

# Information on stable distributions

## Stable densities in four different parameterizations:

$S(, , , ; 0)$  parameterization (top left), the "standard"  $S(, , , ; 1)$  parameterization (top right),  $S(, , , ; 2)$  parameterization (bottom left),  $S(, , , ; 3)$  parameterization (bottom right). The values of  $\alpha$  are indicated on the plots, skewness is indicated by color:  $\beta = 0$  (black),  $\beta = 0.25$  (red),  $\beta = 0.5$  (green),  $\beta = 0.75$  (yellow),  $\beta = 1$  (blue). In all cases, scale  $\sigma = 1$  and location  $\mu = 0$ . Note the discontinuity in the standard 1-parameterization near  $\alpha = 1$ .

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(I will reply to questions if I can, and I will not share your e-mail with anyone else. Please see the note below about the book I am writing; it is not complete yet.)

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<http://fs2.american.edu/jpnolan/www/stable/stable.html>".

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## Papers on stable distributions

[An introduction to stable distributions](#) (PDF format, 0.4 mb). This is Chapter 1 in a forthcoming book on stable distributions. It describes one dimensional stable distributions in a non-technical way, explaining the two main parameterizations of stable laws. I would appreciate any comments you have on this chapter - what you find useful, what's missing, spelling/grammar mistakes, etc. (NOTE: THIS BOOK IS STILL BEING WRITTEN. Even though amazon.com lists the book, it is not available yet, do not order it from them [or anyone else]. I will put information on the book here when it is complete.)

If you want to refer to this document, use the following reference (in BibTeX format)

```
@book{nolan:2018,  
  author = {J. P. Nolan},  
  title = {Stable Distributions - Models for Heavy Tailed Data},  
  year = {2018},  
  publisher = {Birkhauser},  
  address = {Boston},  
  note = {In progress, Chapter 1 online at  
http://fs2.american.edu/jpnolan/www/stable/stable.html}  
}
```

[StableBibliography.pdf](#) A list of papers and books that relate to stable distributions. It is in PDF format and approximately 0.4 mb. If you have corrections or additions to this, please let me know. BibTeX format is preferred

for all additions, required if you want to add more than a few entries.

[A projection approach to multivariate stable laws](#) Slides from a talk at the XXVIII International Seminar on Stability Problems for Stochastic Models, Zakopane, Poland, May 31 - June 5, 2009. (0.9 mb)

[Advances in nonlinear signal processing](#) A paper on using stable distributions in signal processing. It shows that significant improvement can be made in the presence of heavy tailed noise. (0.54 mb)

[Modeling financial data with stable distributions](#) A paper from 2002 on using stable distributions in finance (with some later corrections). It describe basic analysis of financial data and examines some real data for the presence of heavy tails. (0.57 mb)

[Multivariate elliptically contoured stable distributions: theory and estimation](#) A paper from 2006 on multivariate stable distributions that are elliptically contoured, including radial symmetry. The examples are in finance - analyzing multiple heavy tailed assets, but can also be used in engineering problems. (0.32 mb) (An extended version of this paper will appear in Computational Statistics in 2013.)

[mle.pdf](#) Moderately technical document that describes a program for maximum likelihood estimation of parameters for general (non-symmetric) stable distributions. (0.4 mb)

[DataAnalysis.pdf](#) Analyzing data using stable distributions - includes estimation, diagnostics, examples. Paper from Heavy Tails Conference (50 pages with many graphs, 0.7 mb).

[overview.pdf](#) Overview article on multivariate stable distributions.

[tails.pdf](#) Technical paper that examines the tail behavior of stable distributions. In particular, the issue of when the asymptotic Pareto behavior is an accurate estimate of the density or distribution function is examined. It is shown that the degree of accuracy is highly dependent on the parameters alpha and beta and unless alpha is small, say less than 1.2, the Pareto behavior does not occur until very far out on the tail. This implies that tail estimators for alpha are likely to be of limited value for stable distributions. Also included are some results on the mode of stable distributions and quantiles are discussed (see the data file quantiles.dat below). (1 mb)

[spectral.pdf](#) Estimation of stable spectral measures, by Nolan, Panorska and McCulloch.

# STABLE program for Windows

The program is "stable.exe", instructions for use are in "stable.txt". If you have problems running the program, you may need to download the program again. (Depending on your browser settings, you may have to right click on the links and use the "Save as..." or "Save target as..." menu choices.) If you run the program under Windows 2000, XP, or 7, you will need to have write access to the directory in which you are running stable.exe.

[STABLE for R, matlab, Excel, Mathematica or in library form](#) is available. This allows direct access to the stable routines from popular applications programs or your own custom code.

[stable.exe](#) - calculates stable densities, cumulative distribution functions and quantiles. Also includes stable random number generation and maximum likelihood estimation of stable parameters using a fast 3-dimensional cubic spline interpolation of stable densities. (Version 3.14.02, February 2005, 1.4 mb)

[stable.txt](#) - description of stable program and instructions for use. You can read this ascii file online, or use the "Save as..." feature of your browser to save it to your local disk (16 KB).

[stablec.exe](#) - a command line version of stable.exe with no windows and no graphics.

# MVSTABLE program for Windows

(Version 2.0, 15 March 2000). Calculates multivariate stable densities, simulates random vectors and fits multivariate data.

[mvstable.exe](#) Multivariate stable program.

[mvstable.txt](#) description of the mvstable program. You can read this online or use the "Save as" feature of your browser.

# Stable regression program for Windows

Performs linear regression when the error terms are heavy tailed stable laws.

[stablereg.exe](#) Stable regression program.

[stablereg.txt](#) description of the stablereg program. You can read this online or use the "Save as" feature of your browser.

# Stable quantiles

[quantile.dat](#) Table of stable quantiles (0.7 mb). Use "Save as" feature of your browser to save to local disk if desired. This extensive table lists quantiles of a general stable distribution for  $\alpha=0.1,0.2,\dots,1.9,1.95,1.99,2.0$  and  $\beta=0,0.1,0.2,\dots,0.9,1$ . (Symmetry can be used for negative  $\beta$ ). The quantiles are tabulated for p-values of 0.00001 to 0.00010 (step 0.00001), 0.0001 to 0.0010 (step 0.0001), 0.001 to 0.010 (step 0.001), 0.01 to 0.10 (step 0.005), 0.10 to 0.90 (step 0.01), and upper tail similar to lower tail. This table was computed with modifications to the program STABLE that increase the accuracy significantly.

## Miscellaneous Links

[Applications of Heavy Tailed Distributions in Economics, Engineering and Statistics Conference](#). 3-5 June 1999.

[mathestate](#) Web site for working on quantitative real estate problems, including some sections on stable distributions. For learning and theoretical experimentation purposes, choose Tools -> Tutorial Tools -> Tool #4 "Risk, Variation, and Tail Behavior". For estimating stable parameters from your own data set, choose Tools -> Hands On Tools -> Tool #7 "Stable Data Analysis".

[Mathematica package for stable distributions](#). Programs by Bob Rimmer to calculate densities, cumulative d.f., quantiles, and simulate stable random variables.

Obtaining financial data: here are two places to get free financial data:

[Yahoo Finance](#). You can look up a stock using it's symbol (GE=General Electric, MSFT=Microsoft, etc.) in the search box near the top of the page. Once you are looking at a particular stock, you can view a summary and chart prices. To download price data, click on "historical quotes", and select start and stop dates. If you click on "Get data", you will see the data on the screen and can cut and paste. You can also download the data to a file by clicking on "Download to a spreadsheet"; the data will be saved as a .csv file, which you can import into Excel or edit with notepad or some other editor. Suggestions: Always use the last column, which is adjusted closing price. And always compute the return or log return before analyzing the data; don't just look at price.

[Google Finance](#) has similar information.

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For questions, please use the form above.

