Task for practice to 3rd lecture on the topic:

Enterprise resources - CA = circulating (current, short-term) assets optimization with using a static stochastic model

Inventory Theories: A number of organizations have a significant percentage of their assets in stock (CA). Inventory management optimization is very useful as it can contribute to the partial release of such funds and, moreover, leads to a reduction in costs associated with ongoing supply processes. The two main questions that arise in relation to inventory management are:

- at what point should be ordered a new supply of the given stock (CA)
- how big (how many units, pieces) this order should be

Various models are used to determine the optimum stock size, one of which is the so-called static stochastic model:

- **static** – independent of time
- **stochastic** – the stock size can only be estimated with certain probability. A typical example of stochastic demand is, for example, the demand for newly introduced goods.

Static stochastic model is characterized by only one order to replenish the stock and the unused supply is becoming worthless after the end of the period when it is consumed (e.g. spare parts to a more unique device).

The probability that a certain phenomenon will occur (we will need a certain number of stock units) can be described, for example, by Poisson's distribution of the random variable (the law of sparse distribution):

$$p(m) = \frac{(\lambda T)^m . e^{-\lambda T}}{m!}$$

where:

$\lambda = 1/n$	- failure rate [failures / year]
n	- mean time of trouble-free operation [years]
T	- time period under investigation (e.g. economic lifetime)
m	- number of failures (amount of OP inventory) = discrete random variable

ESF II project of the University of West Bohemia in Pilsen, reg. number: CZ.02.2.69/0.0/0.0/18_056/0013239

The total cost dependent on the stock size N_x [CZK] in this model is given by the sum of the cost of acquisition and storage (maintenance) of the N_Z [CZK] and of the costs resulting from the lack of the stock N_D [CZK]:

$$N_x = N_Z + N_D = n_Z \cdot x + n_D \cdot \sum_{y=x+1}^{\infty} p(y) \text{ [CZK]}$$

where:

n_Z - specific cost of acquisition and storage of inventory unit [CZK / pcs]
n_D - specific costs resulting from lack of inventory unit [CZK / pcs]
x - the amount of inventory taken [pcs]

Using cumulative probability $P(x)$ you can write:

$$\sum_{y=x+1}^{\infty} p(y) = 1 - P(x)$$

then

$$N_x = n_Z \cdot x + n_D \cdot [1 - P(x)]$$

We are also looking for an optimal solution as a minimum of cost function, assuming the only solution, using the inequality

$$N_{x_0+1} \geq N_{x_0} \leq N_{x_0-1}$$

where: x_0 – the optimal amount of inventory taken

After editing, we get the default condition for determining x_0

$$p(x_0 + 1) \leq \frac{n_Z}{n_D} \leq p(x_0)$$

Finally, we verify the correctness of the solution by calculating the cost N_x for $x = x_0, x_{0-1}, x_{0+1}$:

Example:

A control computer should be installed in the power plant, with an estimated life of 15 years. It includes a special exchange module with an average life of 50,000 hours. Specify how many replacement modules should be purchased in one delivery when you purchase your computer.

The price of one module is CZK 15,000, the cost of storage is negligible. If there is no spare part during a fault, the company will lose CZK 350,000 (including additional replacement module supply). At the end of the economic life, unused spare modules are virtually worthless.

Solution Procedure:

We create the probability table ***p(y)*** of the number of replacement modules of ***y*** over the economic life of the computer.

Assuming that the lifetime of a module is a random variable with exponential distribution, the number of replacement modules will be governed by Poisson's law of division.

y [pcs]	0	1	2	3	4	5	6	7
p(y)								

Tab.1:

Next, we create a cumulative probability table $P(x) = \sum_{y=0}^{x} p(y)$

x [pcs]	0	1	2	3	4	5	6	7
P(x)								

Tab.2:

We find the optimum stock size x_0, ie we calculate the ratio

$$\frac{n_Z}{n_D} =$$

And find $x_0 = y$ from tab 1. under the condition $p(x_0 + 1) \le \frac{n_Z}{n_D} \le p(x_0)$

$x_0 =$

We verify the correctness of the result by calculating the costs N_{x_0}, $N_{x_{0-1}}$ and $N_{x_{0+1}}$ [CZK] according to $N_x = n_Z \cdot x + n_D \cdot [1 - P(x)]$