

# Computational methods for probability distributions

Viktor Witkovský

<sup>1</sup>*Institute of Measurement Science, Slovak Academy of Sciences,  
Bratislava, Slovakia*

## Abstract

The contribution deals with numerical methods for calculating the exact probability distributions using the numerical inversion of the characteristic function. We shall present the general concept of *The Characteristics Functions Toolbox* (CharFunTool) [1] – the MATLAB repository of characteristic functions and tools for their combinations and numerical inversion. We shall motivate its applicability by computing the exact probability distribution of estimators and test statistics in linear models with constraints (we consider known covariance structure) and in specific multivariate models.

Moreover, here we shall illustrate that the method is suitable for fast calculation of the exact bootstrap distribution of the sample mean (as well as other linear functions, e.g., the sample moments) on the lattice distributions (i.e. such discrete distributions that every possible value can be represented in the form  $a + bn$ , where  $b \neq 0$  and  $n$  is an integer).

## Keywords

Characteristic function approach, Linear regression model with constraints, Best linear unbiased estimator, Exact bootstrap distribution.

## Acknowledgements

The work was supported by the Slovak Research and Development Agency, project APVV-18-0066, and by the projects VEGA 2/0081/19 and VEGA 2/0096/21.

## References

- [1] Witkovský V. (2021) *CharFunTool: The Characteristic Functions Toolbox (MATLAB)*. <https://github.com/witkovsky/CharFunTool>.