

Row column designs

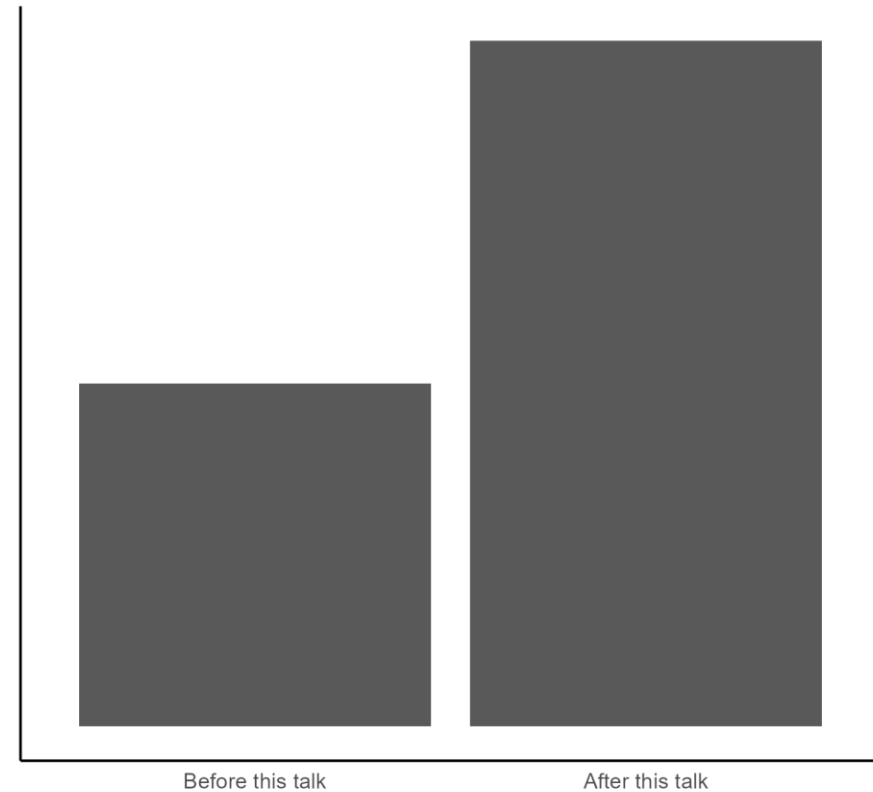
1	7	3	6
6	5	4	8
3	8	5	1
5	4	2	7
8	2	7	3
7	1	8	4
2	6	1	5
4	3	6	2

About me and this talk

- Statistician at Danish Technological Institute working with the design and analysis of field trials, climate scenarios, etc.
- Writing statistical R-package for the new Nordic Field Trial System (NFTS)
- This system includes row-column type designs: row column design and t-latinized alpha design.



How much you like row-column designs

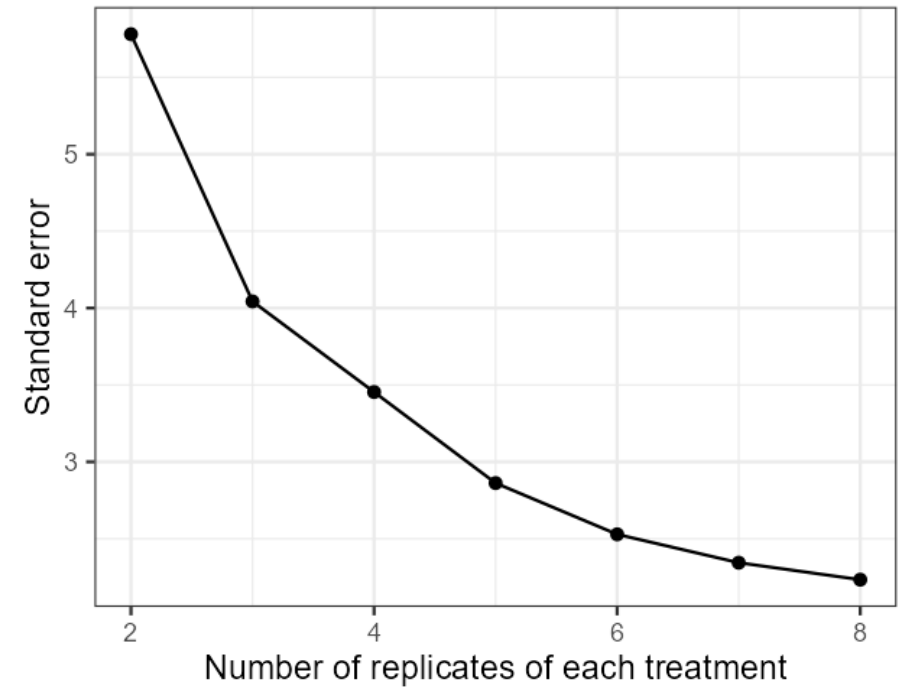
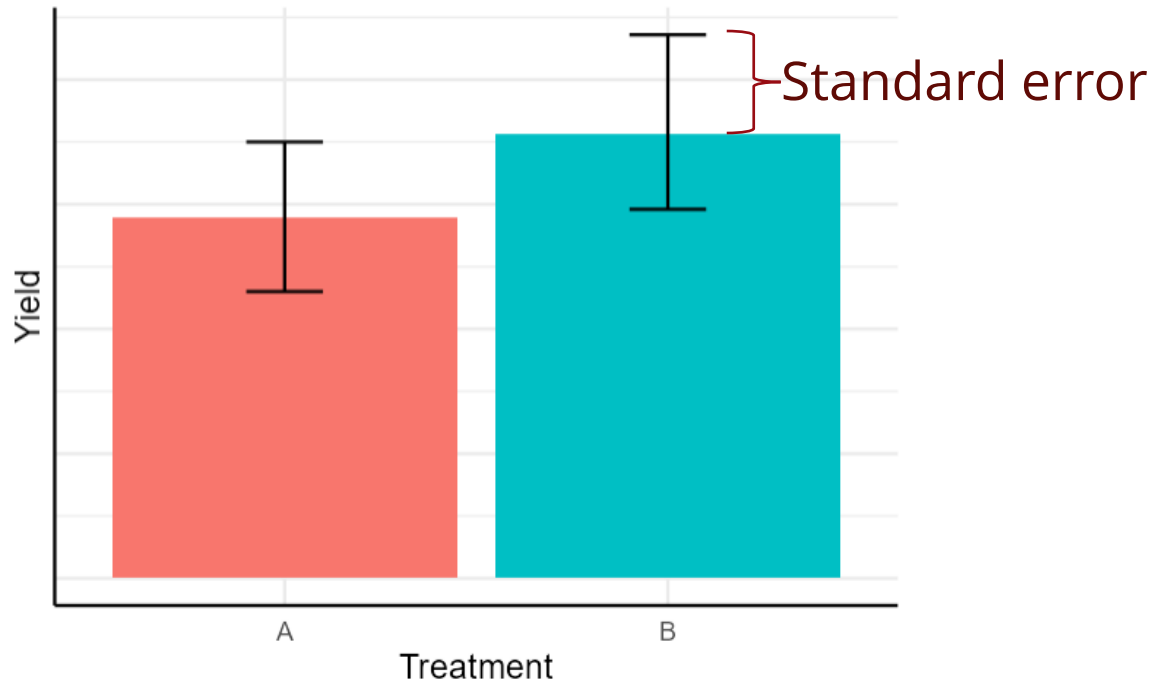


Agenda

- Motivation for row-column designs
- When to use the designs

What is a good design?

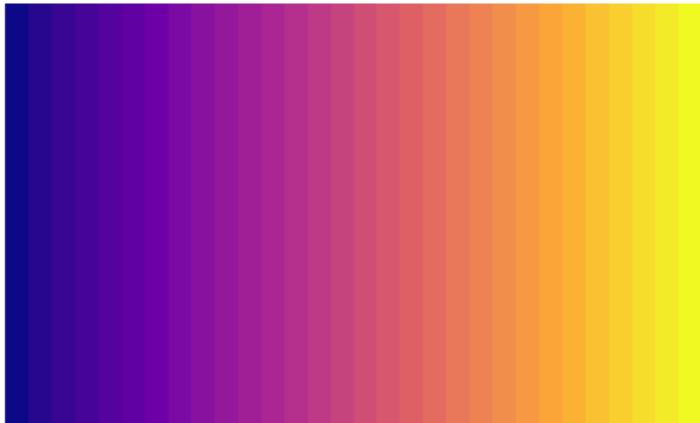
- Not too expensive to conduct in real life
- Induces small standard errors to detect treatment differences



Importance of design for standard error

- Consider the situation where there is a soil gradient, but our design is only randomized

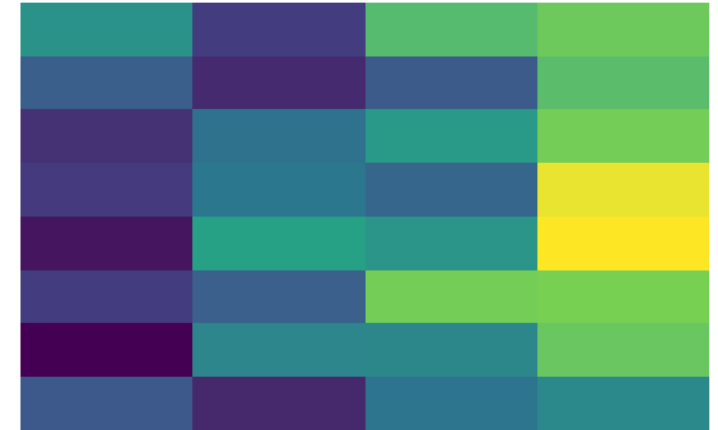
Soil gradient



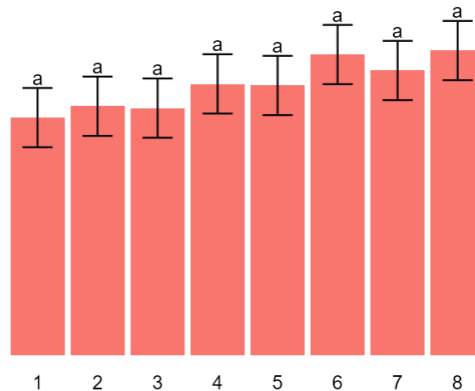
Randomized design

8	1	7	5
7	2	2	6
4	3	4	6
3	4	2	7
3	8	5	8
5	5	8	6
1	6	3	4
7	1	2	1

Observed yields



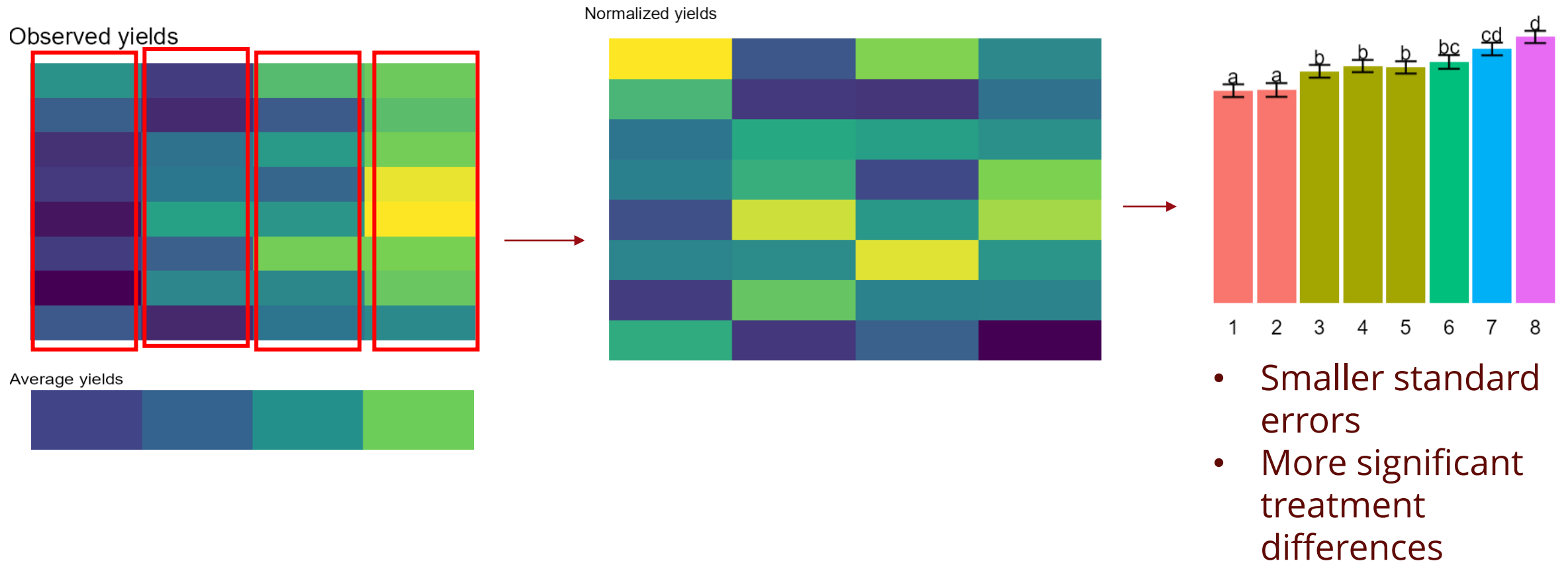
Estimation of effects



- High standard errors
- No significant differences between treatments

Blocking

- A good trick is to designate blocks and compute how much yield deviates from the block average.

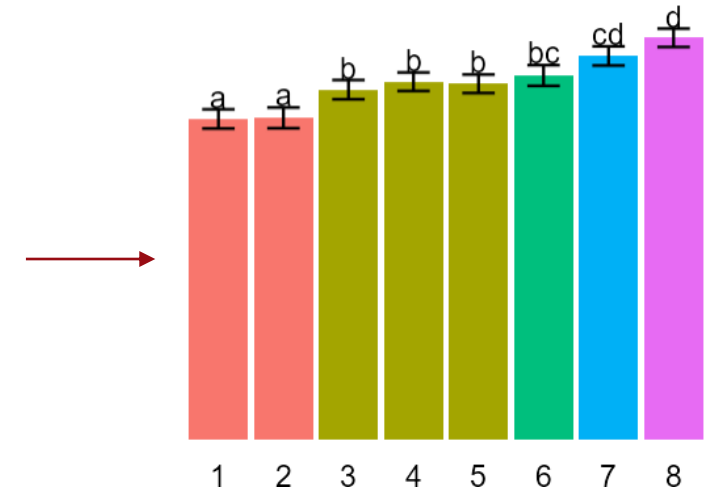


Blocking, trick 2

- Mathematically, it is not optimal to randomize every single treatment if we are going to use the blocks to analyze the data

Randomized design

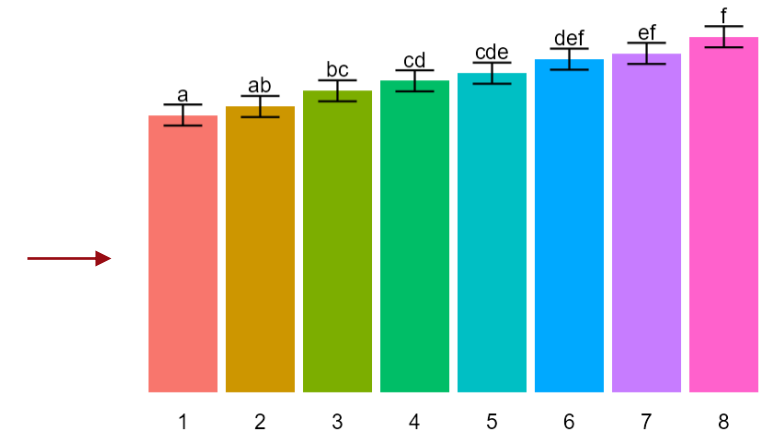
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4	3	4	6
3	4	2	7
3	8	5	8
5	5	8	6
1	6	3	4
7	1	2	1



- It is optimal to put an equal number of each treatment in each block

Block design

2	7	6	4
3	4	5	7
6	6	8	5
8	5	1	1
1	2	3	6
7	3	4	2
4	8	7	8
5	1	2	3



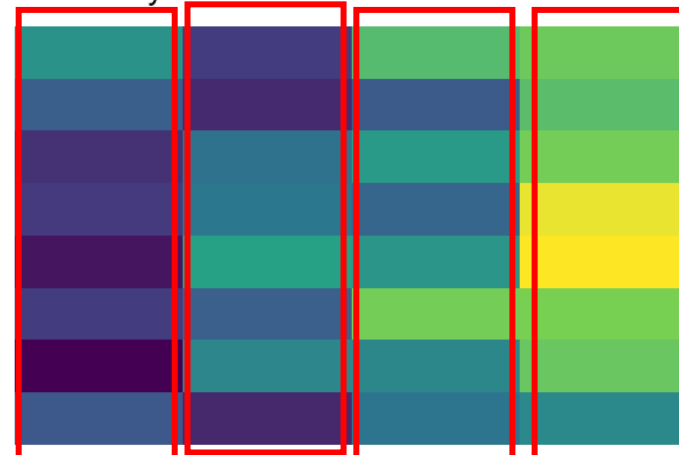
Block design

- To make a block design:
 - Treatments are distributed equally among the block
 - The yields are normalized within each block.
- It works best if the blocks reflect (all) the soil variation and it can be hard to know beforehand

Block design

2	7	6	4
3	4	5	7
6	6	8	5
8	5	1	1
1	2	3	6
7	3	4	2
4	8	7	8
5	1	2	3

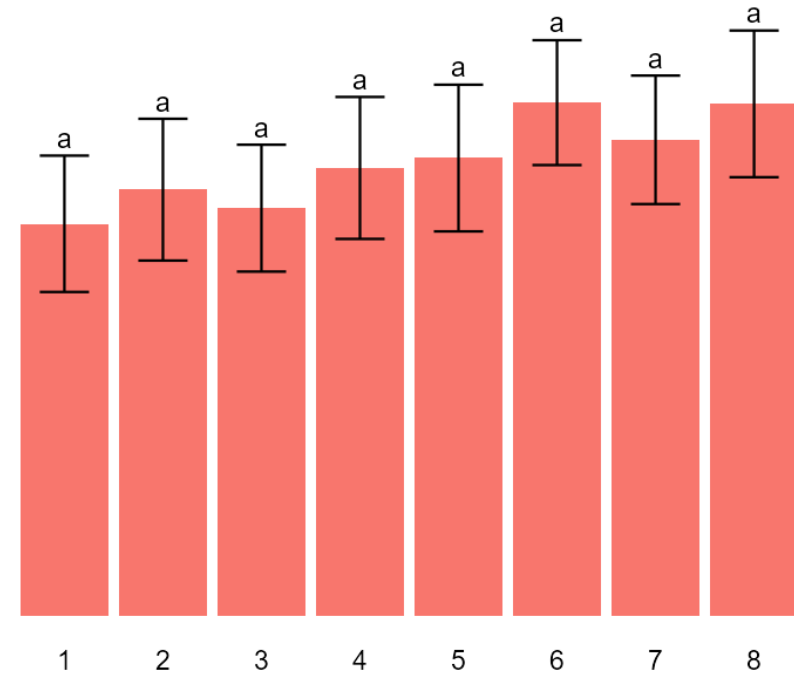
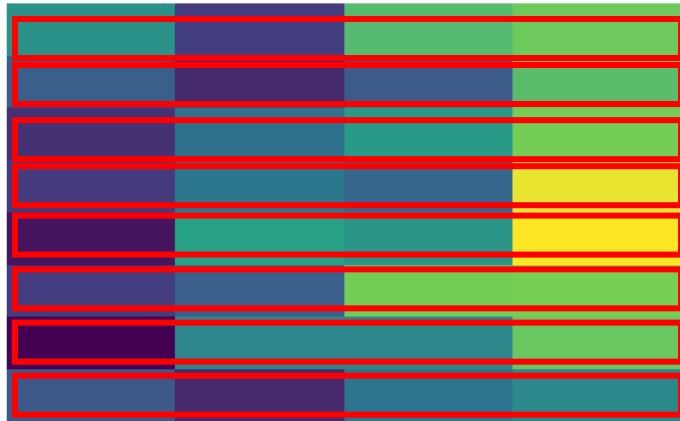
Observed yields



If the blocks don't follow the soil gradient

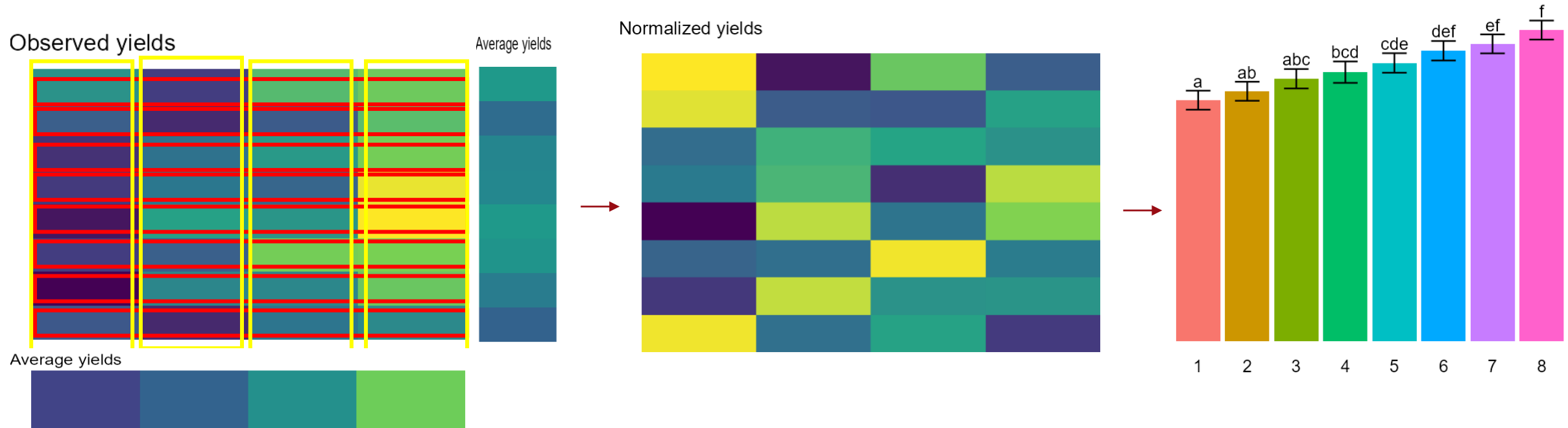
- If the blocking that we chose did not follow the soil gradient, we would have had much higher standard errors

Observed yields



Solution: row-column designs

- In a row-column design, we put the blocks in both directions making it unnecessary to know the gradient beforehand

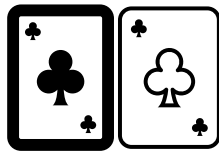


Generating an optimal row-column

- We generate optimal row-column design by distributing treatments equally between rows and columns (aiming for D-optimality).
- Needs a computer to be generated

Block design

2	7	6	4
3	4	5	7
6	6	8	5
8	5	1	1
1	2	3	6
7	3	4	2
4	8	7	8
5	1	2	3



Row column design

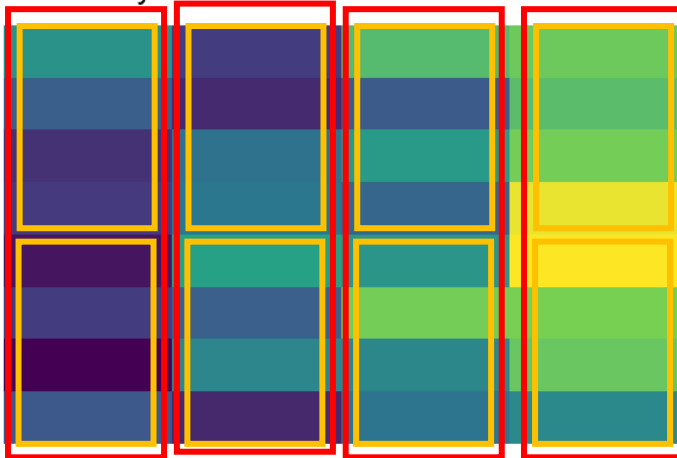
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Extensions

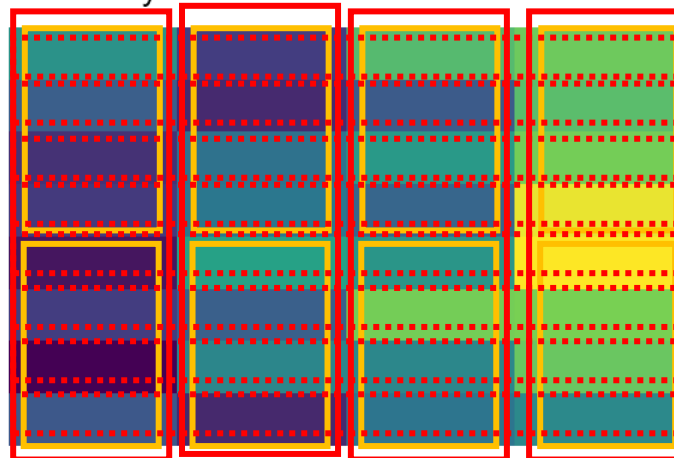
- There are many designs that can be made by defining a blocking structure and then letting a computer distribute treatments equally among them (aiming for D-optimality)

Observed yields



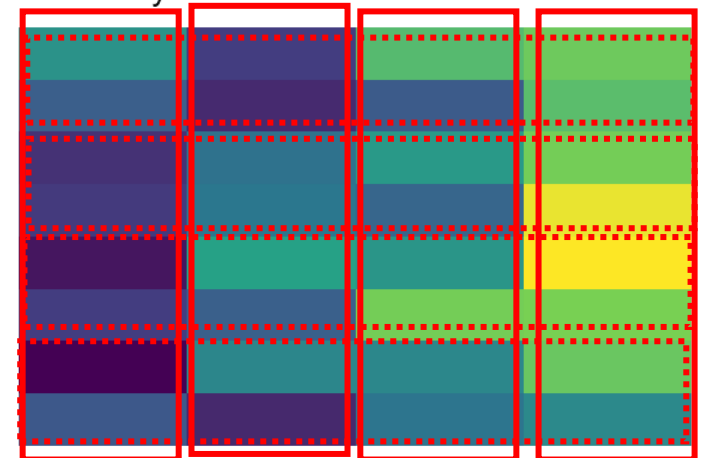
- Nested blocks makes incomplete block designs (alpha designs)

Observed yields



- Nested blocks and blocks in the other direction (t-latinized alpha designs)

Observed yields



- Blocks of bigger size (row-column group designs)

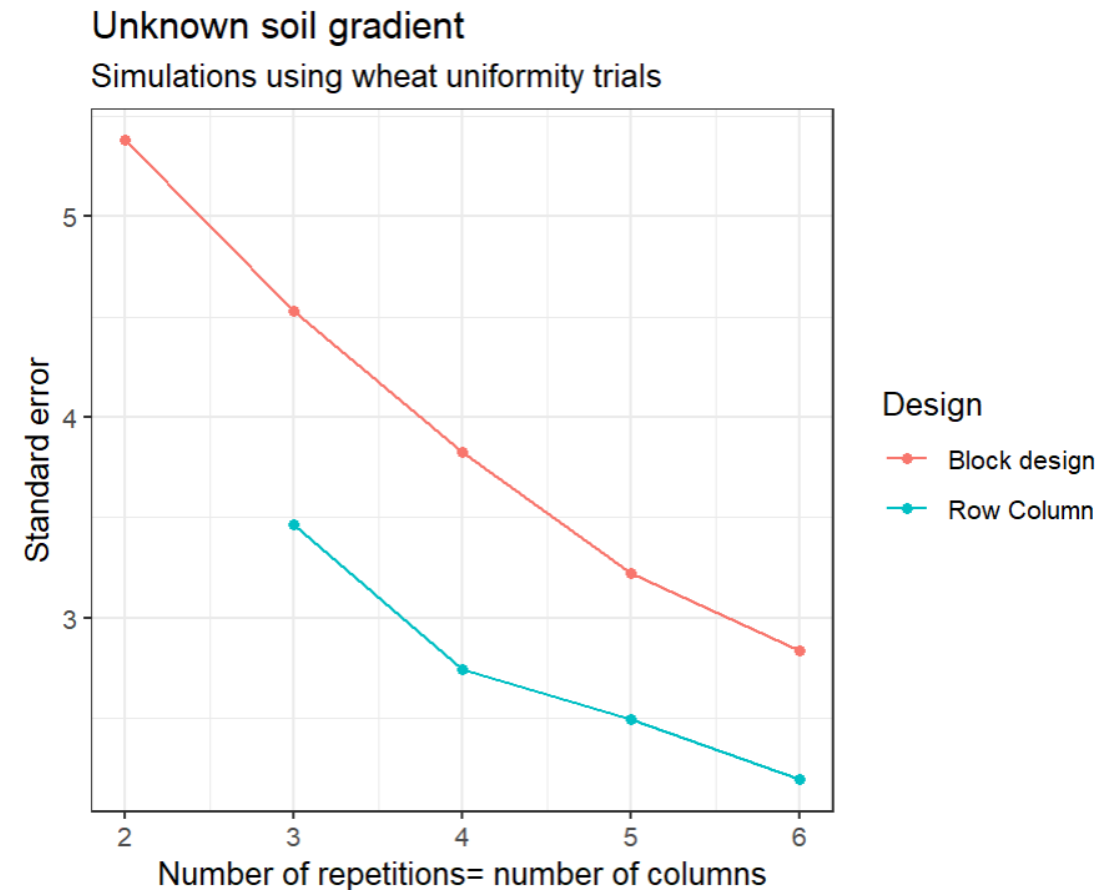
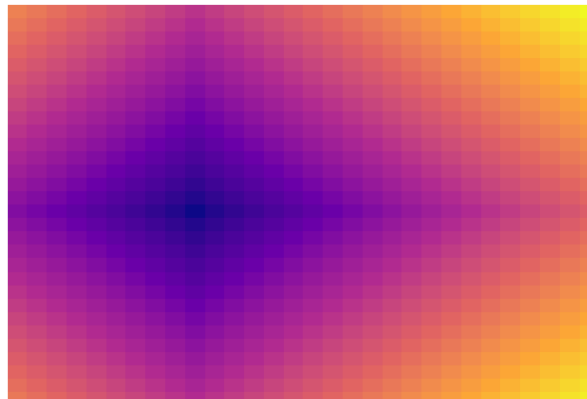
When to use row-column designs?

- Small to medium-sized designs which has
 - More than two columns
 - More than two rows
- Unsure about the direction of the soil gradient or if there are gradients in both row- and column directions

Soil gradient



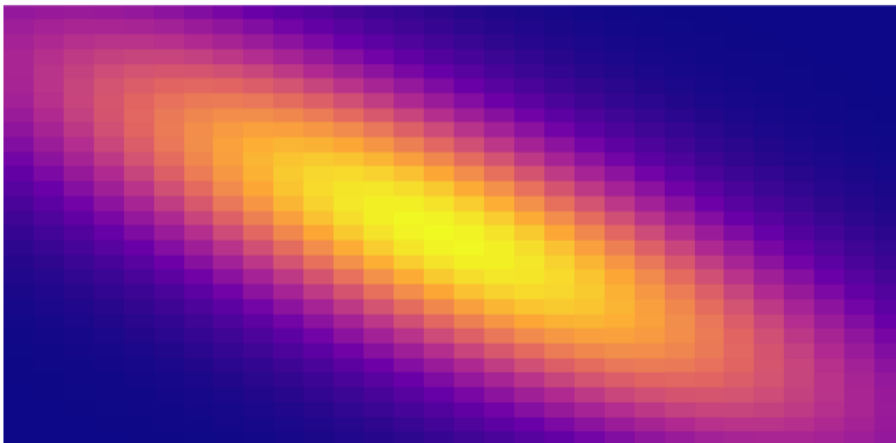
Soil gradient



When to consider more sophisticated models?

- When the trials are very big it is easy to discover more sophisticated patterns such as islands or ridges in the soil pattern
- Spatial designs field trial designs can then be used

Soil gradient



Giant design



Thank you!