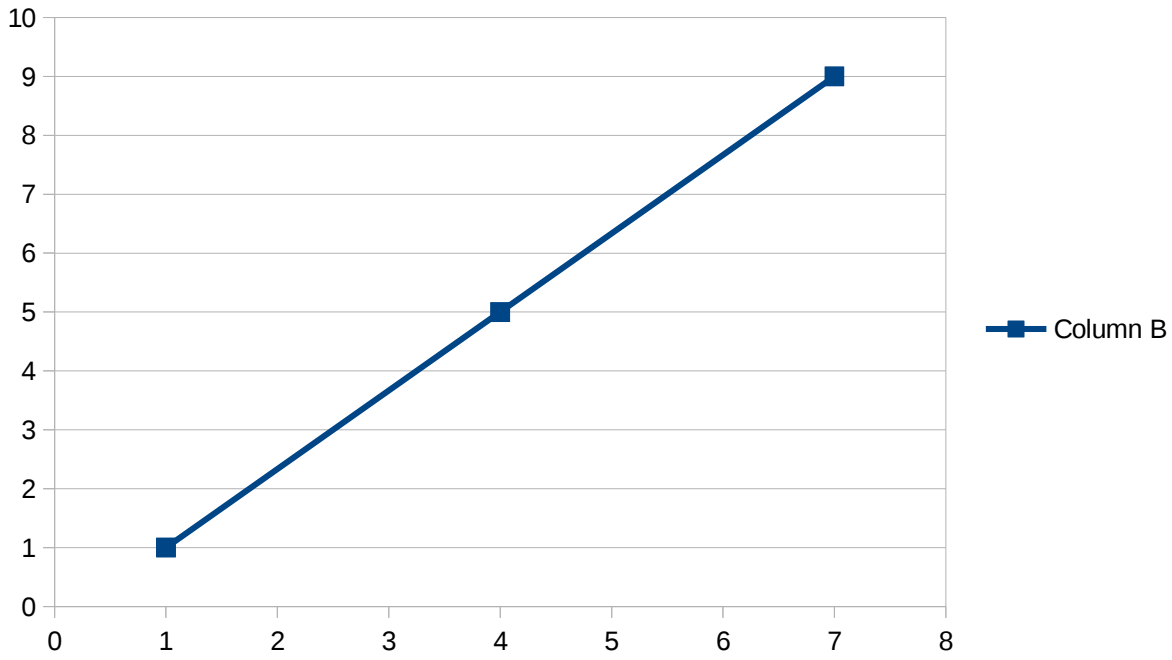
Jiaming Chen
ML HW4
Problem 1
1. Since I can fit a line that goes straight through them, the eigen vector would be the unit vector that goes through them. [3,4] normalize into [3,4] / sqrt(3^2 + 4^2) = [3/5,4/5]

2. z1 = [-3,-4] . [3/5,4/5] = -5
z2 = [0 , 0] . [3/5,4/5] = 0
z3 = [3 , 4] . [3/5,4/5] = 5
mean = (-5 + 0 + 5) / 3 = 0
variance = 1/3 (25 + 0 + 25) = 50/3

3.
The follow graph is a line that best fit the three points. Since the line fits the points perfectly, there will be no reconstruction error.



Problem 2
1.

$$\prod_j \sum_{i=1}^{k} \frac{1}{\sqrt{(2\pi)^m |\sum_i|)}} exp(-\frac{1}{2}(x^j - \mu_i)^T (\sum_i)^{-1}(x^j - \mu_i))p_i$$

2. p1 = (1 + .4 + 0) / 3 = 0.467
p2 = (0 + 0.6 + 1)/3 = 0.533

3. μ1 = (1 * 1 + 0.4 * 10 + 0 * 20)/ 1.4 = 3.57
μ2 = (0 * 1 + 0.6 * 10 + 1 * 20)/ 1.6 = 16.25

4.

$\sum 1$ = (1 * (1-3.57)^2)+0.4*(10-3.57)^2)/1.4 = 16.531
$\sum 2$ = (0.6*(10-16.25)^2+1*(20-16.25)^2)/1.6 = 23.4375

E Step
1.

$$P(y = c|x^i)\alpha \frac{1}{\sqrt{(2\pi)\ \ |\sum_c|)}} exp(-\frac{1}{2}(x^j - \mu_c)^T(\sum_c)^{-1}(x^j - \mu_c))p_c$$

2. P(x1 in G1) = 1/(sqrt((2pi)*16.531)) exp(-(1-3.57)^2/(2*16.531))*0.467 = 0.037524
P(x1 in G2) = 1/(sqrt((2pi)*23.4375)) exp(-(1-16.25)^2/(2*23.4375))*0.533 = 0.000307611
p(x1) = [.992,.008]
P(x2 in G1) = 1/(sqrt((2pi)*16.531)) exp(-(10-3.57)^2/(2*16.531))*0.467 = 0.013121416
P(x2 in G2) = 1/(sqrt((2pi)*23.4375)) exp(-(10-16.25)^2/(2*23.4375))*0.533 = 0.0190884
p(x2) = [.407,.593]
P(x3 in G1) = 1/(sqrt((2pi)*16.531)) exp(-(20-3.57)^2/(2*16.531))*0.467 = 0.000013036
P(x3 in G2) = 1/(sqrt((2pi)*23.4375)) exp(-(20-16.25)^2/(2*23.4375))*0.533 = 0.032538182
p(x3) = [.0004,.9996]

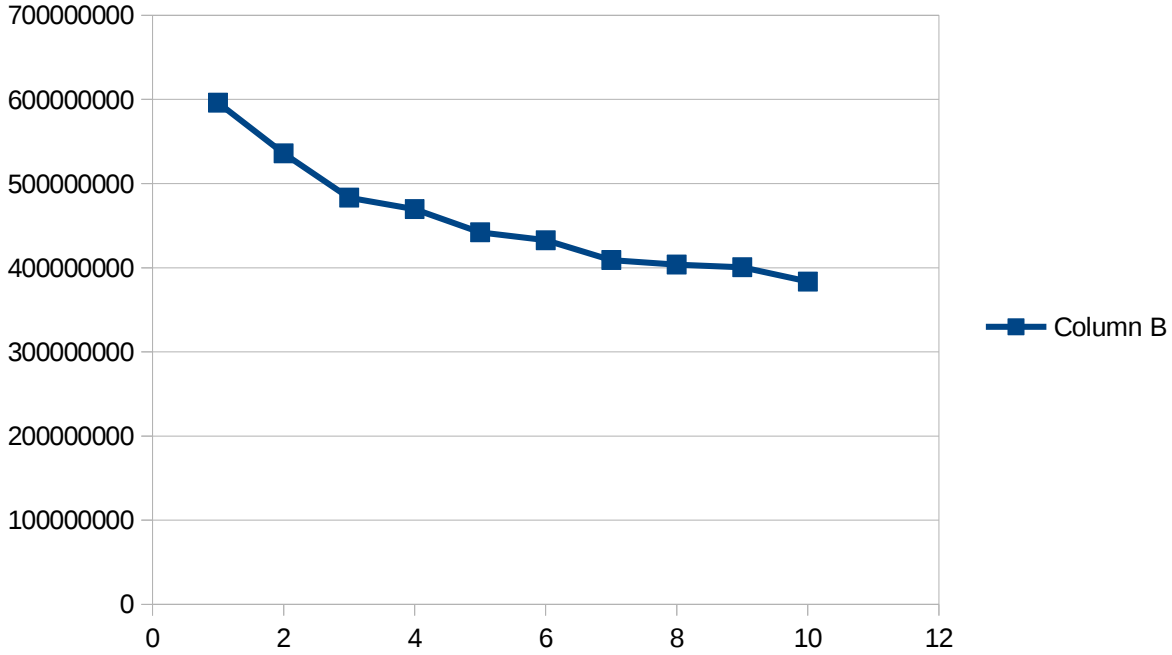
R = [.992,008;
.407,.593;
.0004,.9996]

Problem 3
3.5.1

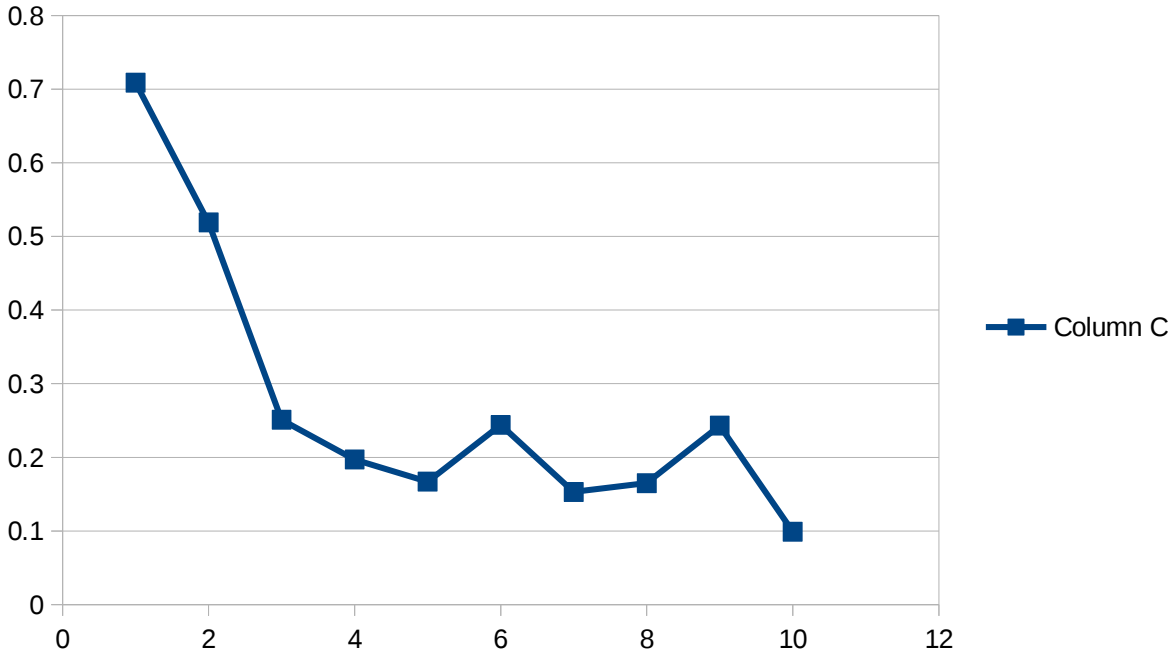
K	SOS	Mistake Rate
K = 2	536477102.543	0.52
K = 4	461110943.962	0.243
K = 6	431349182.916	0.18

3.5.2
Iterations 8.

3.5.3


700000000
600000000
500000000
400000000
300000000
200000000
100000000
0
0
2
4
6
8
10
12
Column B

3.5.4


0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
2
4
6
8
10
12
Column C