

**Doubly noncentral t distribution** (from <http://www.math.wm.edu/~leemis/chart/UDR/UDR.html>)

The shorthand  $X \sim t''(n, \delta, \gamma)$  is used to indicate that the random variable  $X$  has the doubly noncentral t distribution with positive integer parameter  $n$  and positive noncentrality parameters  $\delta, \gamma$ . A doubly noncentral t random variable  $X$  with parameters  $n, \delta$ , and  $\gamma$  is defined by the transformation

$$t''(n, \delta, \gamma) = \frac{U + \delta}{\chi'(n, \gamma)/\sqrt{n}}$$

with  $U$  being a  $N(0, 1)$  random variable and  $\chi'(n, \gamma)$  being distributed as a mixture of  $\chi(n + 2j)$  distributions in proportions  $e^{-\gamma/2}(\gamma/2)^j/j!, j = 0, 1, 2, \dots$

Alternative representations exist, and can be found along with additional information on page 533 of Johnson, N.L., Kotz, S., and Balakrishnan, N. (1994), "Continuous Univariate Distributions" (Vol. I, 2nd ed.), New York: Wiley. See also Krishnan, Marakatha (1968), "Series Representation of the Doubly Noncentral  $t$ -Distribution," *Journal of the American Statistical Association*, Volume 63, Number 323, pp. 1004–1012.