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Random Indexed Random in Limit Theorems Number Characteristics of Quantities Calculation

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Annotation: This paper provides information on the calculation of numerical characteristics of random quantities in random index limit theorems.

Keywords: mathematical expectation, variance, moments, sum of random quantities with random index.

In probability theory, when calculating the numerical characteristics of random quantities (mathematical expectation, variance, moments), it is important to know what values the random quantities take with probability. If a random quantity takes different values with the same probability, then the mathematical expectation of a random quantity gives the average value of that quantity, if it takes different values, it is a mathematical expectation.

This paper examines the numerical characteristics of the sum of random quantities with different distributed random indices.

Definition. **If**

1. $\xi_1, \xi_2, \dots, \xi_n, \dots.$ (1)

unless the sequence of random quantities is interrelated.

2. $v = v(\lambda), \quad (\lambda > 0)$ - if a random quantity is a random quantity that receives all positive values,

3. (1) and v If the random variables are not interdependent, then the random variables $\xi_1, \xi_2, \dots., \xi_n, \dots., v$ are called random quantities that obey Wald's law.

From (1) we construct the following sum:

$$\zeta_v = \sum_{j=1}^{v} \xi_j \qquad (2)$$

$$M\xi_j = a_j, \quad D\xi_j = \upsilon_j^2$$

for $v = v(\lambda)$, say $p(v = k)$,

we define $$Mv=\sum_{k=1}^{\infty}k\ \ p\ \ (v=k)=\alpha$$

$$D\gamma=\sum_{k=1}^{\infty}(k-\alpha)^2\,p(v=k)=\gamma^2\ .$$

(2) is a complex set that is called “random index random variables” and their properties are studied. Such issues are common in the social spheres, economics, and physics.

We enter the following definition:

$$A_k=\sum_{j=1}^{k}a_j,\quad A_v=\sum_{j=1}^{v}a_j,\quad MA_v=\sum_{k=1}^{\infty}A_k\,p(v=k)=\rho$$

$$DA_v=\sum_{k=1}^{\infty}(A_k-\rho)^2\,p(v=k)=\gamma_1^2\,,$$

$$V_k^2=\sum_{j=1}^{k}\upsilon_j^2,\quad V_v^2=\sum_{k=1}^{\infty}\upsilon_k^2\,p(v=k)$$

$$MV_v^2=\sum_{k=1}^{k}V_k^2\,p(v=k)=\sigma^2,$$

Lemma.

$$M\zeta_v=\sum_{k=1}^{\infty}A_k\,p(v=k)=\rho\,,$$

$$MA_v=M\zeta_v=\rho$$

Proof is given in [2].

Theorem 1. (2) The variance of the sum

$$D\zeta_v=\sigma^2+\gamma_1^2$$

Proof.

$$D\zeta_v=M\zeta_v^2-[M\zeta_v]^2=M\zeta_v^2-\rho^2\,,$$

$$M\zeta_v^2=\sum_{k=1}^{\infty}M\left(\sum_{j=1}^{\infty}\xi_j\right)^2p(v=k)=$$

$$=\sum_{k=1}^{\infty}M\left(\sum_{i=1}^{k}\xi_j^2\right)p(v=k)+2\left(\sum_{1\le i<j\le k}a_ia_j\right)p(v=k)\qquad(2)$$

$$\sum_{j=1}^{k}M\xi_j^2\,p(v=k)=V_k^2+\sum_{j=1}^{k}a_j^2\qquad(3)$$

(2) and (3) from the relationship

$$D\zeta_v = \sum_{k=1}^{\infty} V_k^2 p(v=k) + \gamma_1^2 = \sigma^2 + \gamma_1^2$$

Based on the above data, (3) is the third-order moment of the sum $-\beta_3$ can be calculated.

Theorem 2. $\beta_3 = M\zeta_v^2 - 3M\zeta_v^2\rho + 2\rho^2$.

Proof. $\beta_3 = M(\zeta_v - M\zeta_v^2)^3 = M(\zeta_v - \rho)^3$.

Let’s simplify this by lifting the cube

$$M\zeta_v^3 - 3\rho M\zeta_v^2 + 3\rho^3 - \rho^3 = M\zeta_v^3 - \rho \cdot 3M\zeta_v^2 + 2\rho^2.$$

(2) By giving values to random quantities, the values of are found.

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