# 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 μm) | 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?~~

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