Below is the result of question1:

```
(base) EdwardChao:109062703 chaoyangsheng$ python3 hw3.py
1a. Sw: [[ 0.20887959 -0.00498406]
 [-0.00498406  0.20637619]]
1a. Sb: [[100.   0.]
 [  0. 100.]]
1a. Sm [[ 1.00208880e+02 -4.98405870e-03]
 [-4.98405870e-03  1.00206376e+02]]
1a. J3 965.8521681177155
1b. Sw: [[ 0.20887959 -0.00498406]
 [-0.00498406  0.20637619]]
1b. Sb: [[1. 0.]
 [0. 1.]]
1b. Sm [[ 1.20887959 -0.00498406]
 [-0.00498406  1.20637619]]
1b. J3 11.638521681177153
1c. Sw: [[ 3.13319382 -0.07476088]
 [-0.07476088  3.0956428 ]]
1c. Sb: [[100.   0.]
 [  0. 100.]]
1c. Sm [[ 1.03133194e+02 -7.47608806e-02]
 [-7.47608806e-02  1.03095643e+02]]
1c. J3 66.25681120784768
```

Below is the result of question2 and 3:

Q2: As we can see, the both FDRs of question 2b are bigger than question 2a since the sigma(cov) of 2b are smaller than 2a. Which means 2b is harder to distinguish.

Q3: The second column(feature) of the eigenvalue is bigger than the first column which means the second column of the eigenvector should be the principle component direction. And it is parallel to b(x1 + x2 = 0).

```
2a. feature_1_FDR: 0.11968617999950013
2a. feature_2_FDR: 17.443873029534384
2b. feature_1_FDR: 0.4787447199980003
2b. feature_2_FDR: 69.77549211813756
3. cov of X: [[ 33.81288757 -33.79195858]
 [-33.79195858  34.12889148]]
3. eigenvalues: [ 0.17856157 67.76321749]
3. eigenvector: [[-0.70875795  0.70545174]
 [-0.70545174 -0.70875795]]
3. first principle component direction: [[ 0.70545174]
 [-0.70875795]]
```