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«Metrological Support of Innovative Technologies» ICMSIT-2020

«Mapping distributions in the entropy–parametric space»

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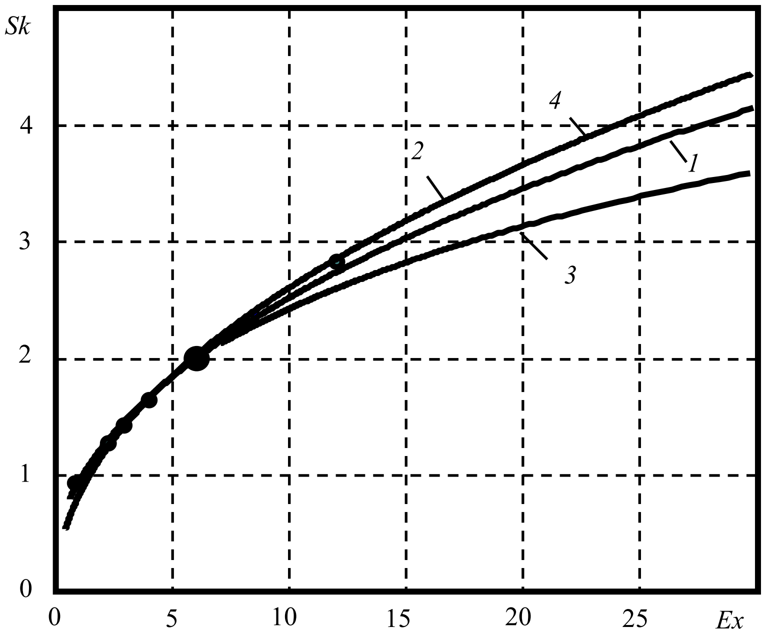
ICMSIT-2020 Metrological Support of Innovative Technologies

A indistinguishable Shape of asymmetric distributions in a Space of Statistically Signs



A lot Shapes for the asymmetric approximation Model in a Space of Distributions Signs of asymmetry and kurtosis is indistinguishable .

- If we choose the Shape for the asymmetric Distributions of different types then it is difficult due close Position of the Graphic in the Space of Kurtosis and Asymmetry.
- For Examples.

1. A family of a generalized gamma distribution

$$f_{ggd}(x,\alpha,\tau,\lambda)=\frac{\tau}{\lambda\Gamma(\alpha)}\left(\frac{x}{\gamma}\right)^{\alpha\tau-1} e^{-\left(\frac{x}{\lambda}\right)^{\tau}}$$

where, the (α,τ) shape parameters.

Graphics at numbers 1 and 2 are correspond to the positions a lot of Shapes of the subfamilies of the Weibull ($\tau = 1$) and gamma ($\alpha = 1$) distribution.

2. A subfamily of the Pareto distribution. It is graphics at numbers 3.

3. A subfamily of the logarithmic normal distribution

Graphics at numbers 2 and 4 are correspond to the positions a lot of Shapes of the subfamilies of the gamma and logarithmic normal distribution.

Information Measure for the Uncertainty Interval Distribution of Controlled Parameters Examples

Solution Methods:

the Entropy Coefficient of the Asymmetric Distribution

$$k_H = \frac{\Delta_H}{\sqrt{m_2}}$$

- Let is it, the entropy of uncertainty distribution equal entropy of a continuous asymmetric distribution

$$H_{ud}(Y)=H(X,\alpha,\tau,\lambda)$$

- The entropy of a uniform distribution is given as

$$H_{ud}(Y)=\ln(\Delta_H)$$

- It is a model of the Δ_H uncertainty entropy interval. If we apply the mathematical operation of potentiation then after the transformation we obtain the entropy potential. It is given as

$$\Delta_H=\exp(H(X,\alpha,\tau,\lambda))$$

- Other the Uncertainty Interval Distribution is the initial moment of the second order of the non-symmetric distribution: $m_2(X)$

Discussion the possibility of approximate identification of models in the information and probability space of distribution signs

Solution Methods:

the Entropy Coefficient of the Asymmetric Distribution

$$k_H = \frac{\Delta_H}{\sqrt{m_2}}$$

- Entropy Coefficient of the Family of Generalized Gamma Distribution

$$k_{H\ ggd}(\propto, \tau, \lambda) = \frac{(\Gamma(\alpha))^{\frac{3}{2}}}{\tau}\left(\frac{exp\left(\left(\frac{1}{\tau} - \alpha\right)\psi(\alpha\ ) + \alpha\right)}{\sqrt{\Gamma\left(\alpha + \frac{2}{\tau}\right)}}\right)$$

- Entropy coefficient of the family of Pareto distribution

$$k_{H\ Prt}(\alpha, \lambda) = \frac{(\alpha - 2)}{2 \cdot x_0^3} \exp\left(-1 - \frac{1}{\alpha}\right)$$

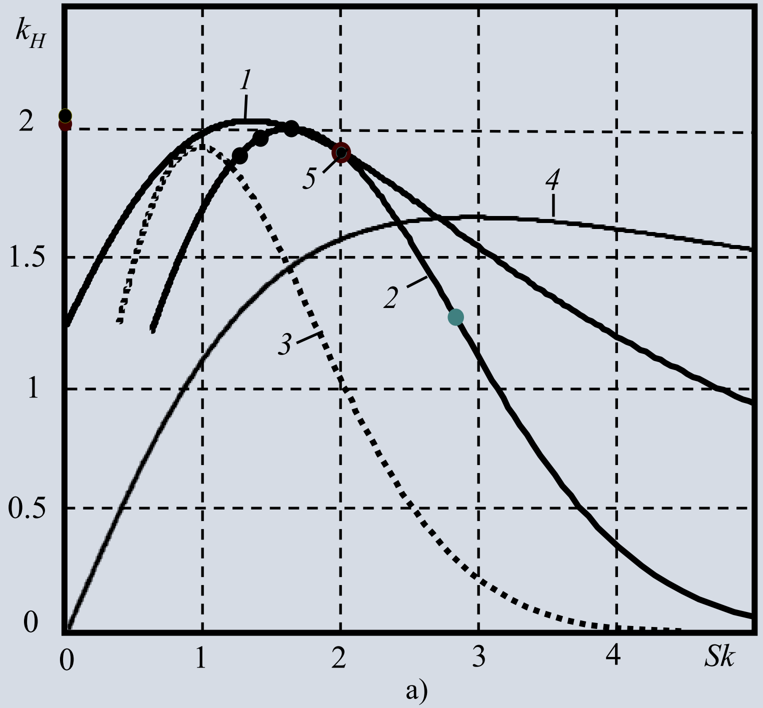
- entropy coefficient for the logarithmic normal distribution

$$k_{H\ LN}(\alpha, \lambda) = 4{,}131 \cdot \frac{\alpha}{\exp(\alpha^2)}$$

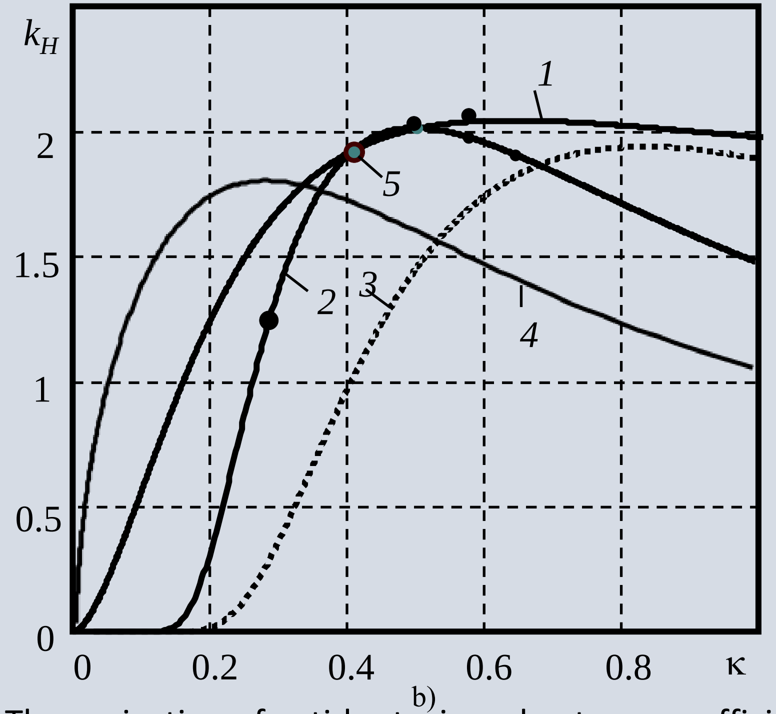
Solution Methods:

Mapping in Entropy–Parametric Space of the Asymmetry and Anti-Kurtosis and Entropy Coefficient Distributions

Entropy – Parametric Space for Asymmetry Distribution



The projection of asymmetry and entropy coefficient



The projection of anti-kurtosis and entropy coefficient

In the figure,
the number 1 indicate by positions of possible shapes for the subfamily of Weibull distributions,
the number 2 indicate by positions of possible shapes for the subfamily of gamma distributions,
the number 3 indicate by positions of possible shapes for the family of general gamma distributions,
the number 4 indicate by positions of possible shapes for the logarithmic normal distributions,
the number 5 indicate by the point of shapes position for the exponential distributions.

Conclusions

Thus, the use of the entropy coefficient of asymmetric distributions as an additional informational sign of distribution uncertainty, together with the probabilistic signs of asymmetry and anti-Kurtosis, it is allows us to create a space of entropy-parametric signs for mapping and classifying asymmetric distributions by controlling their shapes.

- In point 5 the graphics of shapes for the Weibull and gamma subfamilies of distributions is intersect. Point 5 is position of exponential distribution.
- The use of an additional feature of the entropy coefficient of asymmetric distributions provides good distinguishability of the family of shape of the logarithmic normal and general gamma distribution.
- In the projection only parametric signs of the distributions of asymmetry and kurtosis, the graphic of the logarithmic normal distributions is imposed the graphic of the gamma distributions.

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