3

Visualising & Quantifying data

(2012 – 2013 Academic Year: Tutorial Questions)

Exercises

3.1 Compute the mean μ, variance σ^2, standard deviation σ, and skew γ of the data sets Ω and κ (to 3 d.p.), where

$$\Omega = \{0.5, 0.9, 1.2, 1.5, 1.8, 2.0, 3.4, 4.1, 5.0, 5.1, 7.5, 8.5\},$$

and

$$\kappa = \{0.7, 0.8, 1.1, 1.2, 1.5, 1.8, 1.9, 2.0, 2.5, 2.6, 2.9, 3.5\}.$$

3.2 Compute the covariance matrix of the combined data set Ω and κ given in question 1, where Ω corresponds to x, and κ corresponds to y.

3.3 Given the covariance matrix in the previous question, compute the correlation matrix.

3.4 Compute the eigen values and eigen vectors corresponding to the error matrix V obtained in question 2, thus determine the diagonalised form U of the error matrix.

3.5 Compute the arithmetic average, variance, standard deviation, and skew of the data set $\Omega(x) = \{1.0, 2.5, 3.0, 4.0, 4.5, 6.0\}$.

3.6 Compute the arithmetic average, variance, standard deviation, and skew of the data set $\Omega(x) = \{0.5, 1.0, 1.5, 1.6, 3.0, 2.1, 2.5\}$.

3.7 Compute the mean, standard deviation and correlation matrix for the following data.

x	0.10	0.22	0.25	0.50	0.55	0.70	0.80	0.90	1.00	1.11	1.12
y	1.0	1.1	1.1	1.2	1.3	1.4	1.4	1.3	1.6	1.5	1.4
z	0.1	-0.2	0.3	0.4	0.1	-0.4	0.1	-0.1	0.6	0.7	-0.3

3.8 Compute the mean, standard deviation and correlation matrix for the following data.

x	0.0	0.2	0.3	0.4	0.5	0.7	0.8	0.9	1.0	0.9	1.1
y	0.9	1.1	1.2	1.2	1.3	1.4	1.5	1.3	1.6	1.5	1.3
z	-0.1	-0.2	0.1	0.2	0.1	0.0	0.2	0.1	0.5	0.6	0.3

3.9 Compute the Spearman rank correlation coefficient for

x	0.5	0.7	0.8	0.9	1.1	1.3
y	0.9	0.8	1.1	1.2	1.2	1.0

3.10 Compute the Spearman rank correlation coefficient for

x	0.1	0.3	0.2	0.0	0.4	0.5	0.1	0.2	0.6	0.5
y	0.5	0.7	0.2	0.3	0.8	0.1	0.9	0.0	0.4	0.6

3.11 Starting from

$$V = U^T V' U,$$

where V is the covariance matrix, V' is the diagonal covarince matrix (in terms of u and v),

and U is a two-dimensional rotation matrix, determine expressions for both σ_u^2 and σ_v^2 hence θ, where θ is the angle of rotation.

3.12 Diagonalise the error matrix

$$V = \begin{pmatrix} 1.0 & 0.2 \\ 0.2 & 1.0 \end{pmatrix}. \tag{3.0.1}$$

3.13 Diagonalise the error matrix

$$V = \begin{pmatrix} 1.0 & 0.5 \\ 0.5 & 2.0 \end{pmatrix}. \tag{3.0.2}$$

3.14 Compute the rotation angle and matrix required to transform (x, y) to uncorrelated variables (u, v) given that $\sigma_x = 1.0$, $\sigma_y = 0.5$, and $\sigma_{xy} = 0.25$.

3.15 Compute the rotation angle and matrix required to transform (x, y) to uncorrelated variables (u, v) given that $\sigma_x = 2.0$, $\sigma_y = 1.5$, and $\sigma_{xy} = 1.0$.