

## Analysis of bi-temporal satellite data

The data considered in this assignment are observations from the Landsat Thematic Mapper satellite. Each observation consists of values of reflected light from 6 spectral bands shown in the table below. The pixel size is 30 m × 30 m.

Spectral band	Wavelength (in $\mu\text{m}$ )	Description
b1	0.45 – 0.52	visible blue
b2	0.52 – 0.60	visible green
b3	0.63 – 0.69	visible red
b4	0.76 – 0.90	near infrared
b5	1.55 – 1.75	near infrared
b6	2.08 – 2.35	near infrared

We consider images from two acquisitions, one in March, and one in May. The images have been co-registered so that the pixel values from the two months may be combined into one 12 dimensional measurements, (mr1-mr6, my1-my6)'. The values for the first 10 out of the 600 pixels considered in this assignment are shown below. The data is stored in a permanent dataset that is available from Campusnet in the folder 'Getting started with SAS'. To make it easy for yourself, you should save it in the folder 'stat2data' that you created when working with SAS for the first time in this course. When you do this, you will be able to access the data from SAS with the command 'data=stat2.sat'.

Pixel	mr1	mr2	mr3	mr4	mr5	mr6	my1	my2	my3	my4	my5	my6
1	133	67	100	77	166	115	160	84	130	98	205	139
2	135	72	108	83	173	123	160	85	133	102	202	139
3	141	76	116	88	184	130	164	90	141	108	211	148
4	142	79	122	93	189	134	166	93	145	110	214	149
5	141	78	121	94	186	133	165	93	145	110	212	149
6	145	78	120	94	186	135	165	92	146	111	212	149
7	145	77	120	93	186	134	165	93	147	111	213	149
8	146	78	122	93	188	132	166	93	147	110	215	149
9	140	71	108	84	178	123	164	92	143	108	214	150
10	131	68	101	78	167	116	162	89	138	106	211	149

**Problem 1.**

1. Find the principal components based on the correlation matrix.
2. How many percent of the total variation is described by the first three principal components?
3. Are the nine smallest eigenvalues of the dispersion matrix significantly different, or may we assume that they are the same?

**Problem 2.**

1. Find the principal factor solution with three factors.
2. Can you interpret the factors?
3. Find the Varimax rotated solution.
4. How much of the total variation is explained by the three un-rotated and by the three rotated factors?
5. Can you interpret the rotated factors?

**Problem 3.**

1. Find the canonical correlation coefficients.
2. How many of those are significantly different from 0?
3. Consider the correlations between the canonical variables and the original variables. Is it possible to interpret/explain why the different sets of canonical variables are so strongly correlated?