Graph-Aware Sparse Regression for Block-Missing Multimodal Neuroimaging Data

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Multimodal neuroimaging studies, such as the Alzheimer's Disease Neuroimaging Initiative (ADNI), frequently exhibit blockwise missing data, where subjects contribute only a subset of imaging and biomarker modalities. This structured missingness limits conventional graph-aware regression methods, which assume complete observations and a well-defined covariance matrix. Existing moment-based estimators, such as DISCOM, exploit all available paired observations without imputation but often yield covariance matrices that are not positive definite because covariance entries are estimated from heterogeneous sample sizes, preventing stable inverse-based graph regularization. We propose **Graph-Aware Sparse Regression for Block-Missing Multimodal Neuroimaging Data (GASR-BM)**, a unified framework that operates entirely at the covariance level. The method constructs a covariance estimator from all available paired observations, applies a positive definite correction to ensure stability and invertibility, and integrates graph-guided regularization to exploit anatomical and functional relationships among brain regions. By encouraging smooth coefficient estimation across connected features, GASR-BM identifies biologically meaningful subnetworks while accommodating incomplete multimodal observations. The proposed framework unifies covariance estimation, positive definite regularization, and graph-aware sparse regression into a scalable methodology for high-dimensional neuroimaging analysis

Decoding Antartic Microbial Biodiversity through Hybrid Machine Learning and Constrained Ordination

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In microbial ecology, the study of community diversity often involves ordering samples from biological communities in a space of latent variables that integrate information from observed environmental variables. In this context, Redundancy Analysis (RDA) is one of the most widely used multivariate technique (Legendre and Legendre, 2012). RDA extends Principal Component Analysis into a constrained ordination framework based on multivariate linear regression. However, it should not be applied to species abundance matrices, particularly when many zeros are present, since the assumptions of linear regression are violated, and it imposes the restrictive condition that the relationship between communities and environmental conditions be linear. We propose a novel hybrid framework, termed hyb-RDA, that integrates constrained ordination and machine learning to address some of the limitations of traditional RDA when analysisng complex ecological datasets. Using hyb-RDA, we identify patterns in the composition of airborne microbial communities in Antarctica arising from local meteorological factors and the back trajectories of air masses. By capturing nonlinear relationships while preserving interpretability, hyb-RDA highlights the potential of hybrid ML-ordination approaches for analysing microbial biodiversity under complex environmental conditions.

Assessment of Methodological Quality in Non-Commercial Clinical Studies: The Impact of International Reporting Guidelines on Studies Approved

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Non-commercial clinical trials are pivotal for advancing evidence-based medicine, yet their impact heavily relies on methodological robustness, transparency, and reproducibility. While Institutional Review Boards and Ethics Committees (IRBs/ECs) serve as primary gatekeepers of study quality, systematic assessments of protocol efficiency and reporting fidelity remain scarce.
This study evaluates the efficiency and quality of non-commercial clinical protocols, assessing their administrative trajectory, adherence to protocol-specified publication timelines, and eventual reporting fidelity against international standard guidelines. I analyzed a comprehensive sample of nearly 200 clinical protocols spanning both interventional and observational studies. To enhance generalizability, the sample was drawn from two distinct international regulatory frameworks and institutional settings: IRCCS Azienda Ospedaliero Universitaria di Bologna in Italy and the McMaster University Research Ethics Board (HIREB) in Canada. I assessed the adherence between the statements in the original protocol and the final published article, specifically focusing on discrepancies in primary objectives, pre-specified endpoints, and sample size calculations. Moreover I evaluated the completeness of the final publications using international reporting frameworks tailored to the study designs, specifically CONSORT for RCT, TREND for non-randomized evaluations, and STROBE for observational studies.