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Analysis of random vectors, frequencies of discrete distributions of reference streams, by the method of complex moments

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Sequences of small volume samples of $n \leq 10$ numbers of reference k_j particle fluxes with mean $0 \leq \bar{k} \leq 5$ correspond to random vectors ($\mathrm{RV} - v(.)$) of frequencies $v_j\,(k_j)$ of values $k_j : v(.) = (v_0, v_1, \ldots, v_l)\,, n = \sum_{j=0}^{i} v_j\,(k_j)$ and RV of relative frequencies $v'_j(.) = v_j/n$. Analysis of homogeneity of individual RV pairs and their large $M >> 1$ sequences remains a critical data handling procedure.
A method for evaluating homogeneity of random vectors $v(.)$ and $v'(.)$ pregrouped in peaks with several fixed components $v_j(.)$ of multimodal distributions of functionals $ID(v(.))$ is proposed [1].
$ID(v(.))_m = a_0 v_{0.m} + a_1 v_{1.m} + \ldots + a_l v_{l,m}$, where $a = (a_0, \ldots, a_l)$ - is a defined vector [1, 2].

The method is based on an analysis of the $\rho\left(\mu(v, \ldots, S)_m, \mu(v, \ldots, S)\right)_q$ metric of the phase trajectory projections of the complex functions of the empirical central moments of RV of fractional orders $S > 1$
$\mu(v(.), S) = \frac{1}{1-n} \sum_{j=1}^{n} \left(k_j - \bar{k}\right)^s = \mathrm{Re}\left(\mu(v, S) + i\mathrm{Im}(\mu(v, S)\right), \quad i^2 = -1$

m, q	ν_m	$P\,(\nu_m)$	$\rho(, m)$	$\rho(, m)$
1	6031	0.0006	0.013	0.0087
2	5131	0.0043	0.0092	0.0046
3	4231	0.0123	0.0048	0
4	3331	0.0193	0	0.0048
5	2431	0.0169	0.0047	0.0092
6	1531	0.0079	0.0094	0.013
7	0631	0.0015	0.016	0.018

Contrary to [2] the proposed method takes into account besides the imaginary one also the real component $\mathrm{Re}(\mu(v, S))$ of the momentum function $\mu(v, S)$. In particular, for RV, forming one of peaks in distributions $M(ID(v(.)))$ at $\bar{k} = 1.176\ldots; n = 10$ probabilities of their realization $P(v(.))$ and values of metrics $\rho(.)$ are $S_{\max} = 4.9\rho(m = 3, m) \quad \rho(m = 4, m)$ at $S_0 = 1$

References:

1. G. Babenko, V. M. Vakhtel, V. A. Rabotkin // Procelding of the "NUCLEUS –2019", Dubna, 2019, p.330.
2. N.M. Bliznyakov and others // Proceedings of the International Conference. Voronezh Winter Mathematical School, Voronezh, Voronezh State University Press, 2021, pp. 54 - 56.

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