**Theory of probability and Mathematical Statistics**

**Problem 1.** Two doctors from the medical team of 14 people are appointed on duty a day for 7 days. What is the number of different schedules if every doctor is on duty only once?

**Problem 2.** What is the probability that a randomly taken four-digit number is composed of odd digits containing the number 3 (the digits are not repeated in numbers)?

**Problem 3.** Six groups study in six consecutive classrooms. What is the probability that in a schedule groups 1 and 2 are in adjacent classrooms?

**Problem 4.** Eight bags of linen are delivered to … floors of the hotel. How many ways can the bags be distributed by floors? What is the probability that only one bag will be brought to the fifth floor?

**Problem 5.** Joint meeting of the company elects the president, chairman and … members of the Board of Directors from … employees. In how many ways can this be done?

**Problem 6.** Five employees of the firm, which employs … people, have to leave on a business trip. How many combinations can be done so that the director of the company, his deputy and chief accountant do not leave at the same time?

**Problem 7.** It is needed to select the monitor and three members of student committee of the group of … people. In how many ways this can be done?

**Problem 8**. Seven people entered the elevator on the first floor of an …-storeyed building. What is the probability that … people go out on the same floor, and the rest people- on the different?

**Problem 9.** An urn has … white and … black balls. Two balls are removed from the urn at random. What is the probability that they will be: a) … white balls; b) … black balls; c) … black and … white?

**Problem 10.** … clients randomly applied to … firms. What is the probability that at least one company was not applied by anyone?

**Problem 11.** … people are standing in the queue to the cash-desk (… men, … women and … children). What is the probability that … children and … woman will be standing between some two men?

**Problem 12.** The party of … products has … products of the highest quality. Find the probability that among the selected …products one product will be exactly of the highest quality.

**Problem 13.** … of … sold per day refrigerators have hidden defects. Find the probability that randomly selected … refrigerators would have exactly … refrigerators without hidden defects.

**Problem 14**. … balls are arranged randomly in … boxes. Find the probability that the first box will have … balls.

**Problem 15.** A group of … students write three variants of a test (each - for … people). Find the probability that there are students who wrote all three variants among randomly selected … students.

**Problem 16.** In three groups there are … students (… people in each group - … boys and … girls). … people are randomly selected. What is the probability that some of them will be girls from all three groups?

**Problem 17**. The shooter makes three shots, at that he hits the target with a probability of … in one shot. The event *Аi* = {*i-*th bullet hits the target}, *i*=1,2,3. Find the probability of the event: there is exactly … hit.

 ***Problem 18***. … passengers got on the train, randomly choosing any of the … carriages. What is the probability that at least one of them will get on the first carriages if it is known that people got into different carriages?

***Problem 19***. … balls are randomly put into … boxes. Find the probability that all the boxes will have a different number of balls provided (on the condition) that not all boxes are empty.

 ***Problem 20***. There are … red, … green and … blue balls in box. … balls are randomly taken out. What is the probability that taken out balls are of different colors if you know that blue ball is not taken out?

 ***Problem 21***. Two equivalent players play … games. Find the probability of the victory of the first player if it is known that each player won at least once.

 ***Problem 22***. … people enter the elevator on the ground floor of …-storeyed building. Assuming for each passenger equiprobable exit on any of the nine floors, find the probability that the … people will go out on the same floor and the rest - on different floors.

***Problem 23***. A firm participates in four projects each of which can fail with probability …. In case of failure, the probability to ruin one project is …%, two projects - …%, three projects - …%, four projects - …%. Determine the probability of bankruptcy of the company.

 ***Problem 24***. Two auditors checked … firms (each auditor - … firms), two of which are flawed. The probability of detecting violations by the first auditor is …%, the second - …%. Find the probability that the violations of the both firms will be identified.

 ***Problem 25***. In the first urn there is … white and … black balls, in the second - … white balls and one black ball. One ball is moved from the first urn into the second one without looking, and one ball is then moved from the second urn to the first one. After that, one ball was taken out of the first urn. What is the probability that it is white?

1.Out of the box with … details, including … standard, they randomly have selected … details. Create the law of distribution of a discrete random variable X - the number of standard details among the selected.

2.The book was published in edition of … thousands. Probability of defect of 1 copy is … . Find the probability that the edition contains exactly … defective books.

3.Find the dispersion and standard deviation of the random variable X, given by the distribution law. Find MX, DX:

 X .. … … …

 P … .. … …

 4.Find the dispersion of a discrete random variable X - the number of failure of some element of the device in … independent experiments if the probability of failure of the element in each experiment is … .

5.The probability of a lottery billet being successful is … . A customer buys … billets. Find the distribution law and expectation MX and standard deviation  of the number of successful billets among … billets.

6. A shooter hits a target with probability … at one shot. He shoots until the first hit but makes not more than … shots. Find the distribution law and expectation MX and standard deviation  of the number of successful hits.

7.Two machines produce a detail with probabilities of defect … and … respectively. In a sample one detail is produced by the 1-st machine and two – by the 2-nd one. Find the distribution law and expectation MX and standard deviation  of the number of defective details.

8.Two shooters hit the target with probabilities … and … respectively (at one shot). Find the distribution law and expectation MX and standard deviation  of general number of hits at the target, if the 1-st shooter shoots once, the 2-nd - twice.

9.From an urn, which has … white and … black balls, one ball of unknown color was lost. After that, … balls, which turned to be white, were retrieved from the urn (without replacement). Under this condition, find the probability that a black ball was lost.

10.Each of … lamps has defect with probability … . A defective lamp burns immediately after turning on and it is replaced with a new one. Build the distribution law and expectation MX and standard deviation  of the number of tested lamps.

11.Only … of … keys fit the door. The keys are tested one after another until the door is opened. Build the distribution law and expectation MX and standard deviation  of the number of tested keys.

12.Among … details there are … of necessary size. The details are tested in turn until two details of the wanted size are selected, at that no more than 4 tests is done. Build the distribution law and expectation MX and standard deviation  of the number of tested details.

13.A coin is tossed until Head is obtained twice, at that no more than 3 trials are done. Find the distribution law and expectation MX and standard deviation  of the number of tosses.

14.The distribution law of random variable X has the form:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *xi* |  |  |  |  |
| *pi* |  |  |  |  |

Find the distribution function and expectation MX and standard deviation  of the random variable. Calculate P(-1<X<3/2).

15.The distribution law of random variable X has the form:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *xi* |  |  |  |  |
| *pi* |  |  |  |  |

Find the distribution function and expectation MX and standard deviation  of the random variable. Calculate P(-1<X<3/2).

16.The controller of the conveyer gets … details. The probability of defect for each detail is … . The details are examined one after another until … nondefected details are found. Find the distribution law and expectation MX and standard deviation  of the number of examined details.

17.A device is consists of 2 details. The probability of the defect for 1 detail is …, for the second one is … . … devices are selected. A device is considered defected if it has at least one defected detail. Build the distribution law and expectation MX and standard deviation  of the number of defected devices among four devices.

18.Continuous random variable X is given throughout Ox by a distribution function. Find the probability that the variable X takes a value in the interval (0, 1)

19.A continuous random variable is uniformly distributed in the interval […; …]. Find MX and  of this random variable.

20.The random variable X is given by the distribution function

.

Find the probability that X takes values: a) less than 0.2; b) less than 3; c) not less than 3; d) not less than 5.

21.A continuous random variable is uniformly distributed in the interval [1; 6]. Find MX and  of this random variable.

22.Given the density distribution of continuous random variable X



find its expectation and dispersion.

23.The random variable X is defined on the positive half-Ox by distribution function . Find the expectation and dispersion of X.

24.The random variable X is given by the interval (…, …) density distribution; outside this interval. Find the dispersion of X.

25.The random variable X is given density distribution. Find the mean and dispersion.

26.Find the dispersion and standard deviation of the random variable X, uniformly distributed in the interval (.., …).

**Problems 3**

**Problem 1.** Find the density function : a) the sum ; b) the difference of two random variables with uniform distribution on [0; ] .

**Problem 2**. Random variables  defined and independent and have the same density function



Find the distribution function and the density distribution

values:  .

**Problem 3**. The random variables independent and uniformly distributed on the interval . Find the distribution function and the density function values

 and 

Prove that 

**Problem 4.** A random variable distributed according to the Cauchy law : Find a) the coefficient ; b) function distribution; c) the probability of hitting on the interval (-1, 1). Show that the expectation £ does not exist.

**Problem 5**. The density distribution of the random variable  has the form



Calculate the constant C, the distribution function  ,  and  the probability 

**Problem 6.** The density distribution of the random variable  has the form



Calculate the constant C, the distribution function,  and  the probability 

**Problem 7 .** Random variable  distribution has function



Calculate the density of the random variable, expectation, variance and probability 

**Problem 8**. Check that the function



may be a distribution function of the random variable. Find the numerical characteristics  and of this magnitude

**Problem 9**. A random variable uniformly distributed on the interval [ 2 ; 6]. Write the density distribution. Find function distribution. Find the probability of getting a random variable on the interval [ 2 ; 5] and on the interval [ 5; 7 ] .

**Problem 10**. The density distribution ξ is equal to



Find the constant C , density distribution  and probability 

**Problem 11.** A random variable  is uniformly distributed on the interval [ 1 ; 3] . Find the density distribution of the random variable 

**Problem 12.** A random variable  is uniformly distributed on the interval [ -1; 1] . Find the density distribution of the random variable 

**Problem 13.** A random variable ξ has a distribution function



Find the distribution function of the random variable 

**Problem 14.** A random variable ξ has an exponential distribution with parameter λ. Find the density function of random variables: a)  ; b) .

**Problem 15.** A random variable ξ is uniformly distributed on the interval [ 0 ; 1] . Find the density of distribution of random variables:

a)  ; b) .

**Problem 16.** Show that if  has a continuous distribution function, then the random variable  is uniformly distributed on the interval [ 0, 1] .

**Problem 17.** Find the density function and the distribution function of the sum of two independent random variables ξ and η with uniformly distributed on [ 1 ; 3 ] and [0 ; 1 ], respectively .

**Problem 18.** The random variables ξ and η are independent and uniformly distributed on the interval [0; 2 ] and [3 ; 4] respectively. Calculate the function and the density of the sum ξ + η

**Problem 19** Random variables ξ and η are independent and uniformly distributed on the interval [0; 4] and [1 ;2 ] . Calculate the function and the density of the sum ξ + η

**Problem 20.** Random variables ξ and η are independent and uniformly distributed on the interval [1,3] and [ 2;4] . Calculate the density of the sum ξ + η

**Problem 21.** Random variables  and are independent and have exponential distribution with density  Find the density distribution of their sum .

**Problem 22**. Random variables  defined and independent and have the same density function



Find the distribution function and the density distribution values of 

**Problem 23.** A random variable ξ has an exponential distribution with parameter λ. Find the density function of random variables : c)  ; d) 

**Problem 24.** Find the density function of the product of two random variables with uniform distribution on [0; ] .