

BIOSTATISTICS 667 (Fall 2019)
Homework 2

1. Inspect the program “iml01.sas” and its output. Describe what the program does. Use only standard mathematical language and notation. Do not recite any computer statements. Explain any patterns you observe in the output.
2. Suppose that $Y = (Y_1, Y_2, Y_3, Y_4)^\top$ is a random vector with mean vector $(1, 2, 5, 9)^\top$ and covariance matrix

$$\begin{bmatrix} 6 & 3 & 2 & 1 \\ 3 & 7 & 3 & 2 \\ 2 & 3 & 8 & 5 \\ 1 & 2 & 5 & 9 \end{bmatrix}.$$

Define $a = (1/4, 1/4, 1/4, 1/4)^\top$, $b = (1, 2, 3, 4)^\top$, $y = (10, 11, 7, 15)^\top$.

Define X to be a 4×2 matrix with a in column 1 and b in column 2. Write a SAS/IML program that computes and prints the following quantities:

- (a) $a^\top b$
- (b) $b^\top b$
- (c) $E[a^\top Y]$
- (d) $\text{var}(a^\top Y)$
- (e) $E[b^\top Y]$
- (f) $\text{var}(b^\top Y)$
- (g) $\text{cov}(a^\top Y, b^\top Y)$
- (h) $X^\top X$
- (i) $X^\top y$
- (j) The solution $(\hat{\beta})$ of the linear system $(X^\top X)\hat{\beta} = X^\top y$
- (k) The residuals $r = y - X\hat{\beta}$
- (l) $X^\top r$
- (m) The sum of squared residuals $\sum_{i=1}^n r_i^2$

Do not use any loops!

3. TBA (To be added).