OPTIMIZATION OF RETAIL SUPPLY CHAIN OF A PRODUCT UNDER STOCHASTIC DEMAND

We are given a supply chain consisting of a set of warehouses and a set of stores, and the distances between the warehoses and stores. The transportation cost between a warehouse and a store is simply a product of quantity and the distance. The stores provide predictions of the future (next day) demand as a random variable distribution, in a form of discrete vaiable b_j with a small number of values (say 4). The task is to find the quatities of the product that is to be transported, so that it minimizes both the cost of transport and the expected risk. The cost of risk is either called overstock cost (when some of the product is not sold) or the lost sale cost (when the actual demand is greater and the store runs out of the product. These costs at store j are defined as $OS_j = Exp((x_j - b_j) * OS_{cost\_per\_unit})$ (when $x_j > b_j$) and as $LS_j = Exp((b_j - x_j) * LS_{cost\_per\_unit})$ (when $x_j < b_j$). Here, $x_j = \sum_i x_{i,j}$.

Formally, we are minimizing the expected cost, i.e. find $X = [x_{i,j}]$ such that the sum of $TC = \sum_{i,j} x_{i,j} d_{i,j}$ and $RC = \sum_j \max\{LS_j, OS_j\}$.

Data, artificial and realistic instances, are provided by Tea Vizinger.

Questions.
- Design a heuristics for the problem.
- Prove that a problem is a NP hard.