Politecnico di Milano
Scuola di Ingegneria Industriale e dell'Informazione
Applied Statistics
Exam 2025-07-07 - Part B - 2024/2025

Problem 1: Heart rate and skin temperature monitoring

The files `reference.txt`, `wristband.txt` and `smartwatch.txt` contain the results of a physiological monitoring test in which three devices – a reference sensor, a smart watch, and a wristband – record heart rate (`hr`) and skin temperature (`temp`) from the same 100 volunteers (considered as randomly sampled) during a 5-minute standardized activity.

a) Do you believe that the rows of the consolidated data matrix (i.e., heart rate and skin temperature measurements from the three devices for each subject) are independent realizations from the same 6-dimensional Gaussian distribution? Justify your answer.

b) Test at the exact 95% confidence level whether either of the two wearables (smartwatch and wristband) systematically over- or under-estimates any of heart rate and skin temperature compared to the reference device.

c) Characterize the confidence region of the previous test.

d) Construct Bonferroni simultaneous confidence intervals with an overall 95% confidence level for the mean differences in heart rate and temperature between the ref device and each of the two wearables. What do these intervals tell you about the accuracy of the devices?

e) Overall, which of the wristband and smartwatch devices would you recommend?

Upload your answers there: `https://forms.office.com/e/jsnXbYu3Zr`