Method for processing and analysis of homogeneity of large sets of small-volume samples of low-intensity radiation streams.

Rabotkin V. A., Bliznyakov N.M., Vakhtel V.M., Kostomakha D.E.

Voronezh State University, Voronezh, Russia

E-mail: vakhtel@phys.vsu.ru

A method for processing and analyzing sequences of samples of variation series of values of identifiers $I\left(ν\left(.\right)\right)$ of random vectors (RV) - $ν$ for their corresponding samples of small volume $n\leq 20$ of counts $k\_{i}=0;1;2…$ of registered particles was proposed. The identifier $I\left(ν\left(.\right)\right)$ is a functional in the form of a scalar product RV $ν\left(.\right)=(ν\_{0},ν\_{1},…,ν\_{l})$ of frequencies $ν\_{i}\left(k=i\right)$ of values of counts $k\_{i}$ in the sample
$$\sum\_{0}^{l}ν\_{i}=n<20: I\left(ν\right)=I\left(ν|a\right)=\left(νa\right)=ν\_{0}a\_{0}+…+ν\_{l}a\_{l}$$

where $a=(a\_{0},…,a\_{l})$ – is not a randomly given vector. For a given number $M$ of vectors $ν\left(.\right)$ the frequency distribution of $I\left(ν\right)$ values represents sequences of ordered groups of peaks formed by:

1. similar in components $ν\_{i}$ RV
2. of homogeneous peaks formed by homogeneous RVs.

To evaluate the homogeneity of RV and peaks, it was proposed a test statistic $G$ and a criterion of agreement based on the metric

$$G=\frac{1}{q}\left[\sum\_{l=1}^{l}[\left(x\_{im}-x\_{ir}\right)/\left(x\_{im}+x\_{ir}\right)^{2}]\right]^{1/2}, 0\leq G\leq 1.$$

It was shown that the homogeneity estimation of peaks considered also as random vectors $m$ and $rM\_{1,m},M\_{2,m},…,M\_{l,m};M\_{1,r},M\_{2,r},…,M\_{l,r}$ can be performed by the degree of their collinearity $\left|M\_{m}\right|\left|M\_{l}\right|^{-1}∙M\_{m}∙M\_{l}=cosθ,$ where $θ$-is the angle between vectors and equality of $\left|M\_{m}\right|=\left|M\_{r}\right|$ modules.

The proposed method allows identifying combinatorial types of RV, predicting frequencies of their realization $1<M\_{j}$ and peaks formed by them - also random vectors $M\_{jm},…,M\_{qm}$with

$$\sum\_{l}^{q}M\_{j,m}<10.$$

The method is effective at $n<20;$ average $\overbar{k}<5.$

References

1. BliznyakovN.M., VakhtelV.M., KostomakhaD.E., RabotkinV.A. VoronezhWinterMathematicalSchool. Voronezh: -VSU PublishingHouse 2022. p. 27-33.