Weighted singular value decomposition and application to the study of QTL by environment interactions

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Abstract

A different response of genotypes across environments (location by year combinations) is frequent in multi-environment trials and is known as genotype by environment interaction (GEI). When the analysis is made in the whole genome, the interactions of interest are between QTL (*quantitative trait loci*) and environment (QEI). The study and understanding of these interactions is a major challenge in plant breeding and genetics.

The additive main effects and multiplicative interactions (AMMI) model is performed by applying the singular value decomposition (SVD) to the residuals from the analysis of variance of the two-way original data matrix, and has been widely used to structure and understand GEI. In this paper we present a generalization of this approach in which the SVD is replaced by an weighted low-rank SVD where the weights correspond to the inverse of error variances per environment.

This approach is used to generalize the AQ analysis (AMMI analysis followed by QTL scans) in [2] to better detect and understand QEI. A comparison is made with the mixed models methodology [1] by using two data sets. One on simulated yield in pepper using a simple genotype to phenotype model, and other concerning yield from a doubled haploid barley population.

Keywords

Weighted low-rank approximations, Singular value decomposition, Genotype by environment interaction, AMMI model, Statistical genetics.

References

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