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Application of nonparametric goodness-of-fit tests for composite hypotheses

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In this paper we consider the problem of testing composite hypotheses of the form H_0: $F(x) \in \{F(x,\theta), \theta \in \Theta\}$, when the estimate $\hat{\theta}$ of scalar or vector parameter of the distribution is calculated using the same sample. In this case the conditional distribution $G(S\,|H_0\,)$ of nonparametric test statistics is affected by a number of factors: the form of the tested distribution $F(x,\theta)$; the type and the number of the parameters estimated; and sometimes the value of the parameter and the estimation method.

To solve the problem of testing composite hypotheses using the Kolmogorov, Cramer-von Mises-Smirnov and Anderson-Darling tests different approaches in the studies of various authors were used. In our studies (Lemeshko et al. (2009, 2009a, 2010, 2011)) we used simulation methods to construct models of statistics distributions and tables of percentage points. When statistics distributions of nonparametric goodness-of-fit tests depend on the value of the distribution parameter (for example, in the case of the inverse Gaussian, generalized Weibull distributions), the distribution models were approximated for some integer values of the corresponding parameters in papers of Lemeshko et al. (2009, 2010, 2011).

While testing the composite hypotheses parameters are estimated during the analysis. Therefore, there is no way to find preliminarily the required distribution to test the hypothesis of a goodness-of-fit for the specific value of the parameter $\hat{\theta}$. In this case we propose to find the distribution of the test statistic and to calculate the p-value in the interactive way (while testing the corresponding composite hypothesis).

An implemented interactive technique enables the correct application of the criteria even in the cases when the tests statistics distribution for true H_0 is unknown. The software developed allows us to use methods of parallel computing to accelerate calculations and to use all available computing resources. The software makes it possible to test composite hypotheses for various parametric models of probability distribution using nonparametric Kolmogorov, Cramer-von Mises-Smirnov, Anderson-Darling, Kuiper, Watson and three different Zhang tests.
Keywords: goodness-of-fit testing, composite hypothesis, Kolmogorov, Cramer-von Mises-Smirnov, Anderson-Darling, Zhang tests.

References

Lemeshko B.Yu., Lemeshko S.B. (2009). Distribution models for nonparametric tests for fit in verifying complicated hypotheses and maximum-likelihood estimators. Part I. *Measurement Techniques*. Vol. 52, 6. - P.555-565.

Lemeshko B.Yu., Lemeshko S.B. (2009a). Models for statistical distributions in nonparametric fitting tests on composite hypotheses based on maximum-likelihood estimators. Part II. *Measurement Techniques*. Vol. 52, 8. - P.799-812.

Lemeshko B.Yu., Lemeshko S.B. and Postovalov S.N. (2010). Statistic Distribution Models for Some Nonparametric Goodness-of-Fit Tests in Testing Composite Hypotheses. *Communications in Statistics - Theory and Methods*, 2010. Vol. 39, No. 3. - P. 460-471.

Lemeshko B.Yu., Lemeshko S.B. (2011). Models of Statistic Distributions of Nonparametric Goodness-of-Fit Tests in Composite Hypotheses Testing for Double Exponential Law Cases. *Communications in Statistics - Theory and Methods*, Vol. 40, No. 16. - P. 2879-2892.