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Constructing the Joint Mean-Variance Regions for Univariate and Bivariate Normal Distributions: Approach Based on the Measure of Cumulative Distribution Functions

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Abstract : The usage of the confidence intervals in economics and econometrics is widespread. To be able to investigate a random variable more thoroughly, joint tests are applied. One of such examples is joint mean-variance test. A new approach for testing such hypotheses and constructing confidence sets is introduced. Exploring both the value of the random variable and its deviation with the help of this technique allows checking simultaneously the shift and the probability of that shift (i.e., portfolio risks). Another application is based on the normal distribution, which is fully defined by mean and variance, therefore could be tested using the introduced approach. This method is based on the difference of probability density functions. The starting point is two sets of normal distribution parameters that should be compared (whether they may be considered as identical with given significance level). Then the absolute difference in probabilities at each 'point' of the domain of these distributions is calculated. This measure is transformed to a function of cumulative distribution functions and compared to the critical values. Critical values table was designed from the simulations. The approach was compared with the other techniques for the univariate case. It differs qualitatively and quantitatively in easiness of implementation, computation speed, accuracy of the critical region (theoretical vs. real significance level). Stable results when working with outliers and non-normal distributions, as well as scaling possibilities, are also strong sides of the method. The main advantage of this approach is the possibility to extend it to infinite-dimension case, which was not possible in the most of the previous works. At the moment expansion to 2-dimensional state is done and it allows to test jointly up to 5 parameters. Therefore the derived technique is equivalent to classic tests in standard situations but gives more efficient alternatives in nonstandard problems and on big amounts of data.

Keywords : confidence set, cumulative distribution function, hypotheses testing, normal distribution, probability density function
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