In this article, we present a representation of value-at-risk (VaR) as a difference of convex (D.C.) functions in the case where the distribution of the underlying random variable is discrete and has finitely many atoms. The D.C. representation is used to study a financial risk-return portfolio selection problem with a VaR constraint. A branch-and-bound algorithm that numerically solves the problem exactly is given. Numerical experiments with historical asset returns from representative market indices are performed to apply the algorithm to real-world financial market data.