2. Discrete Probability Distributions

1. Some board games use tetrahedral dice that have four faces and that are labeled from 1 to 4. Estimate the probabilities to get the following results, after throwing one die:

      a) 4, i.e. $f(x=4)$

      b) more than 2, i.e. $f(x>2)$

2. In a large population, 16% of the people are left-handed. In a random sample of 10 people find:

      a) probability that exactly 2 are left-handed

      b) probability that fewer than 2 (i.e. 0 or 1) are left-handed

3. From the past experience you know that the probability of a successful implantation of human glioblastoma into a mouse brain is 60% (so called xenograft experiment). The ethical committee asks you to present the clear proof of a minimal number of animals needed for the study.

      a) Estimate the probability to have at least 3 successful implantations in a group of 5 mice.

      b) How many mice should you take to be >90% sure that you get 3 or more mice with a xenograft tumor?

4. Lots of 20 components are checked by a company. The procedure for sampling the lot is to select 5 components at random and to reject the lot if a defective one is found. Assume the specific lot has $r = 3$ defectives.

      a) What is the probability that exactly 1 defective is found in the sample?

      b) What is the probability that a lot with $r = 3$ defective is rejected?

      c) What is the probability that a lot with $r = 10$ defective is rejected?

5. An ichthyologist studying the *spoonhead sculpin* catches specimens in a large bag seine that she trolls through the lake. She knows from many years experience that on averages she will catch 2 fish per trolling.

      a) Draw distribution for the number of fishes after trolling.

      b) What is the probability of having no fish ($x = 0$)?

      c) What is the probability of having less than 4 fishes ($x < 4$)?

      d) What is the probability of having more than 1 fish ($x > 1$)?

      Hint: do not forget that Poisson distribution has no limitation for the maximal number of events. In principle, the ichthyologist can get 100 fishes in one trolling... but with a very small probability.

6. In an area of heavy infestation, gypsy moths lay egg clusters on trees with a mean number of clusters per tree equal to 3. Identify the distribution and calculate the probability that a randomly chosen tree has

      a) no egg clusters;

      b) at least 1 egg cluster.

7. You are counting *Rana temporaria* in a forest. On average, you know that you can find 6 frogs per hour. What is the probability to find no frogs in the next 20 minutes?