Risk analysis lab 2014. 11. 03. (Portfolio risk)

1. Load the supplied data from the binary (`x.mat`), the variable `x` will be a TxN matrix containing daily returns for N asset and T days. Calculate its mean vector as $\boldsymbol{m}=\{E(x_1), E(x_2), \dots, E(x_N)\}$, and its covariance matrix **K**.

2.

a) Generate a random portfolio vector $\boldsymbol{w}=\{w_{1,} w_{2,} \dots, w_N\}$, where $\|\boldsymbol{w}\|_1=\sum_{i=1}^{N} |w_i|=1$ and $-1 \le w_i \le 1$ (short selling is allowed).

b) If we define $p(t)=\sum_{i=1}^{N} w_i x_i(t)$, then $p \sim N(\mu, \sigma)$ (CLT), where $\mu=\boldsymbol{w}^T \boldsymbol{m}$ and $\sigma^2=\boldsymbol{w}^T \boldsymbol{K}\, \boldsymbol{w}$. Calculate u to fulfill $P=P(p<u)=0.01$.

Display

- the expected daily return
- and the minimal daily return (with 1% uncertainty)

of the given portfolio.

```
[u, mu, sigma] = minrisk(w, m, K, P)
```

3. Determine the optimal portfolio to minimize the risk:

$$\boldsymbol{w}_{opt} := \min_{w} \frac{\boldsymbol{w}^T \boldsymbol{K}\, \boldsymbol{w}}{\boldsymbol{w}^T \boldsymbol{w}} \quad .$$

The optimal portfolio can be calculated as that eigenvector (**vN**) of matrix **K** which belongs to the smallest non-zero (> 10^{-6}) eigenvalue (*lN*). Print the expected daily return and the minimal daily return (with 1% uncertainty) of the optimal portfolio.

```
function [lN, vN] = mineig(K)
```