Problems for exercises in Random phenomena course - 3rd set

1. The thickness of a flange on an aircraft component is uniformly distributed between 0.95 and 1.05 mm.
   (a) Determine the cumulative distribution function of flange thickness. R: $F(x) = 10\,\text{mm}^{-1}(x - 0.95\,\text{mm})$
   (b) Determine the proportion of flanges that exceeds 1.02 mm. R: $P = 0.3$
   (c) What thickness is exceeded by 90% of the flanges? R: $x = 0.96\,\text{mm}$
2. The time to failure of a certain type of computer hard disk is exponentially distributed with a mean of 25 000 h.
   (a) What is the probability that the disc runs without failure for at least 30 000 h? R: $P = 0.301$
   (b) What is the time to failure that at most 10 % of discs exceed? R: $t > 57565\,\text{h}$
3. Two weeks after being sowed, the mean plant height is 10 cm with the standard deviation of 1 cm. It is assumed that the plant height is normally distributed.
   (a) What is the probability that the height of a randomly chosen plant falls between 9 and 12 cm? R: $P = 0.819$
   (b) What height is exceeded by 90 % of the plants? R: $h = 8.72\,\text{cm}$
4. The probability of getting a bad product in a series of 1000 pieces is 0.02.
   (a) What is the probability that more than 30 bad products are found in a randomly selected series? R: $P = 0.0126$ and $P = 0.0119$
   (b) What is the minimum capacity of a warehouse in which all bad products from a selected series can be stored with a probability of 0.95? R: $C \geq 28$
5. Shaft diameter at the point of compression joint is normally distributed with a mean of 100 mm and standard deviation 0.2 mm. The diameter of a hole in a gear is normally distributed with a mean of 99 mm and the same standard deviation as that of the shaft diameter. The compression joint is of a good quality if the shaft diameter is 0.5 to 2.5 mm larger than the hole diameter. What is the probability that a randomly selected gear does not make a good quality joint with a randomly selected shaft? R: $P = 0.038$
6. Pieces with volume of $0.6\,\text{m}^3$ are painted by dipping in a container with volume of $1\,\text{m}^3$. For each piece, the paint is poured in the container by two machines. The amount of the poured paint is normally distributed for both of them. The mean paint volume poured by the first machine is $0.25\,\text{m}^3$, the standard deviation is $0.03\,\text{m}^3$, while the other machine pours paint with mean of $0.1\,\text{m}^3$ and the standard deviation $0.01\,\text{m}^3$. After painting each piece, the remaining paint is removed from the container. What is the probability that during the painting of a randomly selected piece the paint does not flow over the container edge? R: $P = 0.943$
7. It is known that in drilling of mild steel the total length of the holes that can be drilled by one drill bit in its lifetime is normally distributed with a mean of 1 m and a standard deviation of 0.2 m. At least how many drill bits are needed to drill a 6 m long hole with a probability of 95 %? R: $n = 7$

Note: To solve some of the problems a tabulated Gaussian probability distribution is required (Table A.1 in the textbook *Opis naključnih pojavov*).