1. Find the maximum likelihood estimates of the 2×1 mean vector $\boldsymbol{\mu}$ and the 2×2 covariance matrix $\boldsymbol{\Sigma}$ based on the random sample

$$\mathbf{X} = \begin{bmatrix} 3 & 6 \\ 4 & 4 \\ 5 & 7 \\ 4 & 7 \end{bmatrix}$$

from a bivariate normal population.

2. Using the data

$$\mathbf{X} = \begin{bmatrix} 2 & 12 \\ 8 & 9 \\ 6 & 9 \\ 8 & 10 \end{bmatrix}$$

   (a) Evaluate T^2, for testing $H_0 : \boldsymbol{\mu}' = [7, \quad 11]$, using the data
   (b) Specify the distribution of T^2 for the situation in (a).
   (c) Using (a) and (b), test H_0 at the $\alpha = .05$ level. What conclusion do you reach?
   (d) Determine Λ
   (e) Using the Wilk's Lambda (d), calculate T^2

3. Harry Roberts, a naturalist for the Alaska Fish and Game department, studies grizzly bears with the goal of maintaining a healthy population. Measurements on $n = 61$ bears provided the following summary statistics:

Variable	Weight(kg)	Body length(cm)	Neck	Girth	Head length	Head width
Sample mean $\bar{x}$	95.52	164.38	55.69	93.39	17.98	31.13

$$\text{Covariance matrix } \mathbf{S} = \begin{bmatrix} 3266.46 & 1343.97 & 731.54 & 1175.50 & 162.68 & 238.37 \\ 1343.97 & 721.91 & 324.25 & 537.35 & 80.17 & 117.73 \\ 731.54 & 324.25 & 179.28 & 281.17 & 39.15 & 56.80 \\ 1175.50 & 537.35 & 281.17 & 474.98 & 63.73 & 94.85 \\ 162.68 & 80.17 & 39.15 & 63.73 & 9.95 & 13.88 \\ 238.37 & 117.73 & 56.80 & 94.85 & 13.88 & 21.26 \end{bmatrix}$$

   (a) Obtain the large sample 95% simultaneous confidence intervals for the six population mean body measurements.
   (b) Obtain the large sample 95% confidence ellipse for mean weight and mean girth.
   (c) Obtain the 95% Bonferroni confidence intervals for the six means in Part a.
   (d) Refer to Part b. Construct the 95% Bonferroni confidence rectangle for the mean weight and mean girth using $m = 6$. Compare this rectangle with the confidence ellipse in Part b.