq` for chi-squared and `dt` for Student's t distributions.

Examples

```
# NOT RUN {
## Equivalence of pt(.,nu) with pf(.^2, 1,nu):
x <- seq(0.001, 5, len = 100)
nu <- 4
stopifnot(all.equal(2*pt(x,nu) - 1, pf(x^2, 1,nu)),
          ## upper tails:
      all.equal(2*pt(x,     nu, lower=FALSE),
              pf(x^2, 1,nu, lower=FALSE)))

## the density of the square of a t_m is 2*dt(x, m)/(2*x)
# check this is the same as the density of F_{1,m}
all.equal(df(x^2, 1, 5), dt(x, 5)/x)

## Identity:  qf(2*p - 1, 1, df) == qt(p, df)^2  for  p >= 1/2
p <- seq(1/2, .99, length = 50); df <- 10
rel.err <- function(x, y) ifelse(x == y, 0, abs(x-y)/mean(abs(c(x,y))))
# }
# NOT RUN {
quantile(rel.err(qf(2*p - 1, df1 = 1, df2 = df), qt(p, df)^2), .90)  # ~= 7e-9
# }
```