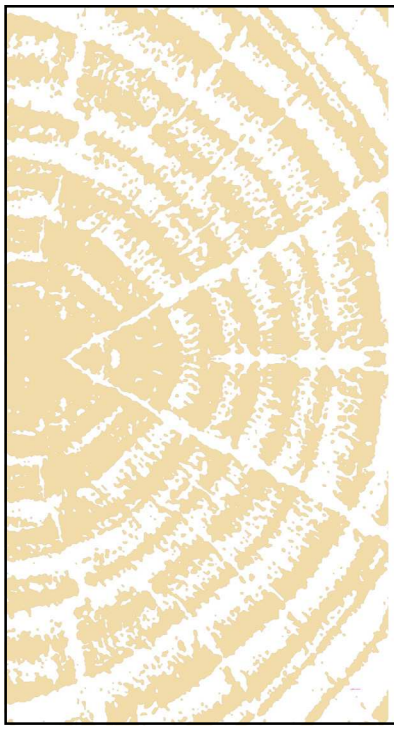

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Optimising machine strength grading with three indicating properties

Andreas Weidenhiller, Julia Denzler

Introduction

- EN 14081-2 / Initial type testing
- Strength class requirements: Strength, MOE, density
- Grading machine: One or more indicating properties (IPs)
- Settings: Lower limits for IPs satisfying the strength class requirements
- How can we find “good” settings?

Material

- 1162 boards of European spruce
  graded with GoldenEye 706
  data provided by MiCROTEC
- Three IPs: IP_f , IP_E , IP_ρ
- Tested in tension (EN 384, EN 408)
  - Tension strength
  - Modulus of elasticity
  - Density

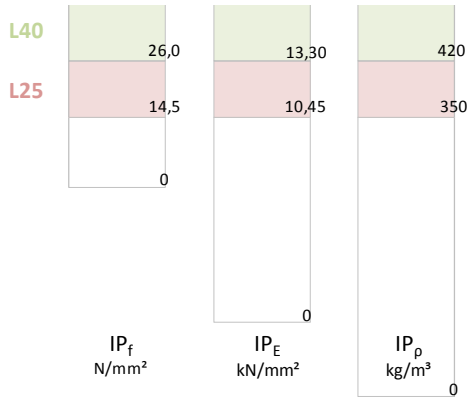
Methods

- Grade combination L40 / L25 / reject
- Settings determined by two methods
  - "advanced method"
  - "trial and error method"
- Comparison of these settings
  - Yield
  - Adaptation to the dataset

The "trial and error method"

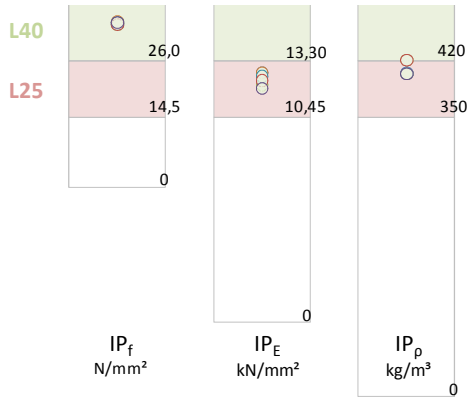
- Each setting is determined in such a way that the respective characteristic value is achieved
- Order of determination of settings becomes relevant:
  - $IP_f - IP_E - IP_\rho$ - $IP_f - IP_\rho - IP_E$
  - $IP_E - IP_f - IP_\rho$ - $IP_E - IP_\rho - IP_f$
  - $IP_\rho - IP_f - IP_E$ - $IP_\rho - IP_E - IP_f$
- Six setting combinations, six different yields

Results



Results

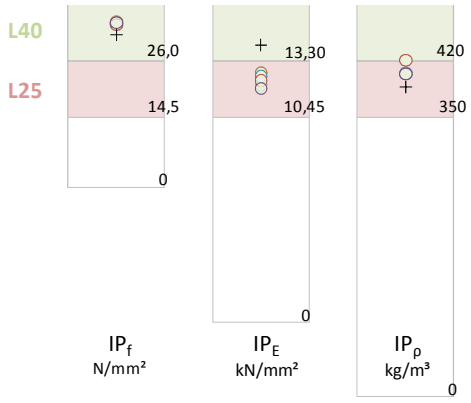
- Yield L40 “trial & error”: 20-21%



Results

○ Yield L40 “trial & error”: 20-21%

\+ Yield L40 “advanced”: 18%



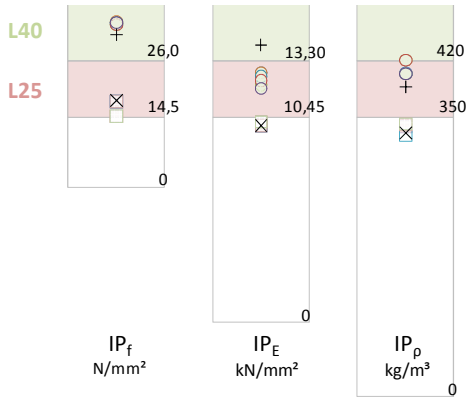
Results

○ Yield L40 “trial & error”: 20-21%

\+ Yield L40 “advanced”: 18%

☐ Yield L25 “trial & error”: 54-56%

X Yield L25 “advanced”: 56%



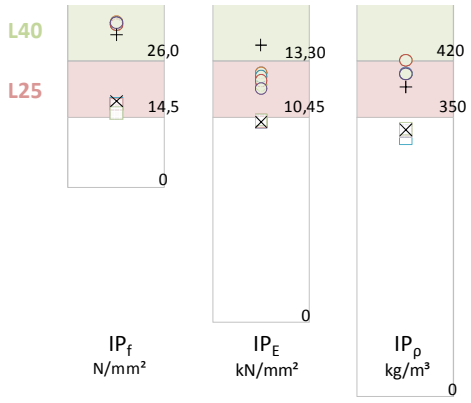
Results

○ Yield L40 “trial & error”: 20-21%

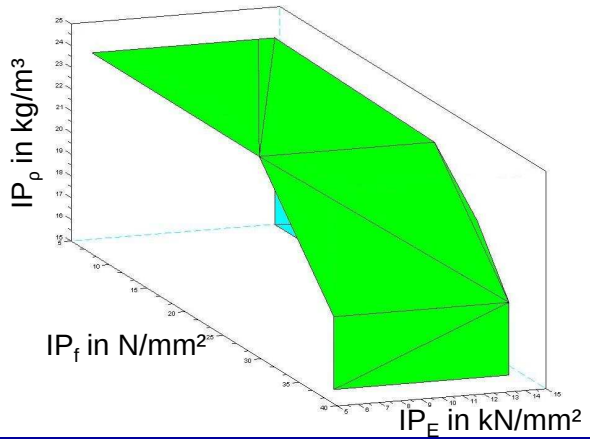
\+ Yield L40 “advanced”: 18%

☐ Yield L25 “trial & error”: 48-49%

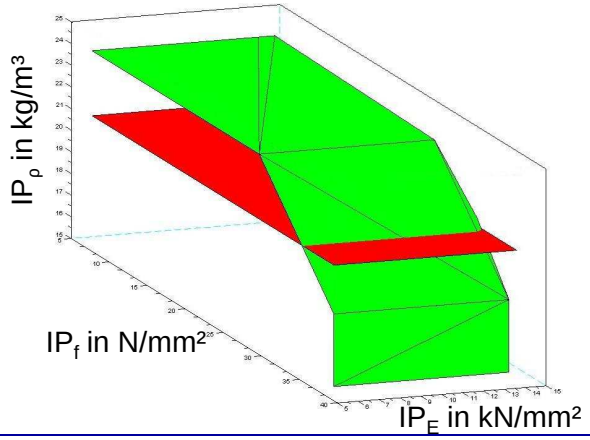
X Yield L25 “advanced”: 49%

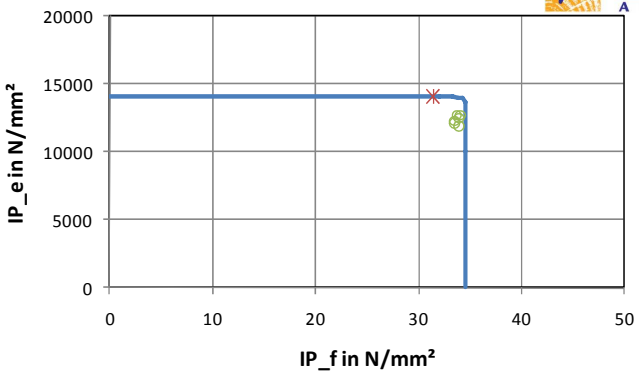


Results: convex hull



Results: convex hull





Results – adaptation to the dataset (L40)

Space of all possible setting combinations with IP_ρ set to 421 kg/m³

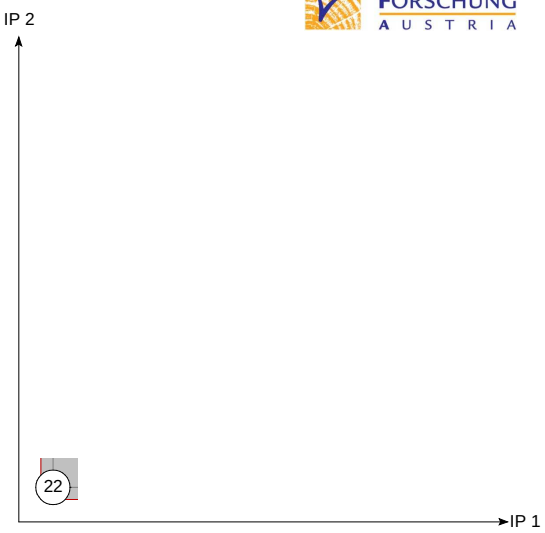
- ✶ Setting combination found by "advanced method"
- O Setting combinations found by "trial and error method"

Conclusion

- Many ways to determine settings
- What are “good” settings?
- The “advanced method”
  - helps to decide whether settings are “good”
  - tries to determine settings which are not adapted to the data

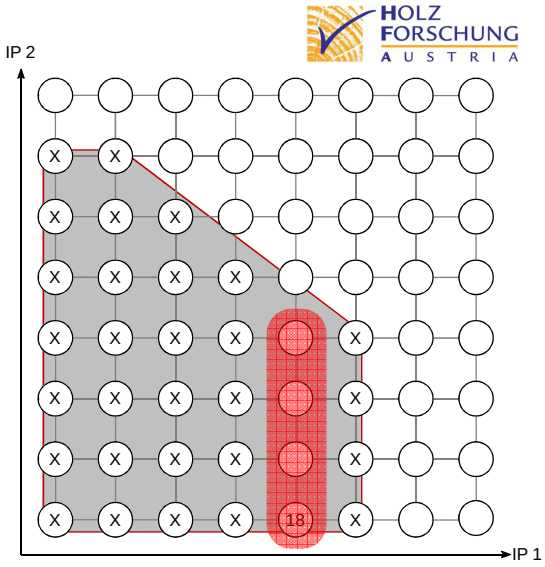
Example: “advanced method”

Best yield: 17
Setting combinations: 64



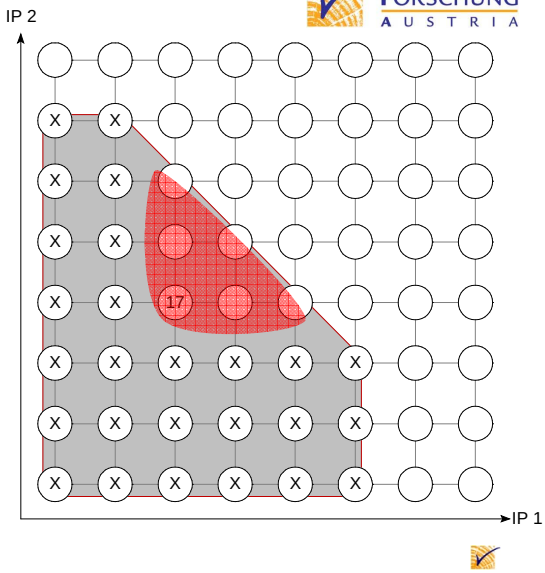
Example: “advanced method”

The **convex hull** excludes setting combinations which are adapted to the dataset.



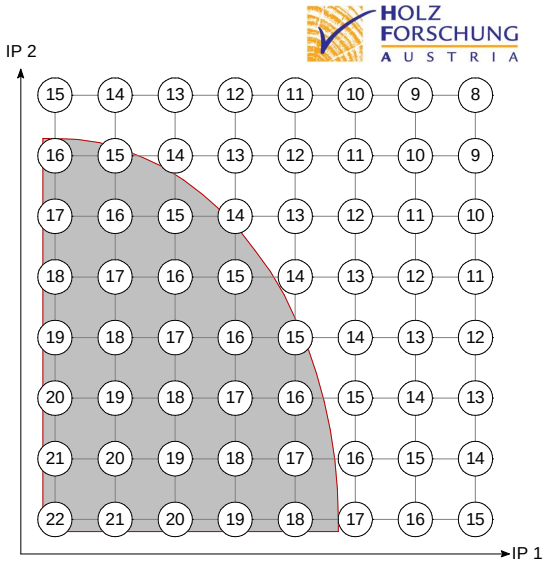
Example: “advanced method”

The **convex hull** excludes setting combinations which are adapted to the dataset.



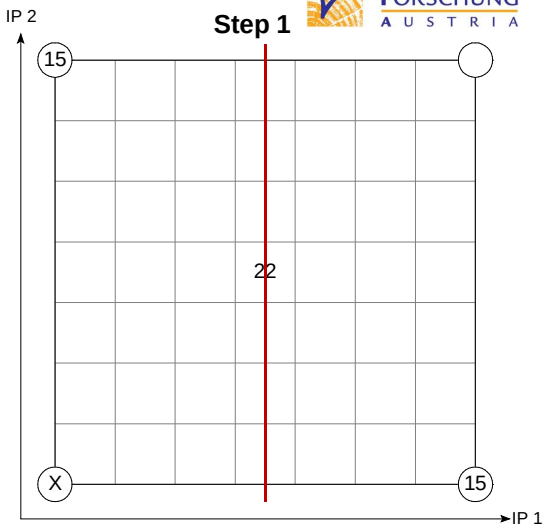
Example: “advanced method”

Best yield: 17
Setting combinations: 64



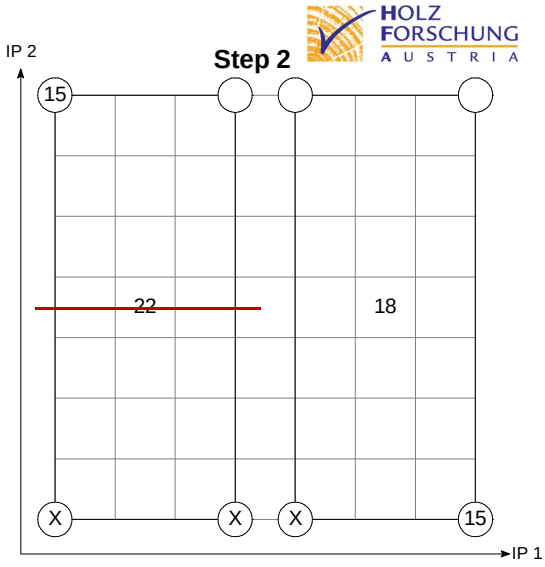
Example: “advanced method”

Best yield: 15
Eval. setting combinations: 4



Example: “advanced method”

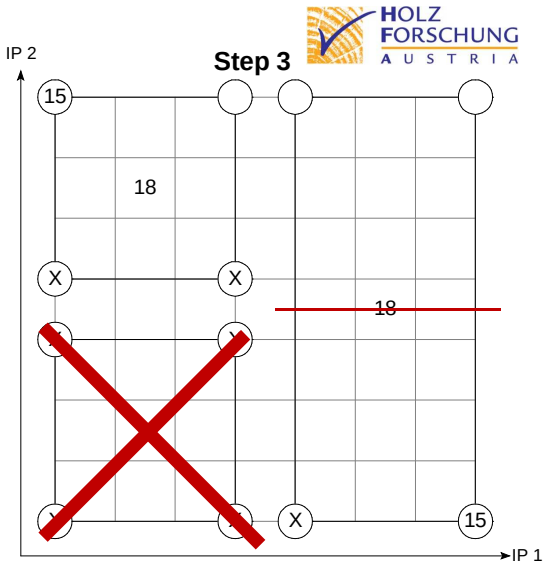
Best yield: 15
Eval. setting combinations: 8



Example: “advanced method”

Best yield: 15
Eval. setting combinations: 12

Remove rectangles: All setting combinations invalid



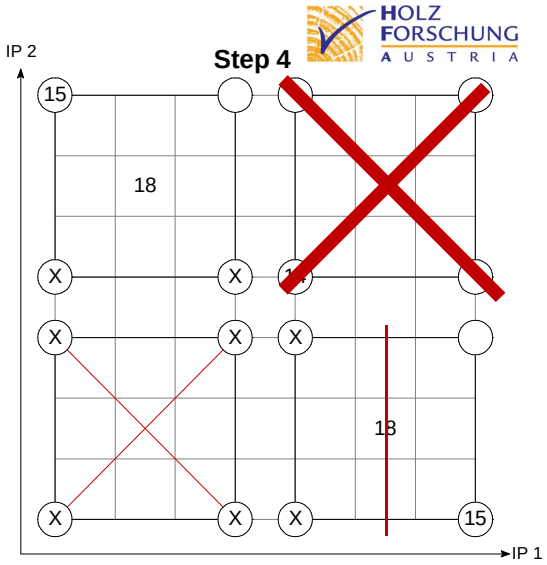
Example: “advanced method”

Best yield: 15

Eval. setting combinations: 16

Remove rectangles: All setting combinations invalid

Remove rectangles: Suboptimal yield



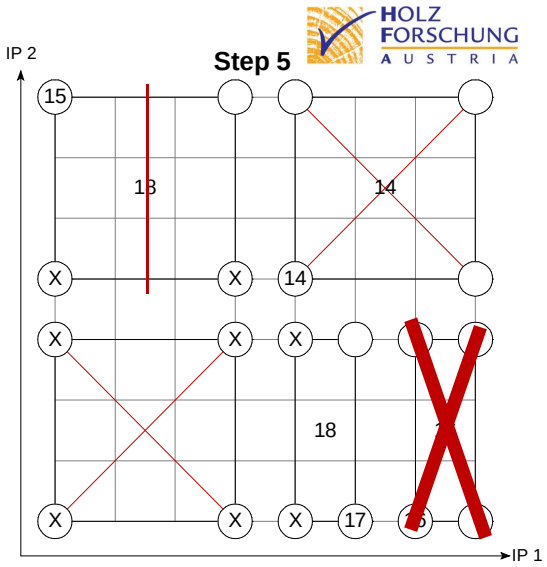
Example: “advanced method”

Best yield: 17

Eval. setting combinations: 20

Remove rectangles: All setting combinations invalid

Remove rectangles: Suboptimal yield



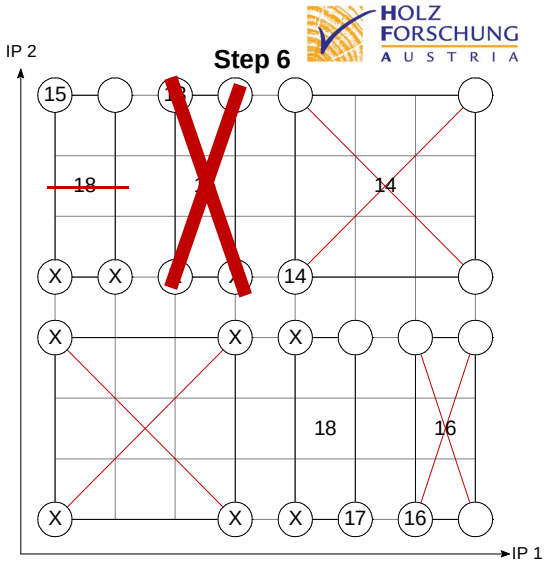
Example: “advanced method”

Best yield: 17

Eval. setting combinations: 24

Remove rectangles: All setting combinations invalid

Remove rectangles: Suboptimal yield



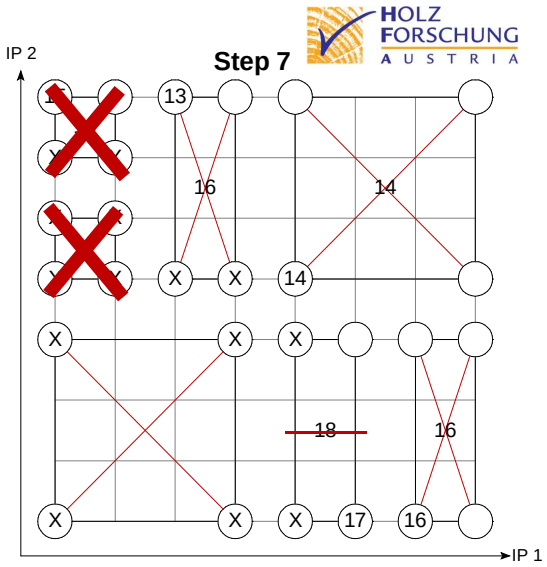
Example: “advanced method”

Best yield: 17

Eval. setting combinations: 28

Remove rectangles: All setting combinations invalid

Remove rectangles: Suboptimal yield



Example: “advanced method”

Best yield: 17

Eval. setting combinations: 32

Remove rectangles: All setting combinations invalid

Remove rectangles: Suboptimal yield