Basic and Expanded Factorial Designs

The simplest factorial design is a 2x2, which can be expanded in two ways:

1) Adding conditions to one, the other, or both IVs

- 2x2 design
- 2x4 design
- 3x2 design
- 3x4 design

Factorial designs are all labeled as \( \times \) Designs
- the first number tells the number of rows in the design
- the second number tells the number of columns in the design

What is each of the following?

- \( \text{a. } 2 \times 3 \)
- \( \text{b. } 4 \times 6 \)
- \( \text{c. } 5 \times 3 \)
This time try to “draw the boxes” (be sure to label each IV and specify each or its conditions) based on the description of the design -- whatever IV is described first will define the rows

1. Males and females completed the task, either under instructions to work quickly, work accurately, to work as quickly as possible without making unnecessary errors or no instructions.

2. Folks completed a depression questionnaire either under instructions to “respond like someone with acute depression,” “respond like someone with chronic depression” or “respond like someone who is trying to ‘fake’ being depressed”. Participants were either clinical psychologists, clinical Ph.D., or volunteers from a local social club.

#1 was a 2x4 design that looks like this...

<table>
<thead>
<tr>
<th>Instructions</th>
<th>Quick</th>
<th>Accurate</th>
<th>Both</th>
<th>None</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#2 was a 3 x 3 design that looks like ...

<table>
<thead>
<tr>
<th>Respond like a ..</th>
<th>Clinician</th>
<th>Clin. Grad.</th>
<th>Soc. Club</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute depressive</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chronic depressive</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Fake” depressive</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

kxk BG Factorial Designs
We’ve worked extensively with the 2x2 design -- the basic factorial Larger factorial designs are often used for the same reasons that multiple-condition 1-factor designs are used . . .

• You may need more than 2 IV conditions to properly test a RH:
  • Want multiple “experimental conditions” (qual or quant diffs)
  • Want multiple “treatment conditions” (standard vs. none, etc)
  • Want to “dissect” a multiple element treatment

You might want to test the replicability of an IV’s effect across more than two situations/settings

• testing the generality of a TX across gender requires just 2 conditions of the 2nd IV
• testing generality of that TX across ages would require more
Statistical Analysis of kxk Factorial Designs

Only a couple of differences from the 2x2

1. Tell IVs and DV
2. Present data in table or figure
3. Determine if the interaction is significant
   - if it is, describe it in terms of one of the sets of simple effects using LSD mmd to compare the cell means
4. Determine whether or not the first main effect is significant
   - if so, describe it using LSD mmd compare 3+ marginal means
   - determine if that main effect is descriptive or misleading
5. Determine whether or not the second main effect is significant
   - if so, describe it using LSD mmd compare 3+ marginal means
   - determine if that main effect is descriptive or misleading

The omnibus ANOVA for the kxk is the same as for the 2x2

BG SS<sub>total</sub> = SS<sub>A</sub> + SS<sub>B</sub> + SS<sub>INT</sub> + SS<sub>Error</sub>

df<sub>total</sub> = df<sub>A</sub> + df<sub>B</sub> + df<sub>INT</sub> + df<sub>Error</sub>
(N - 1) = (a - 1) + (b - 1) + (a-1)(b-1) + ab(n-1)

\[
F_A = \frac{SS_A / df_A}{SS_E / df_E}, \quad F_B = \frac{SS_B / df_B}{SS_E / df_E}, \quad F_{INT} = \frac{SS_{INT} / df_{INT}}{SS_E / df_E}
\]

Things to notice:
- There is a single error term that is used for all the Fs
- All of the effects are equally “powerful” except for sample size differences (stat power)

The LSD follow-ups are a little different than for the 2x2
- the 2x2 uses the LSD only for comparing cell means
  - describe the simple effects to explicate the interaction pattern
- the kxk uses the LSD for comparing cell & marginal means
- different LSD mmd values are computed for different effects
  - if the interaction is significant, then an LSD is computed to compare the cell means -- describe SEs, interaction, etc.
  - If a ME with 2 conditions is significant - no LSD needed
  - If a ME with 3 or more conditions is significant, then LSD is computed to compare the marginal means of that ME

Be sure to use the proper “n” to compute each LSD
- “n” = mean number of data points used to compute the means being compared (more on demo sheet)
There will be 5 statistics:
1. $F_{\text{Gender}}$
2. $F_{\text{Age}}$
3. LSD_{mmd}
4. $F_{\text{Int}}$
5. LSD_{mmd}

"Effects" in this study:
1. Main effect of gender
2. Main effect of age
3. Pairwise age ME effects
4. Interaction of age & gender
5. Pairwise SE of age for males
6. Pairwise SE of age for females
7. SE of gender for 5 yr olds
8. SE of gender for 10 yr olds

Back to: 100 males and 100 females completed the task, either under instructions to work quickly, work accurately, to work as quickly as possible without making unnecessary errors or no instructions.

<table>
<thead>
<tr>
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For the interaction $p = .03$
- will we need and LSD_{mmd} to explore the pattern of the interaction? why or why not?
- what will "n" be?

For the main effect of instruction $p = .02$
- will we need and LSD_{mmd} to explore the pattern of this main effect? why or why not?
- what will "n" be?

For the main effect of gender $p = .02$
- will we need and LSD_{mmd} to explore the pattern of this main effect? why or why not?
- what will "n" be?