Past and Present Issues in the Design of Variety Trials

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Swedish University of Agricultural Sciences
Outline

1. Breeding Trials
2. Interference and Competition
3. Spatial Design
Breeding Trials

- Large number of entries
- Objective: Selection
- The entries could be modeled as random
- Correlated by pedigree
# Multiple Lattice Design

<table>
<thead>
<tr>
<th>Replicate I</th>
<th>Replicate II</th>
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<tbody>
<tr>
<td>5 14 17 4 13</td>
<td>6 C1 2 3 9</td>
</tr>
<tr>
<td>C4 8 9 20 18</td>
<td>C5 10 7 C3 19</td>
</tr>
<tr>
<td>16 2 C2 10 11</td>
<td>15 13 16 11 12</td>
</tr>
<tr>
<td>6 19 15 C3 C5</td>
<td>4 17 20 1 18</td>
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<tr>
<td>3 C1 1 12 7</td>
<td>14 5 C2 8 C4</td>
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Multiple Lattice Design

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<tr>
<td>C3 29 C2 26 21</td>
<td>24 C3 C1 32 C4</td>
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<tr>
<td>38 C1 23 32 C5</td>
<td>37 22 26 35 38</td>
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<td>27 37 30 24 34</td>
<td>C5 40 27 C2 31</td>
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<tr>
<td>28 25 31 40 33</td>
<td>39 30 23 21 33</td>
</tr>
<tr>
<td>35 36 39 C4 32</td>
<td>28 25 34 29 36</td>
</tr>
</tbody>
</table>
Alpha Design

- A family of resolvable incomplete block designs introduced by Patterson and Williams (1976)
- Requires less plots than multiple lattice designs
- More efficient than multiple lattice designs (Piepho, Büchse and Truberg, 2006)
Related entries

• Split-plot design with related entries on whole plots?
• Maximize the number of groups per whole plot?
• Alpha design?
Related entries

Alpha Design

More correct ranking of the entries
Interference and Competition
Interference Groups

1. Short varieties: A, B

2. Medium sized varieties: C, D, E, F, G

3. Tall varieties: H, I
<table>
<thead>
<tr>
<th>Initial design</th>
<th>A C D E H I F G B</th>
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<td>1 2 2 2 3 3 2 2 1</td>
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<table>
<thead>
<tr>
<th>Circular permutation</th>
<th>F G B A C D E H I</th>
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<td>2 2 1 1 2 2 2 3 3</td>
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<th>Reversion</th>
<th>I H E D C A B G F</th>
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<td>3 3 2 2 2 1 1 2 2</td>
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<table>
<thead>
<tr>
<th>Randomization within groups</th>
<th>H I F E G B A D C</th>
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<tbody>
<tr>
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<td>3 3 2 2 2 1 1 2 2</td>
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</table>
Interference Groups

- David and Kempton (1996)
- Similar varieties are kept together
- Weakly valid randomization
- Strong validity requires use of subblocks
Covariance Analysis
Covariance Analysis

• Use average difference in height as a covariate

• Guard plots at the ends of the blocks
Covariance Analysis

- 65 spring wheat trials: 4% per decimeter
- 5 triticale trials: 2% per decimeter
- 17 barley trials: 3.5% per decimeter
Neighbour-Balanced Design

I  A  B  C  D  E
II A  C  E  B  D
III A  D  B  E  C
IV A  E  D  C  B
Inter-Block Randomization

I       A  B  C  D  E

II      A  C  E  B  D

III     A  D  B  E  C

IV      A  E  D  C  B
Neighbour-Balanced Design

I  A  B  C  D  E
II A  E  D  C  B
III A  C  E  B  D
IV A  D  B  E  C
Circular Permutation

I

A

B

C

D

E

II

A

E

D

C

B

III

A

C

E

B

D

IV

A

D

B

E

C
Neighbour-Balanced Design

I  C  D  E  A  B
II D  C  B  A  E
III C  E  B  D  A
IV B  E  C  A  D
## Border Plots

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<thead>
<tr>
<th>I</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>A</th>
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<tbody>
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</table>
Neighbour-Balanced Design

• Strongly valid randomization
Partially Neighbour-Balanced Design

I  G J H I L D C E B F K A G J

II I K D J C A B L G F H E I K

III J I A H B K G C F D E L J I
Spatial Design

Classical analysis

Spatial analysis
Spatial Design

Blocks, rows and columns are not needed?
Spatial Design

• Blocks reduce the variance

• Restrictions should be taken into account in the analysis

• Restricted randomization within blocks
### 2-Latinized Row-Column Design

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<thead>
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<th>R</th>
<th>Q</th>
<th>b</th>
<th>Z</th>
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Spatial Design

Design ↔ Analysis
Thank you for your attention!
References


