Experiment Even More Efficiently Using Definitive Screening Designs

Jeff Upton
JMP Tools in Biotech
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Why DOE?

• To get the most accurate and precise information from experimentation in the most efficient way possible

• To characterize process inputs and determine if/how they impact responses via a mathematical model
What are the Goals of DOE?

To find important inputs

To visualize your modeled response and find optimal input settings
What Type of Experiment Should I Run?

Project Timeline

Screening

Characterization

Optimization

Start

End

Model Parameters:
- Main Effects
- Main Effects + Interactions
- Main Effects + Interactions + Quadratic Effects
What is a Definitive Screening Design?

• Screening design that is useful when you expect higher order effects to be important within the design space

• Continuous factors examined at 3 levels, allowing estimation of quadratic effects

• Allows for two-level categorical factors and blocking

• Typically small designs (2m+1 runs minimum)
What is a Definitive Screening Design?

• Main effects are orthogonal to each other, two-factor interactions (2FI) and quadratic effects

• No 2FI is confounded with another 2FI or quadratic effect, although they may be correlated

• Potential to immediately fit a response-surface model if only a few factors are important
The Goldilocks Approach: A Review of Employing Design of Experiments in Prokaryotic Recombinant Protein Production

by Albert Uhoraningoga, Gamma K.

Using definitive screening design to effectively assess the combinatorial impacts of media supplements on monoclonal antibody production in mammalian cells

Aaron Chen
Cell Sciences, cwchen@seagen.com

By S. Suryanarayana
Case Study: Fermentation Process Flow Diagram
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Case Study: Fermentation Process Flow Diagram
DOE Building: Where Do We Start?

- Response(s): what outcome should we measure?
- Factors: what can we control in our system?
- Model: what would we like to learn?
- # of runs: how much time do we have available?
DOE Building: Where Do We Start?

- Response(s): what outcome should we measure? 
  
  \textit{pDNA Yield}

- Factors: what can we control in our system?

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- # of runs: how much time do we have available?

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<td>pH</td>
<td>6.8</td>
<td>7.2</td>
</tr>
<tr>
<td>% Dissolved Oxygen</td>
<td>20</td>
<td>40</td>
</tr>
<tr>
<td>Induction Temp</td>
<td>39.5</td>
<td>42.5</td>
</tr>
<tr>
<td>Induction OD600</td>
<td>20</td>
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<td>Feed Rate</td>
<td>1.9</td>
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DOE Building: Where Do We Start?

• **Response(s): what outcome should we measure?**
  
  pDNA Yield

• **Factors: what can we control in our system?**

• **Model: what would we like to learn?**
  
  *Optimize fermentation factor settings*

• **# of runs: how much time do we have available?**
  
  Must complete experiments ASAP!

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Options for Screening + Optimization DOE

- One-Factor-at-a-Time (OFAT)
- Classical Screening Design + Augmentation for RSM
- Classical Full Factorial Design + Augmentation for RSM
- Classical Response Surface Design
- Custom Design for RSM
- Definitive Screening Design (+potential augmentation)
Options for Screening + Optimization DOE

- One Factor at a Time (OFAT)  
  No, just no...
- Classical Screening Design + Augmentation for RSM  8+13 run min
- Classical Full Factorial Design + Augmentation for RSM  40 run min
- Classical Response Surface Design  28 run min
- Custom Design for RSM  21 run min
- Definitive Screening Design (+potential augmentation)  13 (+9 with aug) run min
Your Data Workflow in JMP

**INPUTS**
- Files
- Docs
- Webpages
- Databases
- Web APIs
- Cloud Sources
- 3rd Party Files

**PROCESS**
- Data Access
- Design of Experiments
- Quality & Process Engineering
- Mass Customization
- Data Blending & Cleaning
- Basic Data Analysis and Modeling
- Reliability Analysis
- What If Analysis
- Data Exploration & Visualization
- Advanced Statistical Modeling
- Consumer & Market Research
- Content Organization
- Group, Filter & Subset Data
- Predictive Modeling & Machine Learning
- Automation & Scripting
- Sharing and Communicating Results

**OUTPUTS**
- HTML
- Business Docs
- Images
- JMP Live
JMP® helps you make better decisions, faster

- Design of Experiments (DOE)
- Statistics, Predictive Modeling & Data Mining
- Consumer & Market Research
- Quality Engineering, Reliability & Six Sigma
- Data Visualization & Exploratory Data Analysis
- Dashboard Building