"Statistical methods of data processing"

Examination questions

LECTURE 1

1. A random variable is called discrete, if its set of values:

a) countable

b) uncountable

c) finite

d) infinite

2. The sum of probabilities of the infinite discrete random variable distribution set is equal to:

a) 0

b) 1

c) +∞

d) 0,1

3. The cumulative distribution function *F (x)* of the random variable *X* is called the probability of that:

a) that it will take on the value smaller, than the argument of function *x*

b) that it will take on the value not smaller, than the argument of function *x*

c) that it will take on the value larger, than the argument of function *x*

d) that it will take on the value not larger, than the argument of function *x*

4. Cumulative distribution function *F (x)* takes on the values:

a) [0;1]

b) [0; + ∞[

c) [-∞; + ∞[

d) $[-1;+1]$

5. The distribution function $F(x)$ is:

a) nondecreasing function

b) decreasing function

c) nonincreasing function

d) increasing function

6. The probability of the random variable X value getting to the interval $[x_1; x_2)$ is equal to:

a) $F(x_1) - F(x_2)$

b) $F(x_1) + F(x_2)$

c) $F(x_2) - F(x_1)$

d) $F(x_2) + F(x_1)$

7. The distribution density $f(x)$ is equal to:

a) $\dfrac{dF(x)}{dx}$

b) $\int_{-\infty}^{x} F(x)dx$

c) $\int_{-\infty}^{\infty} F(x)dx$

d) $\int F(x)dx$

8. The distribution density $f(x)$ assumes the values:

a) [-1; 1]

b) $[0; +\infty[$

c)] - ∞; + ∞ [

d) [0; 1]

9. The transfer from distribution density *f (x)* to distribution function *F (x)* has the form:

a) $F(x) = \int_{-\infty}^{x} f(x)dx$

b) $F(x) = \int_{-\infty}^{+\infty} f(x)dx$

c) $F(x) = \int_{x}^{+\infty} f(x)dx$

d) $F(x) = \frac{\partial f(x)}{\partial x}$

10. The probability of the random variable X value getting to the interval [a; b) equals:

a) $\int_{a}^{b} f(x)dx$

b) $\int_{b}^{a} f(x)dx$

c) $f(b) - f(a)$

d) $f(a) - f(b)$

LECTURE 2

1. Mathematical expectation of the discrete random variable X is equal to:

   a) $\sum_{i=1}^{n} x_i \cdot p_i$

   b) $\int_{-\infty}^{\infty} x \cdot f(x)dx$

   c) $\frac{1}{n}\sum_{i=1}^{n} x_i$

   d) $\int_{-\infty}^{\infty} f(x)dx$

2. Mathematical expectation of the random variable X characterizes:

   a) average value of the random variable

   b) the most probable value of the random variable

   c) dispersion degree of the random variable values

   d) degree of randomness

3. Mathematical expectation of continuous random variable X is equal to:

   a) $\sum_{i=1}^{n} x_i \cdot p_i$

   b) $\int_{-\infty}^{\infty} x \cdot f(x)dx$

   c) $\frac{1}{n}\sum_{i=1}^{n} x_i$

   d) $\int_{-\infty}^{\infty} f(x)dx$

4. M [X] = 1. Mathematical expectation of variable Y = 4 - 2X is equal to:

a) 2

b) -2

c) 0

d) -4

5. The mathematical expectation of random variable X is equal to:
   a) $\alpha_1(\mathrm{x})$

   b) $\alpha_2(\mathrm{x})$

   c) $\mu_1(x)$

   d) $\mu_2(x)$

6. Mathematical expectation of the centered random variable X is equal to:
   a) 0

   b) 1

   c) -1

   d) D_X

7. Dispersion of the random variable X characterizes:
   a)mean value of the random variable

   b)the most probable value of the random variable

   c)dispersion degree of the random variable values

   d)degree of uncertainty

8. Dispersion of the continuous random variable X is equal to:

   a) $\int_{-\infty}^{\infty} x^2 f(x)dx - m_X^2$

b) $\int_{-\infty}^{\infty} (x-m_X)\ f(x)dx$

c) $\int_{-\infty}^{\infty} x^2 f(x)dx-m_X$

d) $\int_{-\infty}^{\infty} (x-m_X)^2 dx$

9. D [X] = 1. Dispersion of random variable Y = 4 - 2X is equal to:
   a) 8

   b) -2

   c) 0

   d) 4

10. Dispersion of random variable X is equal to:
   a) α_1(x)

   b) α_2(x)

   c) $\mu_1(x)$

   d) $\mu_2(x)\,\Gamma$

11. D [X] = 9. Standard deviation σ_X is equal to:
   a) 1

   b) 2

   c) 3

   d) 4

12. Practically all values of random variable X are within the interval:
   a) $[m_X - 3\sigma_X ; m_X + 3\sigma_X]$

b) $[m_X - \sigma_X ; m_X + \sigma_X]$

c) $[m_X - 3D_X ; m_X + 3D_X]$

d) $[\sigma_X - 3m_X ; \sigma_X + 3m_X]$

LECTURE 3

1. Mathematical expectation of the random variable, uniformly distributed in interval [1; 5] is equal to:
   a) 1
   b) 2
   c) 3
   d) 4

2. Dispersion of the random variable, uniformly distributed in interval [1; 5] it is equal to:
   a) 1
   b) 2
   c) 4/3
   d) 3/4

3. Random variable X with the exponential distribution law assumes the values:
   a) [0; 1]
   b) [0; + ∞]
   c) [- ∞; + ∞]
   d) [-1; 1]

4. Random variable X with normal distribution law assumes the values:
   a) [0; 1]
   b) [0; + ∞]
   c) [- ∞; + ∞]
   d) [-1; 1]

5. Random variable X with the χ^2 (Chi-square) distribution law assumes the values:
   b) [0; 1]

   b) [0; + ∞]

   c) [- ∞; + ∞]

   d) [-1; 1]

6. Random variable X with the χ^2 (Chi-square) distribution law assumes the values:
   c) [0; 1]

   b) [0; + ∞]

   c) [- ∞; + ∞]

   d) [-1; 1]

7. Random variable X with the Student distribution law assumes the values:
   d) [0; 1]

   b) [0; + ∞]

   c) [- ∞; + ∞]

   d) [-1; 1]

8. Random variable X with Fisher distribution law assumes the values:
   b) [0; 1]

   b) [0; + ∞]

   c) [- ∞; + ∞]

   d) [-1; 1]

9. Random variable X with Gamma distribution law assumes the values:
   c) [0; 1]

b) [0; + ∞]

c) [- ∞; + ∞]

d) [-1; 1]

10. Which of the following distributions of the random variable depends on one parameter:
a) uniform

b) χ^2 (Chi-square)

c) normal

d) Gamma

11. Which of the following distributions of the random variable depends on one parameter:
e) Fisher

f) uniform

g) normal

h) Student

12. Which of the following distributions of the random variable depends on two parameters:
i) Fisher

j) Student

k) χ^2 (Chi-square)

l) exponential

13. Which of the following distributions of the random variable depends on two parameters:
m) exponential

n) Student

o) χ^2 (Chi-square)

p) Gamma

LECTURE 4

1. The cumulative distribution function of random variable $Y = \varphi(x)$, where $\varphi(x)$ – is a monotonously increasing function, is calculated under the formula:

a) $G(y) = \int_{-\infty}^{\psi(y)} f(x)dx$

b) $G(y) = \int_{\psi(y)}^{+\infty} f(x)dx$

c) $G(y) = f(\psi(y))\left|\psi'(y)\right|$

d) $G(y) = f(\psi'(y))\left|\psi(y)\right|$

2. The cumulative distribution function of random variable $Y = \varphi(x)$ where $\varphi(x)$ – is a monotonously decreasing function, is calculated under the formula:

a) $G(y) = \int_{-\infty}^{\psi(y)} f(x)dx$

b) $G(y) = \int_{\psi(y)}^{+\infty} f(x)dx$

c) $G(y) = f(\psi(y))\left|\psi'(y)\right|$

d) $G(y) = f(\psi'(y))\left|\psi(y)\right|$

3. Distribution density of random variable $Y = \varphi(x)$ where $\varphi(x)$ – is a monotonously increasing function, is calculated under the formula:

a) $g(y) = \int_{-\infty}^{\psi(y)} f(x)dx$

b) $g(y) = \int_{\psi(y)}^{+\infty} f(x)dx$

c) $g(y) = f(\psi(y))\left|\psi'(y)\right|$

d) $g(y) = f(\psi'(y))\left|\psi(y)\right|$

4. Distribution function of random variable $Y = \varphi()$, where $\varphi()$ – is a monotonously decreasing function, is calculated under the formula:

a) $g(Y) = \int_{-\infty}^{\psi(y)} f(x)dx$

b) $g(Y) = \int_{\psi(y)}^{+\infty} f(x)dx$

c) $g(Y) = f(\psi(y))|\psi'(y)|$

d) $g(Y) = f(\psi'(y))|\psi(y)|$

5. Random variable $Y = -\lambda \ln \alpha$ (where α -is a random variable with uniform distribution *U(0,1)*) have following distribution:

   a) Exponential distribution

   b) Normal distribution

   c) χ^2 (Chi-square) distribution

   d) Student distribution

6. Random variable $Y = a + \sigma\sqrt{-2\ln\alpha_1}\sin(2\pi\alpha_2)$ (where α_1, α_2 -is a random variables with uniform distribution *U(0,1)*) have following distribution:

   a) Exponential distribution

   b) Normal distribution

   c) χ^2 (Chi-square) distribution

   d) Student distribution

7. Random variable $Y = \sum_{i=1}^{k} u_i^2$ (where $u_1,\dots,u_k$ – are independent random variables with normal distribution *N(0,1)*) have following distribution:

   a) Exponential distribution

b) Normal distribution

c) χ^2 (Chi-square) distribution

d) Student distribution

8. Random variable $Y = \dfrac{u}{\sqrt{v/k}}$ (where *U* and *V* – *are* independent random variables, *U* with normal distribution $U \in N(0,1)$, and *V* with χ^2 (Chi-square) distribution $V \in H(k)$)) have following distribution:

   a) Exponential distribution

   b) Fisher distribution

   c) χ^2 (Chi-square) distribution

   d) Student distribution

9. Random variable $Y = \dfrac{v/m}{w/k}$ (where *V* and *W* – *are* independent random variables with χ^2 Chi-square distribution $V \in H(m)$ and $W \in H(k)$ respectively)) have following distribution:

a) Fisher distribution

b) Normal distribution

c) χ^2 (Chi-square) distribution

d) Student distribution

LECTURE 5

1. Chebychev's inequality has the form:
   a) $p(|X - m_X| \geq \varepsilon) \leq D_x / \varepsilon^2$

   b) $p(|X - m_X| \geq \varepsilon) \leq m_x / \varepsilon^2$

   c) $p(|X - m_X| \leq \varepsilon) \leq D_x / \varepsilon^2$

   d) $p(|X - m_X| \geq \varepsilon) \leq \sigma_x / \varepsilon^2$

2. The following relation takes place:
   a) $p(|X - m_X| \geq 3\sigma_x) \leq 1/9$

   b) $p(|X - m_X| \geq 3\sigma_x) \geq 1/9$

   c) $p(|X - m_X| \geq 3\sigma_x) \leq 3/4$

   d) $p(|X - m_X| \geq 3\sigma_x) \leq 1/4$

3. Probability $p(|X - m_X| < 2\sigma_X)$
   a) $\geq$ 0,75;

   b) $\leq$ 0,25;

   c) $\leq$ 0,5;

   d) $\geq$ 0,5;

4. The sequence of random variables X_n converges in probability to variable a $X_n \xrightarrow[n\to\infty]{p} a$, if for ε, δ - arbitrary small positive numbers:
   a) $p(|X - m_X| < \varepsilon) > 1 - \delta$

   b) $p(|X - m_X| < \varepsilon) \leq 1 - \delta$

c) $p(|X - m_X| \geq \varepsilon) > 1 - \delta$

d) $p(|X - m_X| \geq \varepsilon) \leq 1 - \delta$

5. With increase in the number of the conducted independent tests *n*, arithmetic mean of random variable values *X* converges in probability to:
   a) m_X;

   b) D_X;

   c) σ_X

   d) a;

6. With increase in the number of the conducted independent tests *n, the* frequency of occurrence of random event A in *n* tests converges in probability to:
   a) p *(A)*;

   b) n;

   c) 1;

   d) A;

7. The distribution law of the sum of independent uniformly distributed random variables for unbounded increase in the number of summands indefinitely verges towards:
   a) Fisher distribution;

   b) normal distribution;

   c) exponential distribution;

   d) Student distribution;

8. The central limit theorem is applicable for the sum of a great number of random variables X_i, if:
   a) $D_i \approx D$ для $\forall i$ (for)

b) $m_i \approx m$ для $\forall i$

c) $m_i = 0$ для $\forall i$

d) $D_i = 0$ для $\forall i$

9. In the central limit theorem mathematical expectation of the sum of a great number of random variables X_i, is equal to:

   a) $m_Y = \sum_{i=1}^{n} m_i$

   b) $m_Y \approx m$ для $\forall i$

   c) $m_i = 0$ для $\forall i$

   d) $m_i = \mathrm{m_Y}$ для $\forall i$

10. In the central limit theorem the dispersion of the sum of a great number of random variables X_i, it is equal to:

   a) $D_Y = \sum_{i=1}^{n} D_i$

   b) $D_Y \approx D_i$ для $\forall i$

   c) $D_Y = 0$ для $\forall i$

   d) $D_i = \mathrm{D_Y}$ для $\forall i$

LECTURE 6

1. Mathematical ***statistics*** is the science dealing with methods of processing the experimental data, obtained as a result observation:
   a) random phenomena;

   b) nonrandom phenomena;

   c) unusual phenomena;

   d) mysterious phenomena;

2. Sample of *n size* will be representative, if:
   a) n> *100*;

   b) it is carried out randomly;

   c) it contains repeated values;

   d) it does not contain repeated values;

3. The sample of n-size representing general population will be representative, if:
   a) of maximum size;

   b) is representative;

   c) contains maximum values;

   d) does not contain repeated values;

4. Variational series - is a sample:
   a) arranged in ascending order;

   b) carried out randomly;

   c) containing repeated values;

   d) not containing repeated values;

5. Variable X in 10 tests has values: 4, 1, 3, 4, 2, 5, 1, 3, 6, 4. Empirical distribution function F *(3) is equal to:
   a) 0,3;

b) 0,5;

c) 0,4;

d) 0,7;

6. The sample size is equal to 80. The number of intervals in the interval statistical series should be taken equal to:
   a) 9;

   b) 40;

   c) 4;

   d) 20;

7. The sample size is equal to 10000. The number of intervals in the interval statistical series should be taken equal to:
   a) 15;

   b) 100;

   c) 4;

   d) 50;

8. The number of intervals in the interval statistical ***series*** equals 10. The area sum of all histogram rectangles constructed based on its basis is equal to:
   a) 1;

   b) 10;

   c) 0,1;

   d) 100;

9. Rectangles of equi-interval histograms have identical:
   a) width;

   b) height;

c) area;

d) diagonal;

10. Rectangles of equiprobable histograms have identical:

a) width;

b) height;

c) area;

d) diagonal;

LECTURE 7

1. Estimate $\hat{Q}$ is called ***consistent***, if:
   a) with increasing the sample size n it converges in probability to parameter value Q;

   b) its mathematical expectation is precisely equal to parameter Q for any sample size;

   c) its dispersion is minimum relative to dispersion of any other estimate of this parameter;

   d) it is point;

2. Estimate $\hat{Q}$ is called ***unbiased***, if:
   a) with increasing the sample size n it converges in probability to parameter value Q;

   b) its mathematical expectation is precisely equal to parameter Q for any sample size;

   c) its dispersion is minimum relative to dispersion of any other estimate of this parameter;

   d) it is point;

3. Estimate $\hat{Q}$ is called ***as efficient***, if:
   a) with increasing the sample size n it converges in probability to parameter value Q;

   b) its mathematical expectation is precisely equal to parameter Q for any sample size;

   c) its dispersion is minimum relative to dispersion of any other estimate of this parameter;

   d) it is point;

4. The consistent point estimate of mathematical expectation $\overline{x}$ is equal to:

a) $\frac{1}{n}\sum_{i=1}^{n} x_i$

b) $n\sum_{i=1}^{n} x_i$

c) $\sum_{i=1}^{n} x_i$

d) $\frac{1}{n}\prod_{i=1}^{n} x_i$

5. The consistent biased estimate of dispersion S^2 is equal to:

a) $\frac{1}{n}\cdot\sum_{i=1}^{n}\left(x_i-\overline{x}\right)^2$

b) $\sum_{i=1}^{n} x_i^2-(\overline{x})^2$

c) $\frac{1}{n-1}\cdot\sum_{i=1}^{n}\left(x_i-\overline{x}\right)^2$

d) $\frac{1}{n}\sum_{i=1}^{n} x_i^2$

6. The consistent unbiased estimate of dispersion S_0^2 is equal to:

a) $\frac{1}{n}\cdot\sum_{i=1}^{n}\left(x_i-\overline{x}\right)^2$

b) $\sum_{i=1}^{n} x_i^2-(\overline{x})^2$

c) $\frac{1}{n-1}\cdot\sum_{i=1}^{n}\left(x_i-\overline{x}\right)^2$

d) $\frac{1}{n}\sum_{i=1}^{n} x_i^2$

7. Random variable X in 10 tests had values: 4, 1, 3, 4, 2, 5, 1, 3, 6, 4. The estimate of probability that $X = 4$ is equal to:
   a) 0,1;
   b) 0,2;
   c) 0,3;
   d) 0,4;

LECTURE 9

1. The confidence interval for mathematical expectation of random variable X with unknown distribution law has the form:

   a) $\bar{x} - \frac{S_0 \cdot z_\gamma}{\sqrt{n}} < m_X < \bar{x} + \frac{S_0 \cdot z_\gamma}{\sqrt{n}}$

   b) $\bar{x} - z_\gamma \sqrt{\frac{2}{n-1}} S_0^2 < m_X < \bar{x} + z_\gamma \sqrt{\frac{2}{n-1}} S_0^2$

   c) $\bar{x} - \frac{S_0 \cdot z_\gamma}{n} < m_X < \bar{x} + \frac{S_0 \cdot z_\gamma}{n}$

   d) $\bar{x} - z_\gamma \sqrt{\frac{2}{n-1}} S_0 < m_X < \bar{x} + z_\gamma \sqrt{\frac{2}{n-1}} S_0$

2. The confidence interval for dispersion of random variable X with unknown distribution law has the form:

   a) $S_0^2 - z_\gamma \sqrt{\frac{2}{n-1}} S_0^2 < D_X < S_0^2 + z_\gamma \sqrt{\frac{2}{n-1}} S_0^2$

   b) $\frac{(n-1)S_0^2}{\chi^2_{\frac{1-\gamma}{2},n-1}} < D_X < \frac{(n-1)S_0^2}{\chi^2_{\frac{1+\gamma}{2},n-1}}$

   c) $S_0^2 - \frac{S_0 \cdot z_\gamma}{n} < D_X < S_0^2 + \frac{S_0 \cdot z_\gamma}{n}$

   d) $S_0^2 - z_\gamma \sqrt{\frac{2}{n-1}} S_0 < D_X < S_0^2 + z_\gamma \sqrt{\frac{2}{n-1}} S_0$

3. The confidence interval for dispersion of random variable X with the normal distribution law has the form:

   a) $S_0^2 - z_\gamma \sqrt{\frac{2}{n-1}} S_0^2 < D_X < S_0^2 + z_\gamma \sqrt{\frac{2}{n-1}} S_0^2$

   b) $\frac{(n-1)S_0^2}{\chi^2_{\frac{1-\gamma}{2},n-1}} < D_X < \frac{(n-1)S_0^2}{\chi^2_{\frac{1+\gamma}{2},n-1}}$

   c) $S_0^2 - \frac{S_0 \cdot z_\gamma}{n} < D_X < S_0^2 + \frac{S_0 \cdot z_\gamma}{n}$

d) $S_0^2 - z_\gamma \sqrt{\dfrac{2}{n-1}} S_0 < D_X < S_0^2 + z_\gamma \sqrt{\dfrac{2}{n-1}} S_0$

4. The confidence interval for probability of event A in the Bernoulli scheme of independent tests has the form:

a) $p^* - z_\gamma \cdot \sqrt{\dfrac{p^*(1-p^*)}{n}} < p(A) < p^* + z_\gamma \cdot \sqrt{\dfrac{p^*(1-p^*)}{n}}$

b) $p^* - z_\gamma \cdot \sqrt{\dfrac{p^*}{n}} < p(A) < p^* + z_\gamma \cdot \sqrt{\dfrac{p^*}{n}}$

c) $p^* - z_\gamma \cdot \dfrac{\sqrt{p^*(1-p^*)}}{n} < p(A) < p^* + z_\gamma \cdot \dfrac{\sqrt{p^*(1-p^*)}}{n}$

d) $p^* - z_\gamma \cdot \dfrac{\sqrt{p^*}}{n} < p(A) < p^* + z_\gamma \cdot \dfrac{\sqrt{p^*}}{n}$

LECTURE 10

1. The error of first kind ("the target drop-out") for two-alternative hypothesis $\{H_0, H_1\}$ consists in that:
   a) Hypothesis H_0 will be rejected if it is true

   b) Hypothesis H_0 will be accepted if it false

   c) Hypothesis H_0 will be rejected if it is false

   d) Hypothesis H_0 will be accepted if it is true

2. The error of the second sort ("false operation") for a two-alternative hypothesis $\{H_0, H_1\}$ consists that:

   a) Hypothesis H_0 will be rejected if it is true

   b) Hypothesis H_0 will be accepted if it false

   c) Hypothesis H_0 will be rejected if it is false

   d) Hypothesis H_0 will be accepted if it is true

3. Significance level - this is:
   a) Probability to make the error of the first kind

   b) Probability to make the mistake of the second kind

   c) Probability not to make the error of the first kind

   d) Probability not to make the mistake of the second kind

4. In the first series of 25 tests, event random A has appeared in 5 tests, in the second series of 100 tests, event random A has appeared in 25 tests. The criterion for hypothesis test about equality of probabilities of event A in these series is equal to:
   a) 1/20

   b) 9/20

c) 1/4

d) 1/5

LECTURE 11

1. Pirson criterion has the form:

   a) $\chi^2 = n\sum_{j=1}^{M}\frac{\left(p_j - p_j^*\right)^2}{p_j}$

   b) $\chi^2 = M\sum_{j=1}^{M}\frac{\left(p_j - p_j^*\right)^2}{p_j}$

   c) $\chi^2 = n\sum_{j=1}^{M}\frac{\left(p_j - p_j^*\right)^2}{p_j^*}$

   d) $\chi^2 = M\sum_{j=1}^{M}\frac{\left(p_j - p_j^*\right)^2}{p_j^*}$

2. By the sample size of 100 values of random variable *X*, *the* interval statistical series is constructed, containing 10 intervals, and the hypothesis about exponential distribution law of random variable *X* is put forward. The number of degrees of freedom for Pirson criterion is equal to:
   a) 7

   b) 8

   c) 90

   d) 88

3. By the sample size of 100 values of random variable *X*, *the* interval statistical series is constructed, containing 10 intervals, and the hypothesis about normal distribution law of random variable *X* is put forward. The number of degrees of freedom for Pirson criterion is equal to:
   a) 7

   b) 8

   c) 90

d) 88

4. Kolmogorov's criterion has the form:

a) $\lambda = \sqrt{n} \cdot \max_{i=1}^{n} \left| F^*(x_i) - F_0(x_i) \right|$

b) $\lambda = \sqrt{n} \cdot \min_{i=1}^{n} \left| F^*(x_i) - F_0(x_i) \right|$

c) $\lambda = n \cdot \max_{i=1}^{n} \left| F^*(x_i) - F_0(x_i) \right|$

d) $\lambda = n \cdot \min_{i=1}^{n} \left| F^*(x_i) - F_0(x_i) \right|$

LECTURE 13

1. The hypothesis test about equality of mathematical expectations of random variables X and Y is carried out by means of:
   a) t-Student criterion

   b) F-criterion

   c) Wilcoxon test

   d) Pirson criterion

2. The hypothesis test about equality of dispersions of random variables X and Y is carried out by means of:
   a) t- Student criterion

   b) F-criterion

   c) Wilcoxon test

   d) Pirson criterion

LECTURE 14

1. The two-dimensional random variable is:

a) the set of two random variables which take on the values as a result of one and the same experience;

b) the set of two random events which can occur in one and the same experience;

c) the set of two random variables which take on values independently from each other;

d) the set of two random events which can occur independently from each other;

2. Two-dimensional ***cumulative distribution function*** *F (x, y)* assumes the values:

a) [-1; 1]

b) [0; + ∞ [

c)] - ∞; + ∞ [

d) [0; 1]

3. For two-dimensional distribution function *F (x, y) the* limit relation is valid:

a) $F(-\infty, y) = 0$

b) $F(-\infty, y) = 1$

c) $F(-\infty, y) = +\infty$

d) $F(-\infty, y) = -\infty$

4. For two-dimensional distribution function *F (x, y) the* limit relation is valid:

a) $F(x, -\infty) = 0$

b) $F(x, -\infty) = 1$

c) $F(x, -\infty) = +\infty$

d) $F(x, -\infty) = -\infty$

5. For two-dimensional distribution function *F (x, y*) the limit relation is valid:

a) $F(+\infty, +\infty) \; = \; 0$

b) $F(+\infty, +\infty) \; = \; 1$

c) $F(+\infty, +\infty) \; = \; +\infty$

d) $F(+\infty, +\infty) \; = \; -\infty$

6. Transition from two-dimensional distribution function *F (x, y)* to one-dimensional distribution function *F(x)* has the form:

a) $F(x) \; = \; F \; (x, \; + \; \infty)$

b) $F(x) \; = \; F \; (+ \, \infty, y)$

c) $F(x) \; = \; F \; (x, \, - \, \infty)$

d) $F(x) \; = \; F \; (-\infty, y)$

7. The two-dimensional distribution density *f (x, y)* assumes the values:

a) [-1; 1]

b) [0; + ∞ [

c)] - ∞; + ∞ [

d) [0; 1]

8. Transition from two-dimensional distribution density *f(x, y)* to one-dimensional distribution density *f (x)* has the form:

a) $f\;(x) = \int_{-\infty}^{+\infty} f(x, y)dy$

b) $f\;(x) = \dfrac{\partial f(x, y)}{\partial y}$

c) $f\;(x) = \int_{-\infty}^{+\infty} f(x, y)dx$

d) $f\ (x) = \dfrac{\partial f\,(x, y)}{\partial x}$

9. Transition from two-dimensional distribution density *f(x, y)* to one-dimensional distribution density *f (y)* has the form:

a) $f\ (y) = \int\limits_{-\infty}^{+\infty} f\,(x, y)dy$

b) $f\ (y) = \dfrac{\partial f\,(x, y)}{\partial y}$

c) $f\ (y) = \int\limits_{-\infty}^{+\infty} f\,(x, y)dx$

d) $f\ (y) = \dfrac{\partial f\,(x, y)}{\partial x}$

10. The criterion of independence of two continuous random variables *X* and *Y* has the form:

a) $f(x, y) = f_X(x) f_Y(y); \forall\ x, y$

b) $f(x, y) = f_X(x) + f_Y(y); \forall\ x, y$

c) $f(x, y) \neq f_X(x) f_Y(y); \forall\ x, y$

d) $f(x, y) \neq f_X(x) + f_Y(y); \forall\ x, y$

11. Transition from two-dimensional distribution density *f (x, y)* to conditional distribution density *f (x/y)* has the form:

a) $f(x/y) = \dfrac{f(x, y)}{f_Y(y)}$

b) $f(x/y) = \dfrac{f(x, y)}{f_X(x)}$

c) $f(x/y) = f(x, y) - f_Y(y)$

d) $f(x/y) = f(x, y) - f_X(x)$

LECTURE 15

1. Mathematical expectation of component *X* of two-dimensional random variable (*X*, *Y*) is equal to:

a) $\alpha_{1,0}(x, y)$

b) $\alpha_{0,1}(x, y)$

c) $\mu_{1,0}(x, y)$

d) $\mu_{0,1}(x, y)$

2. Mathematical expectation of component *Y* of two-dimensional random variable (*X*, *Y)* is equal to:

a) $\alpha_{1,0}(x, y)$

b) $\alpha_{0,1}(x, y)$

c) $\mu_{1,0}(x, y)$

d) $\mu_{0,1}(x, y)$

3. Dispersion of component *X* of two-dimensional random variable (*X*, *Y*) is equal to:

a) $\alpha_{2,0}(x, y)$

b) $\alpha_{0,2}(x, y)$

c) $\mu_{2,0}(x, y)$

d) $\mu_{0,2}(x, y)$

4. Dispersion of component *Y* of two-dimensional random variable (*X*, *Y)* is equal to:

a) $\alpha_{2,0}(x, y)$

b) $\alpha_{0,2}(x, y)$

c) $\mu_{2,0}(x, y)$

d) $\mu_{0,2}(x,y)$

5. Correlation moment K_{XY} of two-dimensional random variable (X, Y) is equal to:

a) $\alpha_{1,1}(x,y)$

b) $\alpha_{0,0}(x,y)$

c) $\mu_{0,0}(x,y)$

d) $\mu_{1,1}(x,y)$

6. Correlation moment K_{XY} of two-dimensional discrete random variable (X, Y) is calculated under the formula:

a) $\alpha_{1,1}(x, y)-m_x m_y$

b) $\alpha_{0,0}(x,y)-m_x m_y$

c) $\mu_{0,0}(x,y)-\alpha_{1,1}(x, y)$

d) $\mu_{1,1}(x,y)+m_x m_y$

7. Correlation moment K_{XY} of random variables X, Y assumes the values:

a) [-1; 1]

b) $[-\sigma_X\sigma_Y;+\sigma_X\sigma_Y]$

c) $]-\infty;+\infty[$

d) $[-D_X D_Y;+D_X D_Y]$

8. Correlation moment K_{XY} of independent random variables X, Y is equal to:

a) -1

b) 0

c) 1

d) 0.5

9. Correlation coefficient R_{XY} of random variables X, Y assumes the values:
a) [-1; 1]

b) [0; + ∞ [

c)] - ∞; + ∞ [

d) [0; 1]

10. Correlation coefficient R_{XY} of random variables X and $Y=2X - 4$ is equal to:
a) -1

b) 0

c) 1

d) 0.5

11. Correlation coefficient R_{XY} of independent random variables X, Y is equal to:
a) -1

b) 0

c) 1

d) 0.5

12. Regression of X to y (conditional mathematical expectation) $m_{X/y}$ represents:
a) function from x

b) function from y

c) function from x and from y

d) constant

13. Regression Y to x (conditional mathematical expectation) $m_{Y/x}$ represents:

a) function from x

b) function from y

c) function from x and from y

d) constant

LECTURE 16

1. The consistent unbiased estimate of the correlation moment of sample of size *n* is equal to:

a) $\hat{K}_{XY} = \frac{1}{n}\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})$

b) $\hat{K}_{XY} = \frac{1}{n-1}\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})$

c) $\hat{K}_{XY} = \sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})$

d) $\hat{K}_{XY} = n\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})$

2. The consistent estimate of the correlation coefficient is calculated under the formula:

a) $\hat{R}_{XY} = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sum_{i=1}^{n}(x_i - \bar{x})^2\sum_{i=1}^{n}(y_i - \bar{y})^2}$

b) $\hat{R}_{XY} = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2\sum_{i=1}^{n}(y_i - \bar{y})^2}}$

c) $\hat{R}_{XY} = \frac{\frac{1}{n-1}\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sum_{i=1}^{n}(x_i - \bar{x})^2\sum_{i=1}^{n}(y_i - \bar{y})^2}$

d) $\hat{R}_{XY} = \frac{\frac{1}{n-1}\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2\sum_{i=1}^{n}(y_i - \bar{y})^2}}$

3. The confidence interval for correlation coefficient with reliability γ for the case of two-dimensional normal distribution looks like:

e) $I_\gamma(R_{XY}) = \left(R_{XY}{}^* - z_\gamma \cdot \dfrac{1-\left(R_{XY}{}^*\right)^2}{\sqrt{n}}; R_{XY}{}^* + z_\gamma \cdot \dfrac{1-\left(R_{XY}{}^*\right)^2}{\sqrt{n}} \right).$

f) $I_\gamma(R_{XY}) = \left(R_{XY}{}^* - z_\gamma \cdot \dfrac{1-\left(R_{XY}{}^*\right)}{\sqrt{n}}; R_{XY}{}^* + z_\gamma \cdot \dfrac{1-\left(R_{XY}{}^*\right)}{\sqrt{n}} \right).$

g) $I_\gamma(R_{XY}) = \left(R_{XY}{}^* - z_\gamma \cdot \dfrac{1-\left(R_{XY}{}^*\right)^2}{n}; R_{XY}{}^* + z_\gamma \cdot \dfrac{1-\left(R_{XY}{}^*\right)^2}{n} \right).$

h) $I_\gamma(R_{XY}) = \left(R_{XY}{}^* - z_\gamma \cdot \dfrac{\left(R_{XY}{}^*\right)^2}{\sqrt{n}}; R_{XY}{}^* + z_\gamma \cdot \dfrac{\left(R_{XY}{}^*\right)^2}{\sqrt{n}} \right).$

4 The check of the hypothesis that random variables X and Y have the identical distribution law is carried out by means of:

a) t-criterion

b) F-criterion

c) Wilcoxon test

d) Pirson criterion

5 To test the hypothesis about homogeneity (equality) of two samples $H_0 : F_1(x) = F_2(x)$ is used the statistics:

$\lambda = \sqrt{n} \max_x |F_0(x) - F^*(x)|$

$w = \dfrac{n\bar{s}^2}{\sigma^2} = \dfrac{(n-1)s^2}{\sigma^2}$

$\chi^2 = M \sum_{j=1}^{M} \dfrac{\left(p_j - p_j^*\right)^2}{p_j}$

$U = \sum_{i=1}^{n} \sum_{j=1}^{m} \delta_{i,j}$

LECTURE 17

1. Correlation field (scattering diagram) for a two-dimensional random variable *(X,Y)* – this is:

a) The image of test results in the form of points on the plane in the Cartesian coordinate system

b) Regression lines *Y* to *x* and *X* to *y*

c) Empirical regression lines *Y* to *x* and *X* to *y*

d) function graph *f (x, y)*

2. The regression function of random variables *X* and *Y* is
correlation coefficient
conditional dispersion
conditional mathematical expectation
conditional probability density

3. The least squares method is used to determine:

a) dependence type of the empirical regression line

b) the empirical regression line parameter values

c) mathematical expectation point estimates

d) dispersion point estimates

4. The least squares method target function has the form:

a) $\sum_{i=1}^{n}[y_i - \varphi(x_i, a_0, ..., a_m)]^2$

b) $\sum_{i=1}^{n}\left(y_i^2 - \varphi^2(x_i, a_0, ..., a_m)\right)$

c) $\sum_{i=1}^{n}\left(y_i^2 + \varphi^2(x_i , a_0, ..., a_m)\right)$

d) $\sum_{i=1}^{n}[y_i + \varphi(x_i, a_0, ..., a_m)]^2$

5. The system of the equations in the least squares method

for fitting curve $\overline{y} = \sum_{j=0}^{m} a_j x^j$ has the form:

a) $\sum_{j=0}^{m} a_j \hat{\alpha}_{j+k}(x_i) = \hat{\alpha}_{k,1}(x_i, y_i), k = 0,1,....,m$

b) $\sum_{j=0}^{m} a_j \hat{\alpha}_k(x_i) = \hat{\alpha}_{k,1}(x_i, y_i), k = 0,1,....,m$

c) $\sum_{j=0}^{m} a_j \hat{\alpha}_{j+k}(x_i) = \hat{\alpha}_{k,2}(x_i, y_i), k = 0,1,....,m$

d) $\sum_{j=0}^{m} a_j \hat{\alpha}_k(x_i) = \hat{\alpha}_{k,2}(x_i, y_i), k = 0,1,....,m$

6. The system of the equations in the least squares method

for fitting curve $\overline{y} = \sum_{j=0}^{m} a_j x^j$ has the form:

d) $\sum_{j=0}^{m} a_j \hat{\alpha}_{j+k}(x_i) = \hat{\alpha}_{k,1}(x_i, y_i), k = 0,1,....,m$

e) $\sum_{j=0}^{m} a_j \hat{\alpha}_k(x_i) = \hat{\alpha}_{k,1}(x_i, y_i), k = 0,1,....,m$

f) $\sum_{j=0}^{m} a_j \hat{\alpha}_{j+k}(x_i) = \hat{\alpha}_{k,2}(x_i, y_i), k = 0,1,....,m$

d) $\sum_{j=0}^{m} a_j \hat{\alpha}_k(x_i) = \hat{\alpha}_{k,2}(x_i, y_i), k = 0,1,....,m$

7. The estimate of linear regression function Y on X is:

$$\overline{y}(x) = \overline{y} + \overline{r}_{xy} \frac{\overline{s}_y}{\overline{s}_x} \cdot (x - \overline{x})$$

$$\overline{y}(x) = \overline{y} + \overline{r}_{xy} \frac{\overline{s}_x}{\overline{s}_y} \cdot (x - \overline{x})$$

$$\overline{y}(x) = \overline{y} + \frac{\overline{s}_y}{\overline{s}_x} \cdot (x - \overline{x})$$

$$\overline{y}(x) = \overline{y} + \frac{\overline{s}_x}{\overline{s}_y} \cdot (x - \overline{x})$$