

MAFEN MASTER

Academic Year 2025 - 2026

Proposal of M1 tutored project

PROJECT TITLE AND SUMMARY:

Hybrid Statistical and AI models in Agriculture

Modeling plays a central role in agriculture, as it enables the analysis of complex data, yield prediction, resource management, and decision support for farmers. Traditionally, statistical methods have been widely used to model relationships between agroecological variables. They provide robustness and interpretability but face limitations when dealing with highly nonlinear or multidimensional phenomena. On the other hand, artificial intelligence (AI) approaches—such as neural networks, random forests, or deep learning—offer strong predictive capabilities and can handle massive, heterogeneous datasets from sensors, satellite imagery, or climate series. However, these methods are often perceived as “black boxes,” with limited interpretability and sensitivity to overfitting. In this context, hybrid modeling, which combines statistical approaches and AI, emerges as a promising direction. The idea is to leverage the rigor of statistical models to describe processes while using AI algorithms to capture complex interactions. For instance, statistical models may provide solid explanatory foundations, later enhanced by machine learning methods to improve predictive accuracy. Applications of hybrid models are numerous: crop yield forecasting, disease detection through imaging, irrigation management, and adaptation to climate change. Recent studies show that hybrid approaches often outperform traditional standalone methods, as they balance accuracy with interpretability. This bibliographic research project aims to provide a critical synthesis of hybrid modeling in agriculture. It will identify the different types of hybridization (sequential, parallel, nested, mechanistic and data-driven), review studies combining both approaches, and compare their performance. Special attention will be paid to the case of spatial crop yield forecasting and future perspectives in precision agriculture.

In conclusion, hybrid modeling represents a major methodological advancement to meet contemporary agricultural challenges, combining the scientific rigor of statistics with the flexibility of artificial intelligence.

HOST UNIT:

Mathematics Laboratory of Avignon (LMA)

MAIN ACTIVITIES:

Literature review.

CONTACT:

florent.bonneu@univ-avignon.fr