Data mining 1st Report  
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1. For vectors a = (3, 6, −4) and b = (−2, k, 1), determine the value of k such that the two vectors are perpendicular.

Answer:

* Calculate the inner product between vector a and vector b to determine k when the result of the inner product is 0.  
  (3, 6, −4) ・ (−2, k, 1) = -6+6k-4 = 0  
   6k = 10  
   k = 1.6666... = 1.667

2. Determine Eigenvalues and Eigenvectors of the following matrices using R. Explain the results briefly.

Answer:

(a) 1 6 3  
 2 4 -3

8 -6 7

* Source code  
  x <- rbind(c(1,6,3), c(2,4,-3), c(8,-6,7))  
  eigen(x)
* Results

$values

[1] 10 7 -5

$vectors

[,1] [,2] [,3]

[1,] 1.606191e-16 0.5570860 -0.6811149

[2,] -4.472136e-01 0.7427814 0.3632613

[3,] 8.944272e-01 -0.3713907 0.6357073

(b) 1 6 3  
 6 4 -3

3 -3 7

* Source code  
  x <- rbind(c(1,6,3), c(6,4,-3), c(3,-3,7))  
  eigen(x)
* Results

$values

[1] 9.076064 8.070688 -5.146752

$vectors

[,1] [,2] [,3]

[1,] 0.3279853 -0.5910090 0.7369762

[2,] 0.7369762 -0.3279853 -0.5910090

[3,] -0.5910090 -0.7369762 -0.3279853

3. Multiply the following two matrices showing manual calculations.

Answer:

1\*2+2\*5 1\*7+2\*3 12 13  
 3\*2+4\*5 3\*7+4\*3 = 26 33  
 5\*2+6\*5 5\*7+6\*3 40 53  
  
4. Discuss the meaning and limitations of correlation/covariance coefficients.

Answer:

The covariance of (X, Y) is defined by:

The correlation of (X, Y)(X,Y) is defined by:

As it is apparent from the above equation, the correlation is a scaled version of covariance.   
When changing the same two variables between the unit, the correlation does not change but the covariance change. Moreover, the covariance and the correlation always have the same sign. When the sign is positive, the variables are to be positively correlated, when the sign is negative, the variables are to be negatively correlated, and when the sign is 0, the variables are to be uncorrelated. The correlation is dimensionless, because the numerator and denominator have the same physical units, namely the product of the units of X and Y.