

# Quality Control in Field Trials

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Sommertagung AG Landwirtschaftliches Versuchswesen, Soest, June 28, 2024



# Field Trials

Why are they important for plant breeding?



**Figure:** Plant Breeding in cereals;  
University of Hohenheim; Florian  
Gerlach

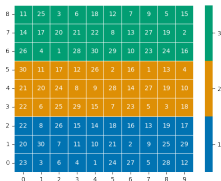
- **Field trials** are needed to obtain indicators of the cultivar performance (i.e., cultivar effect).
  - Based on these cultivar effect indicators, breeders **estimate the cultivar effect**
- ⇒ and take important **breeding decisions**.



# Field Trials

How do we conduct a field trial?

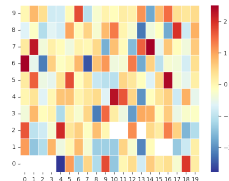
## 1) Experimental Design



## 2) Field Trial



## 3) Spatial Analysis



→ account for **a priori known** field effects

→ Grid-based **data Y**:  
Cultivar effect indication

→ Hypothesis of **stationarity**:  
 $Y \sim \mathcal{N}(X\beta, \Sigma)$   
Cultivar effect estimations



# Field Trials

What can go wrong?

- Not all field effects are known / accounted for **a priori** of the trial conduction.



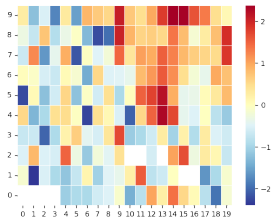
Figure: Drone picture of a field trial; AgReliant



# Field Trials

What can go wrong?

- **A posteriori** of the trial conduction: spatial patterns persist in the residuals (i.e., **residual blocks**)
- Hypothesis of **stationarity** is violated:  $\mathbf{Y} \not\sim \mathcal{N}(\mathbf{X}\boldsymbol{\beta}, \boldsymbol{\Sigma})$

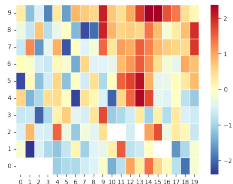


→ This leads to **imprecise cultivar effect estimates!**



# Field Trials

How can we check if something went wrong and **WHERE?**

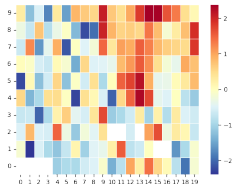


- In some cases, visual detection is possible.
- However, even if it is possible, breeders have to deal with many trials per season and manual quality control can be tedious.

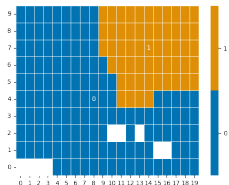


# Field Trials

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- However, even if it is possible, breeders have to deal with many trials per season and manual quality control can be tedious.



- ⇒ We propose a method to **explore the hypothesis of stationarity** for grid-based data (field trials)
- ⇒ and to **pinpoint those parts of the data (plots), where the hypothesis is violated (i.e., residual blocks)**.

# QUALITY CONTROL

## Detection of Residual Blocks

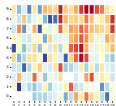




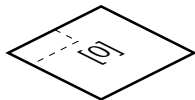
# Detection of Residual Blocks

I. How can we represent our data in a different way?

⇒ **Tree indexation:**



depth  
0

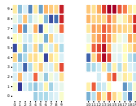
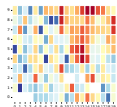




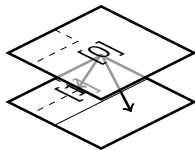
# Detection of Residual Blocks

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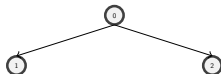
⇒ **Tree indexation:**



depth  
0



1

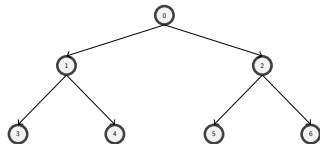
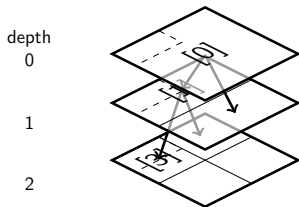
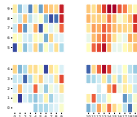
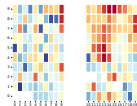
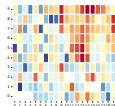




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⇒ **Tree indexation:**

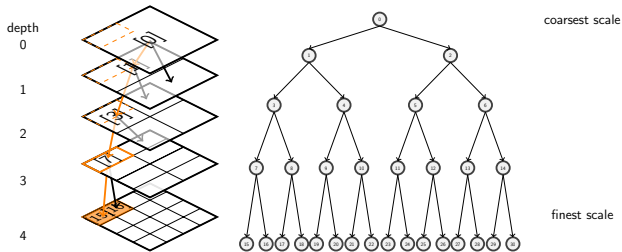




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⇒ **Tree indexation:**





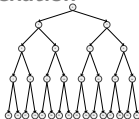
# Summary

## How to detect Residual Blocks?

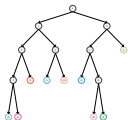
### Simulation



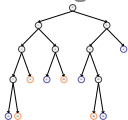
### I. Indexation



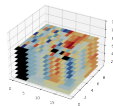
### II. Segmentation



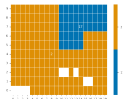
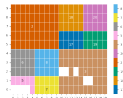
### III. Clustering



### Quad Tree



### Bottom-Up





# Outlook

## Application

- Analyse field trials accounting for residual blocks





# Outlook



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- Analyse multiple field trials in the same field





# Outlook



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- Analyse multiple field trials in the same field
- Suggestions for improved experimental designs for the next year







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- Analyse multiple field trials in the same field
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⇒ to improve the precision of cultivar effect estimation

# Discussion

My questions:

- Do you think this quality control is relevant in  
... **yield** field trials?  
... **disease scoring** field trials?

Your questions:

- ...