Practical Data Science/Analytics (Linear Algebra)

Write R Scripts or use R to perform any mathematical operations while solving the following problems.

Problem 1: Finding the Angle between Vectors

Find the angle between the following 3-dimensional vectors:

a. (1,3,4), (2,1,6)
b. (2,1,3), (6,3,9)

Problem 2: Finding Orthogonal Projection of Vector

- Find the scalar and vector projections of a onto b.

  a = j + ½ k b = 2i - j + 4k

- Given vectors x = (3,4) and y=(1,0), Find the vector projection p of x onto y and verify that p and x - p are orthogonal.

Problem 3: Change of Basis

- Suppose the standard (x,y)-coordinate system of R2 is rotated counter-clockwise by an angle of 60 degrees to yield the new (x',y')-coordinate system. Find the new coordinates of the points (2, 3), (-1, 1), (0,1).

- Let the basis-1 consists of 3 vectors: u1 = (1,1,1), u2 = (1,2,2), u3 = (2,3,4) and basis-2 consists of 3 vectors: v1 = (4,6,7), v2 = (0,1,1), v3 = (0,1,2). Determine the co-ordinates of x with respect to (u1,u2,u3) if x = 2v1 + 3v2 - 4v3

Problem 4: Analysis of Linear Discrete System

Assume that customers are using Apple IOS and Google Android for their mobiles. For each cycle 1/3 of IOS users switch to Android and 2/3 stays. Also lets assume that ½ of the Android OS users switch to IOS and 1/2 stay for each cycle. Answer the following questions:

a) How many users will stay with Android and IOS after 10 cycles If initial vector is (1000, 800)?
b) What will be long term equilibrium state of customers?