

# RISK-AVERSE MIRROR DESCENT FOR CONVEX AND UNIFORMLY CONVEX STOCHASTIC PROGRAMS WITH APPLICATIONS TO HYPOTHESES TESTING OF RISK MEASURES

VINCENT GUIGUES, ANATOLI IOUDITSKI, ARKADI NEMIROVSKI,  
AND ALEXANDER SHAPIRO

ABSTRACT. Given  $m$  independent random variables  $X_1, X_2, \dots, X_m$ , we study for  $i = 1, \dots, m$ , the statistical test

$$H_0^i : \rho(X_i) \leq \rho(X_j) \quad 1 \leq j \neq i \leq m \quad \overline{H_0^i}$$

where  $\rho$  is a coherent risk measure [1] or an extended polyhedral risk measure [2]. Both asymptotic and nonasymptotic tests are proposed. The former approach uses results on isotonic regression while the latter is based on estimators of the risk measure values obtained using the stochastic mirror descent algorithm and its multistep version. We provide accuracy bounds for the performance of these algorithms and show that they attain the minimax rates of convergence for uniformly convex stochastic programs.

## REFERENCES

- [1] P. Artzner, F. Delbaen, J. Eber, and D. Heath. Coherent measures of risk. *Mathematical Finance*, 9:203–228, 1999.
- [2] V. Guigues and W. Römisch. Sampling-based decomposition methods for multistage stochastic programs based on extended polyhedral risk measures. *SIAM Journal on Optimization*, 22:286–312, 2012.

VINCENT GUIGUES: FUNDAÇÃO GETULIO VARGAS, [vguigues@fgv.br](mailto:vguigues@fgv.br), AND ANATOLI IOUDITSKI: UNIVERSITÉ JOSEPH FOURIER, [anatoli.iouditski@imag.fr](mailto:anatoli.iouditski@imag.fr) AND ARKADI NEMIROVSKI: GEORGIA-TECH, [nemirovs@isye.gatech.edu](mailto:nemirovs@isye.gatech.edu) AND ALEXANDER SHAPIRO: GEORGIA-TECH, [alex.shapiro@isye.gatech.edu](mailto:alex.shapiro@isye.gatech.edu)