CharFunTool User Guide

The Characteristic Fuctions Toolbox for MATLAB

1st Edition (21-Oct-2018)

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Preface

This guide is an introduction to the use of CharFunTool, an open source software package that aims to provide repository of algorithms for computing the characteristic functions and tools for their combinations and numerical inversion.

Application of the exact statistical inference frequently leads to a non-standard probability distributions of the considered estimators or test statistics. Frequently, evaluation of the probability density function (PDF), cumulative distribution function (CDF), and/or the quantile function (QF) is possible from the characteristic function (CF).

In many important situations, derivation of the CFs is more simple than derivation of the PDFs and/or CDFs. In particular, the exact distribution of many estimators and test statistics can be structurally expressed as a linear combination or product of independent random variables with known distributions and characteristic functions as is the case for many standard multivariate test criteria. However, analytical inversion of the characteristic function (if possible) frequently leads to complicated expressions of the corresponding distribution functions, CDF/PDF and the required quantiles.

As we shall illustrate here, for many applications, the method based on simple implementation of the numerical inversion of the characteristic functions is fully sufficient.

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CharFunTool:The Characteristic Functions Toolbox

The Characteristic Functions Toolbox (CharFunTool) is a MATLAB repository of characteristic functions and tools for their combinations and numerical inversion.

CharFunTool consists of a set of algorithms for evaluating selected characteristic functions and algorithms for numerical inversion of the combined and/or compound characteristic functions, used to evaluate the cumulative distribution function (CDF), the probability density function (PDF), and/or the quantile function (QF).

Instalation

To install, you can either clone the directory with Git or download a .zip file.

- Option 1: Download .zip file

Download a .zip of CharFunTool from

Inversion algorithms

The toolbox comprises different inversion algorithms, including those based on simple trapezoidal quadrature rule for computing the integrals defined by the Gil-Pelaez formulae, and/or based on using the FFT algorithm for computing the Fourier transform integrals.

Algorithms for numerical inversion of the characteristic functions

cf2DistBV

cf2DistFFT

cf2DistGP

Repository of characteristic funtions

CharFunTool consists of a set of algorithms for evaluating selected characteristic functions and algorithms for numerical inversion of the combined and/or compound characteristic functions,

Characteristic functions of general probability distributions

cf_ArcsineSymmetric

cf_ArcsineSymmetric evaluates the characteristic function of a linear combination (resp. convolution) of independent zero-mean symmetric ARCSINE random variables defined on the interval $(-1,1)$.

cf_Beta

cf_BetaNC

cf_BetaSymmetric

cf_Chi

cf_ChiNC

cf_ChiSquare

cf_Exponential

cf_FisherSnedecor

cf_FisherSnedecorNC

cf_Gamma

cf_GeneralizedExponential

cf_Gumbel

cf_InverseGamma

cf_Laplace

cf_MaxwellBoltzmann

cf_MaxwellBoltzmannNC

cf_Nakagami

cf_NakagamiNC

cf_Normal

cf_Rayleigh

cf_RayleighNC

cf_Rectangular

cf_RectangularSymmetric

cf_Rice

cf_Stable

cf_Student

cf_TrapezoidalSymmetric

cf_TriangularSymmetric

cf_TSPSymmetric

cf_Weibull

cf_WignerSemicircle

Tools for manuipulating with the characteristic function

CharFunTool consists of a set of algorithms for manipulating and combining the characteristic functions.

Utility functions