10.16. Andrews and Herzberg [1] give data obtained from a study of a comparison of nondiabetic and diabetic patients. Three primary variables,

$$X_1^{(1)} = \text{glucose intolerance}$$
$$X_2^{(1)} = \text{insulin response to oral glucose}$$
$$X_3^{(1)} = \text{insulin resistance}$$

and two secondary variables,

$$X_1^{(2)} = \text{relative weight}$$
$$X_2^{(2)} = \text{fasting plasma glucose}$$

were measured. The data for $n = 46$ nondiabetic patients yield the covariance matrix

$$\mathbf{S} = \begin{bmatrix} \mathbf{S}_{11} & \mathbf{S}_{12} \\ \hline \mathbf{S}_{21} & \mathbf{S}_{22} \end{bmatrix} = \left[\begin{array}{ccc:cc} 1106.000 & 396.700 & 108.400 & .787 & 26.230 \\ 396.700 & 2382.000 & 1143.000 & -.214 & -23.960 \\ 108.400 & 1143.000 & 2136.000 & 2.189 & -20.840 \\ \hdashline .787 & -.214 & 2.189 & .016 & .216 \\ 26.230 & -23.960 & -20.840 & .216 & 70.560 \end{array}\right]$$

Determine the sample canonical variates and their correlations. Interpret these quantities. Are the first canonical variates good summary measures of their respective sets of variables? Explain. Test for the significance of the canonical relations with $\alpha = .05$.

10.17. Data concerning a person's desire to smoke and psychological and physical state were collected for $n = 110$ subjects. The data were responses, coded 1 to 5, to each of 12 questions (variables). The four standardized measurements related to the desire to smoke are defined as

$$z_1^{(1)} = \text{smoking 1 (first wording)}$$
$$z_2^{(1)} = \text{smoking 2 (second wording)}$$
$$z_3^{(1)} = \text{smoking 3 (third wording)}$$
$$z_4^{(1)} = \text{smoking 4 (fourth wording)}$$

The eight standardized measurements related to the psychological and physical state are given by

$$z_1^{(2)} = \text{concentration}$$
$$z_2^{(2)} = \text{annoyance}$$
$$z_3^{(2)} = \text{sleepiness}$$
$$z_4^{(2)} = \text{tenseness}$$
$$z_5^{(2)} = \text{alertness}$$
$$z_6^{(2)} = \text{irritability}$$
$$z_7^{(2)} = \text{tiredness}$$
$$z_8^{(2)} = \text{contentedness}$$

The correlation matrix constructed from the data is

$$\mathbf{R} = \begin{bmatrix} \mathbf{R}_{11} & \mathbf{R}_{12} \\ \hline \mathbf{R}_{21} & \mathbf{R}_{22} \end{bmatrix}$$