DSS Statistics Seminar

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https://uniroma1.zoom.us/j/86881977368?pwd=SWRFcVFjMDZTa0lXZk05TE1zNm5adz09

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The Ultrametricy in Dimensionality Reduction

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The ultrametricity has several applications in mathematics, biology, physics and statistics. In mathematics, it defines a metric space, i.e., an ultrametric space, in which the triangle inequality for each triplet of points in the space is strengthened to require that an isosceles acute or equilateral triangle is identified. The *p*-adic numbers form, for example, a complete ultrametric space. In physics spin glasses, which are magnetic states characterized by randomness, satisfy ultrametricity both in the high-temperature (paramagnetic) phase and in the low-temperature (spin glass) phase. In Hierarchical clustering, ultrametricity regards the bijection between the indexed hierarchies and the ultrametrics both defined on the same set of multivariate units.

In this presentation, we wish to consider the ultrametricity, i.e., a hierarchy, to reconstruct the relationships among variables in the covariance matrix, via a set of nested latent factors, which represent concepts that are hierarchically linked, from the most specific to the most general. We wish to define a dimensionality reduction in the form of a hierarchy in a parsimonious number of dimensions.

Two approaches can be considered. The first identifies a limited set of nested components with maximal total variance. The second approach considers the ultrametricity of the covariance matrix. However, ultrametricity is a condition that requires non-negativity. Here, this condition is relaxed in order to define an extended Ultrametric Covariance Matrix able to reconstruct the hierarchical relationships in a parsimonious way.

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