**Multi-dimensional scaling**

**QUESTION** **4: 2009**

An honours student is studying the water quality of streams near a housing development. He collected ten samples of water from a stream close to the development, then 10 samples at each of two sites distant to the development. From each sample, 12 different water quality parameters were measured (temperature, pH, N concentration, P concentration, pesticide content, etc..). The following is the output from a multidimensional scaling (MDS) ordination of the data from the 30 samples:

Stress: 0.15

Site

1 (distant)

2 (development)

3 (distant)

1. How would you describe what the ordination represents to the managers of the development site? (5 marks)

The following is the output from an analysis of similarities (ANOSIM) used to contrast the three sites:

ANOSIM:

Sample statistic (Global R): 0.795

Significance level of sample statistic: 0.1%

Number of permutations: 999 (Random sample from a large number)

Number of permuted statistics greater than or equal to Global R: 0

1. Do the ordination and the results of the ANOSIM indicate that the development site is highly polluted? (10 marks)
2. What are the advantages of calculating probabilities by permutation tests? (5 marks)

**QUESTION ??** 2003

An honours student is studying the properties of soil at a site that was once a copper mine. He collected ten samples of soil from the site, and ten samples from each of two sites that were directly adjacent to the old mining area. The following soil properties were measured from each sample: concentration of copper, pH, moisture content, concentration of nitrates, concentration of phosphates, proportion of silt, proportion of clay, proportion of sand, and the depth of the organic horizon.

The following is the output from multidimensional scaling (MDS) of the 30 samples:

1 (old mine)

2

3

Stress: 0.15

Site

1. How would you describe what the ordination represents to the managers of the old mine site? (5 marks)
2. With reasons, state whether you would recommend a distance-based or correlation-based measure of similarity for analyses these data? (3 marks)
3. Does the ordination and the results of the ANOSIM indicate that the mine site has been successfully rehabilitated? (8 marks)
4. What is the minimum value of R that would have been significant? (4 marks)

**QUESTION** **6: 2006 supp**

A palaeontologist was trying to find characters to distinguish two similar species of dinosaur. Ten measurements were taken from each of five skulls. The following figure is a MDS ordination of the skulls based on the morphological measurements.

1

2

3

4

5

Stress = 0.01

a) A competing researcher believes skulls 3 and 5 belong to one species while skulls 1,2 and 4 belong to another. Does the ordination support this conclusion? (5 marks)

b) How might you test the competing researcher’s hypothesis? (5 marks)

c) What do the axes represent? (2 marks)

d) Using the numbers 1-10 as a similarity index (with 1 most similar), recreate the similarity matrix between samples. (5 marks)

e) What does the stress value of 0.01 tell you about this particular ordination? How would you interpret the figure if the stress values were 0.3? (3 marks)

**QUESTION** **5: 2007**

An honours student is studying a marine reserve on the NSW coast. She measured the abundance of fish from 10 replicate transects at each of three sites. One site was within the reserve, one site just outside the reserve boundary and one site was external to the reserve. Forty-five species of fish were recorded from all transects. The following is a multidimensional scaling (MDS) ordination that contrasts fish species composition of the 30 samples:

Stress: 0.15

Site

Boundary

External

Reserve

1. What are the variables and what are the samples? (4 marks)
2. Assuming the reserve does effectively protect fish, and that the external site is exploited, does the ordination support the idea that the benefits of marine reserves “spill over” to areas beyond their boundaries? Give reasons for your answer

(6 marks)

1. Describe the process of going from the raw data to the ordination plot. What decisions need to be made during that process (6 marks)
2. Why does the ANOSIM test use random permutations to determine the probability of R? (4 marks)

**QUESTION ?:2006**

A soil scientist was testing whether efforts at cleaning contaminated soil near a mine site were successful. He took 8 samples of soil from a site that was known to still have high levels of contamination, and 8 samples of soil from the site that had been cleaned. The concentration of seven heavy metals was measured from each of the soil samples. The following is a MDS plot of the resultant data:

contaminated

clean

1. What do the symbols on the plot represent? What does the distance between the symbols represent? (5 marks)
2. Describe the process of going from the raw data to the ordination plot. What decisions need to be made during that process? (5 marks)
3. “The plot clearly shows that the clean site has lower concentrations of heavy metals” With reasons, state whether this is true or false (5 marks)
4. Write a few sentences in plain language that would explain the above plot to the mine manager (5 marks)