

1.  $\Sigma = \begin{pmatrix} 19 & 30 & 2 & 12 \\ 30 & 57 & 5 & 23 \\ 2 & 5 & 38 & 47 \\ 12 & 23 & 47 & 68 \end{pmatrix}$  is given in Example 9.1 on page 484. Answer the followings by quoting results from SAS output. Do not submit the SAS output.

- (1) What is the first principal component for  $X$ ?
- (2) Which percentage of total variances in  $X$  is explained by the second principal component?
- (3) To have at least 85% of total variances explained, how many principal components should we use?
- (4) What is the first principal component for  $Z$ , the standardized  $X$ ?

2. In 5.1 (a) on page 261 a sample of size 4 is given by  $X = \begin{pmatrix} 2 & 8 & 6 & 8 \\ 12 & 9 & 9 & 10 \end{pmatrix}$  (caution: book uses  $X'$  for sample). Answer the followings by quoting results from SAS output. Do not submit the SAS output.

- (1) Sample mean  $\bar{X}$
- (2) SSCP matrix
- (3) CSSCP matrix
- (4) Sample covariance matrix  $S$
- (5) Sample correlation matrix  $R$

3.  $X \in R^{p \times n}$  is a random sample with  $X \sim (\mu 1_n', \Sigma, I_n)$ . Find  $E(\text{SSCP})$ .