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INTRODUCTION

Dynamic crop models used by agronomists for crop management include many parameters. Often, only a subset of these parameters can be calibrated. The question is: How to select these parameters?

Objectives

- Develop a Sensitivity Index (SI) for dynamic models by decomposing the matrix of observations inertia.
- Use this SI for selecting the most influent parameters for a simple model WWDM (Winter Wheat Dry Matter Model).

METHODS

❖ Dynamic model

The mathematical form of a dynamics model is:
 $Y(t)=f(X, t)$, with $t= 1,2...T$, X is a vector of unknown parameters.

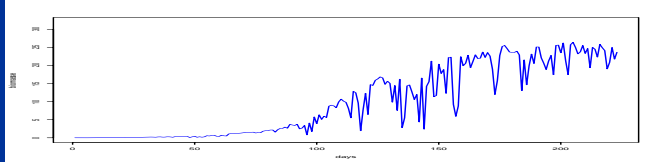
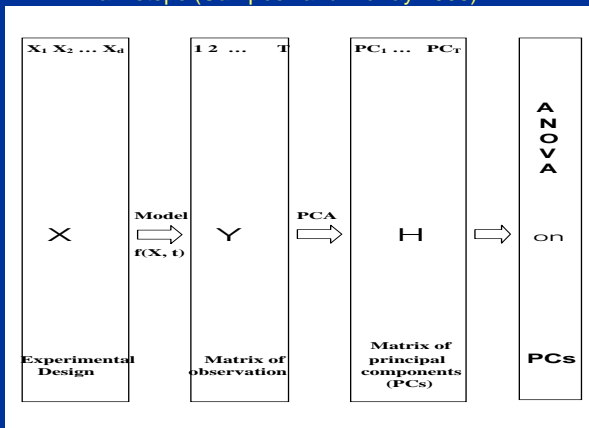


Fig 1: Simulation of dynamic Winter Wheat Dry Matter model

❖ Main steps (Campbell and McKay 2006)



❖ Inertia decomposition and Sensitivity Global Index (SGI) in Three steps:

1. Calculate Sum of Square '(SS)' over all components:

$$SS_{X_a} = \sum_{k=1}^T SS_{X_a \cdot k}$$

2. Remark that Matrix of observation Inertia can be decompose as:

$$I = \sum_{i=1}^d SS_{X_i} + \sum_{i < j} SS_{X_i X_j} + \dots$$

3. Compute Sensitivity Global Index as:

$$SGI_{X_a} = \frac{SS_{X_a}}{I}$$

❖ Approximated Sensitivity Global Index

In practice, we retain a few parameter interactions and the first P PC. We define approximated SGI as:

$$S \tilde{G} I_{X_a} = \frac{SS_{X_a}^P}{I^P}$$

To assess the quality of approximated SGI, we define a Global criterion,

$$GC = \frac{I^P}{I}$$

RESULTS

Application to the Winter Wheat Dry Matter (WWDM) model

$Y(t)=f(X, t)$, with $t= 1,2...223$, X is a vector of 7 parameters

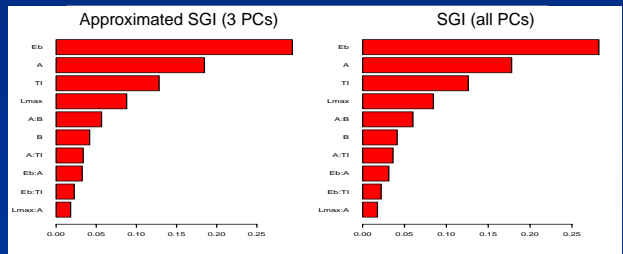


Fig2: Sensitivity indices for the top 10 factorial terms

The two most important parameters of WWDM are Eb and A. The Global criterion of 91% means that the approximated SGI was computed by using 91% of total inertia

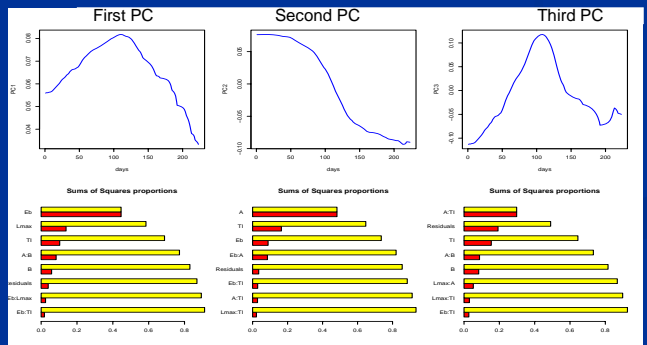


Fig3: Classical indices on the first three PCs (red)

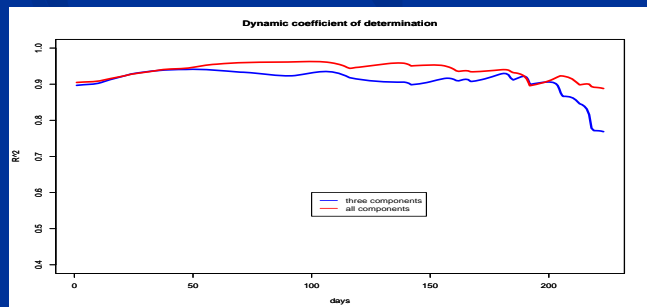


Fig 4: Coefficient of determination

CONCLUSION

- Multivariate sensitivity analysis for selecting the important parameters of dynamics models
- Method coherent with the classical multivariate analysis: Inertia decomposition
- Parameter Eb (radiation use efficiency parameter) seems to be the most important parameter of WWDM
- In what extent use the GC to select the best Experimental design?
- How to adapt this method to another basis (Legendre polynomials ...)