

### Homework 3

Date given out: 2/23/09. Please submit your solutions to the problems to me by 5.15pm March 4, 2009. This homework contributes 10% of the course grade.

1. Consider the mouse T2 vertebra in the Small, Large and Control groups (qset2.dat, qlset2.dat, qcet2.dat). Carry out partial Procrustes analysis (without scaling), and provide a plot of the three Procrustes means. What percentage of variability is explained by the first three PCs for the three groups of mouse T2 vertebra and provide an interpretation of the PCs.
2. Carry out full Procrustes shape analysis of the DNA data (dna.dat) and provide an interpretation of the PCs.
3. In the Computer Practical 3 we carried out a short simulation study to investigate the performance of various shape estimators.

Carry out another simulation study which investigates the bias and mean square error of the Bookstein mean, full Procrustes, partial Procrustes, full reflection Procrustes, and partial reflection Procrustes means. In particular, consider the cases when the mean shape has Bookstein co-ordinates  $(U^B, V^B)$  equal to:

- (a)  $(0.2, 0.5)$
- (b)  $(-0.4, 0)$

and the errors at landmarks are i.i.d. Gaussian with standard deviations

- (a)  $\sigma = 0.1$
- (b)  $\sigma = 0.2$
- (c)  $\sigma = 0.5$

and sample sizes

- (a)  $n = 10$
- (b)  $n = 30$
- (c)  $n = 100$ .

Try to summarize your findings succinctly.