A3 Index to mathematical notation and symbols

Matrices and vectors

A = matrix containing elements $a_{ij} = -\frac{1}{2} d_{ij}^2$
B = matrix of variables (*N* × *s*) that are linear combinations of normalised **X** variables having maximum correlation with CAP axes
C = matrix of CAP axes (*N* × *s*), standardised by the square root of their respective eigenvalues
D = matrix containing elements d_{ij} corresponding to distances or dissimilarities
G = Gower's centred matrix, consisting of elements $g_{ij} = a_{ij} - \bar{a}_{i.} - \bar{a}_{j.} + \bar{a}_{..}$
H = 'hat' matrix = $\mathbf{X}[\mathbf{X}'\mathbf{X}]^{-1}\mathbf{X}'$, used as a projection matrix for regression models
I = identity matrix, with 1's along the diagonal and 0's elsewhere
Q = matrix of PCO axes, standardised by the square root of their respective eigenvalues
$\mathbf{Q}^0$ = matrix of PCO axes, orthonormalised to SSCP = **I** ('sphericised')
U = matrix whose columns contain the left singular vectors from a singular value decomposition (SVD) of a matrix (e.g., **X** = **UWV**′); if **X** is (*N* × *q*) and *q* < *N*, then **U** is (*N* × *q*)
V = matrix whose columns contain the right singular vectors from a singular value decomposition (SVD) of a matrix (e.g., **X** = **UWV**′); if **X** is (*N* × *q*) and *q* < *N*, then **V** is (*q* × *N*)
W = diagonal matrix of eigenvalues from a singular value decomposition (SVD) of a matrix (e.g., **X** = **UWV**′); if **X** is (*N* × *q*) and *q* < *N*, then **W** is (*q* × *q*)
X = matrix of predictor variables (*N* × *q*) (often a set of environmental variables)
$\mathbf{X}^0$ = matrix of **X** variables, orthonormalised to SSCP = **I** ('sphericised')
Y = matrix of response variables (*N* × *p*) (often a set of species variables)
$\mathbf{Y}^0$ = matrix of **Y** variables, orthonormalised to SSCP = **I** ('sphericised')
$\hat{\mathbf{Y}}$ = **HY** = matrix of fitted values (*N* × *p*)
$\mathbf{y}_{ij}$ = vector of *p* response variables for the *j*th observation in the *i*th group
$\bar{\mathbf{y}}$ = the centroid vector of *p* response variables for group *i*
Z = matrix of dbRDA canonical axes (*N* × *s*)

Letters

a, *b*, *c*, etc… = number of levels of factor A, B, C, etc… in an ANOVA experimental design
AIC = multivariate analogue to Akaike's 'An information criterion'
AIC_c = multivariate analogue to the small-sample-size corrected version of *AIC*
B_l = the lth variable in the space of normalised **X** variables that has maximum correlation with the lth coordinate axis (C_l) from a CAP analysis

BIC = multivariate analogue to Schwarz's 'Bayesian information criterion'
C_l = the lth coordinate axis scores from a CAP analysis
d_{ij} = distance or dissimilarity between sample *i* and sample *j*
df = degrees of freedom
F = pseudo-*F* statistic for testing hypotheses in PERMANOVA or DISTLM
i = index used for samples (i.e., *i* = 1, …, *N*) or index used for groups (*i* = 1, …, *a*)
j = second index used for samples (i.e., *j* = 1, …, *N*) **or** index used for replicates within a group (*j* = 1,…, *n*)
k = index used for variables (i.e., *k* = 1, …, *p* or else *k* = 1, …, *q*)
l = index used for canonical axes or eigenvalues for either dbRDA **or** CAP (i.e., l = 1, …, *s*) **or** either the abbreviation for 'log-likelihood' or the 'length' of a vector (depending on context).
m = number of PCO axes chosen as a subset for analysis by CAP
MC = Monte Carlo
MS = mean square
N = total number of samples
n = number of samples (replicates) within a group or cell in an experimental design
P = *P*-value associated with the test of a null hypothesis
p = number of multivariate response variables in matrix **Y**
q = total number of predictor variables in matrix **X**
r = Pearson correlation coefficient
R = the ANOSIM *R* statistic (see Clarke (1993))
R^2 = proportion of explained variation from a model
s = number of canonical eigenvalues and associated canonical axes obtained from either a dbRDA **or** a CAP analysis *SS* = sum of squares
SSCP = sum of squares and cross products
SVD = singular value decomposition
t = pseudo-*t* statistic = $\sqrt{\text{pseudo-}F}$
tr = 'trace' of a matrix = the sum of the diagonal elements
X_k = the *k*th predictor variable
Y_k = the *k*th response variable
z_{ij} = distance to group centroid for the *j*th replicate within the *i*th group.

Greek symbols and matrices

α = significance level chosen for a test (usually α = 0.05).
δ_l^2 = the lth eigenvalue from a CAP analysis, a squared canonical correlation
Δ = diagonal matrix containing the square roots of the eigenvalues from a CAP analysis (a capital delta)
γ_l^2 = the lth eigenvalue from a dbRDA analysis, a portion of the explained (regression) sum of squares from a dbRDA model.
Γ = diagonal matrix containing the square roots of the eigenvalues from a dbRDA analysis (a capital gamma)
λ_i = the *i*th eigenvalue from a PCO analysis
Λ = diagonal matrix of eigenvalues from a PCO analysis (a capital lambda)
ν = number of parameters in a particular model during model selection

ρ = Spearman rank correlation (rho)
$\sum$ = sum over the relevant index

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