Indian Institute of Technology Madras

Web M.Tech Industrial AI

ID5004: AI in Predictive Maintenance, Reliability, and Warranty

Assignment: Multivariate Statistics and Fault Detection

Instructions

1. Assignment shall be submitted before the due date. Late submissions will not be entertained. If you can not submit the assignment due to some reasons, please contact the instructor by email.
2. All the assignments must be the student's work. The students are encouraged to discuss or consult friends or classmates. However, they have to submit their work. Any malpractice will be reported to the authorities, and actions will be taken as per the IIT Madras rules.
3. If you find the solution in the book, article, or website, please indicate the reference in the solution.

Problems

1. (a) When does the T^2 statistic follows a χ^2 distribution? [1]
   (b) Derive the proof for part (a). [2]
2. For the given dataset,
   (a) Find the trace of Λ. [1]
   (b) Find the basic statistics (mean and standard deviation) for the all the types of seeds. [1]
   (c) Split the data into training and test data (80:20) and calculate the T^2 statistic. [1]
   (d) Perform PCA and visualize the explained variance ratio for the training set. [1]
   (e) Find the T^2 statistic threshold for the training data with 90% confidence interval using PCA representation
      - Assuming that the T^2 statistic follows a χ^2 distribution [1]
      - Using the sample covariance [1]
   (f) Report whether there are faults in the test data and outliers in the training set. [2]
3. Show that the T^2 statistic constructed from the data for the m variables and n observations follows
   (a) χ^2-distribution when the covariance is known. [2]
   (b) $F-$distribution when the covariance is unknown. [2]