

STA 674

Regression Analysis And Design Of Experiments

Experiments with Multiple Factors – Lecture 3



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Experiments with Multiple Factors

- Last time, we finished uncovering the types of effects in multiple-factor experiments and looked at an example.
- This time, we will consider just an example three-factor experiment.

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Cell Means Model

- The cell means model for the $2 \times 2 \times 2$, or 2^3 factorial design is:

$$y_{ijkl} = \mu_{ijk} + e_{ijkl}, i, j, \text{ and } k = 1, 2.$$

where

- μ_{ijk} is the mean response units treated with level i of factor 1, level j of factor 2, and level k of factor 3
- e_{ijkl} is the error for the l^{th} unit treated with level i of factor 1, level j of factor 2, and level k of factor 3, that is $e_{ijkl} = y_{ijkl} - \mu_{ijk}$
- y_{ijkl} is the response from the l^{th} unit treated with level i of factor 1, level j of factor 2, and level k of factor 3

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Example – consumer preference

- The example we'll consider comes from a study of the exposure effect published in the journal *Advances in Consumer Research* Volume in 1994 (Lee, 1994). The article studies the belief that people can come to prefer a commercial brand not necessarily through positive experiences with the brand's products but simply by being repeatedly exposed to the brand's marketing. This is called the exposure effect because individuals make decisions based on their exposure to a brand not based on their experience.

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Example – consumer preference

The three factors in the experiment were:

1. Objective familiarity (OBJECTIVE):

whether the test pictures were old (included in the training set) or new (not included in the training set)

2. Subjective familiarity: (SUBJECTIVE)

whether the participant was told that the test pictures were old or new

3. Pattern density (DENSITY):

the density of the squares and triangles in the random pictures.

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Example – consumer preference cell means model

- The cell means model for this 2^3 factorial design is:

$$y_{ijkl} = \mu_{ijk} + e_{ijkl}, i, j, \text{ and } k = 1, 2.$$

where

- $i = 1, 2$ represents the level of DENSITY,
- $j = 1, 2$ the level of OBJECTIVE,
- $k = 1, 2$, the level of SUBJECTIVE, and
- y_{ijkl} is the rating of the 4 pictures for each subject $l = 1, \dots, 60$.

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Example – consumer preference

The following table of estimated treatment means was provided in the paper:

			Subjective Familiarity	
			Old	New
High Density	Objective Familiarity	Old	– 0.60	– 0.23
		New	0.27	– 0.23
Low Density	Objective Familiarity	Old	1.23	1.30
		New	0.80	0.30

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Example – consumer preference

The original research questions were:

- Does the average rating of the pattern on the new card depend on whether or not the subjects have seen the pattern before?
- Does the difference in the average rating for subjects who had and had not seen the card before depend on whether or not they believed the pattern was new?
- Does the difference in the average rating for subjects who had and had not seen the card before depend on whether the pattern has a high or low density of points?

State whether each of these questions involves a simple effect, a main effect, or an interaction.

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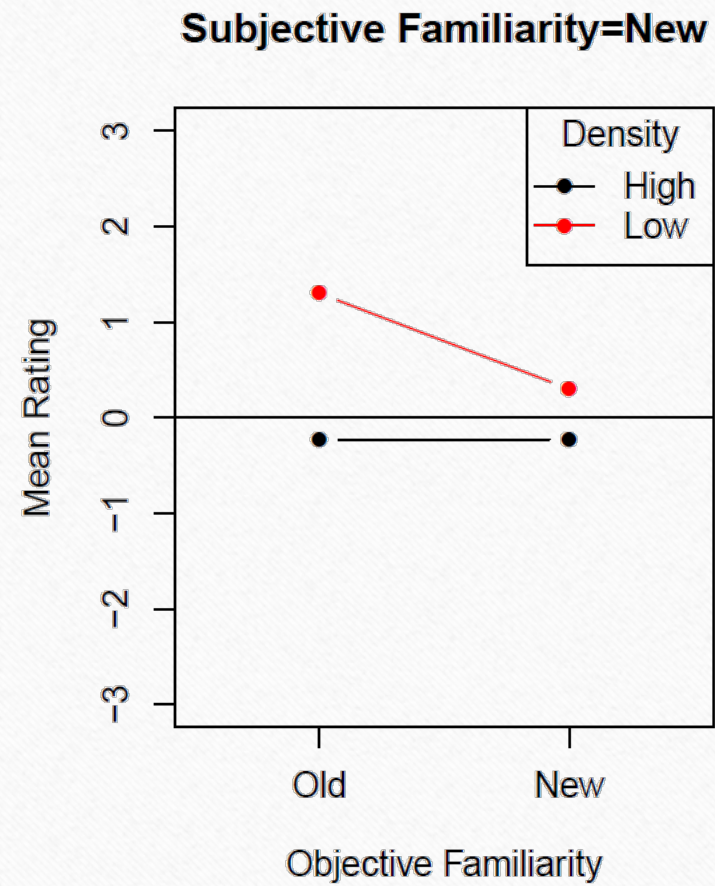
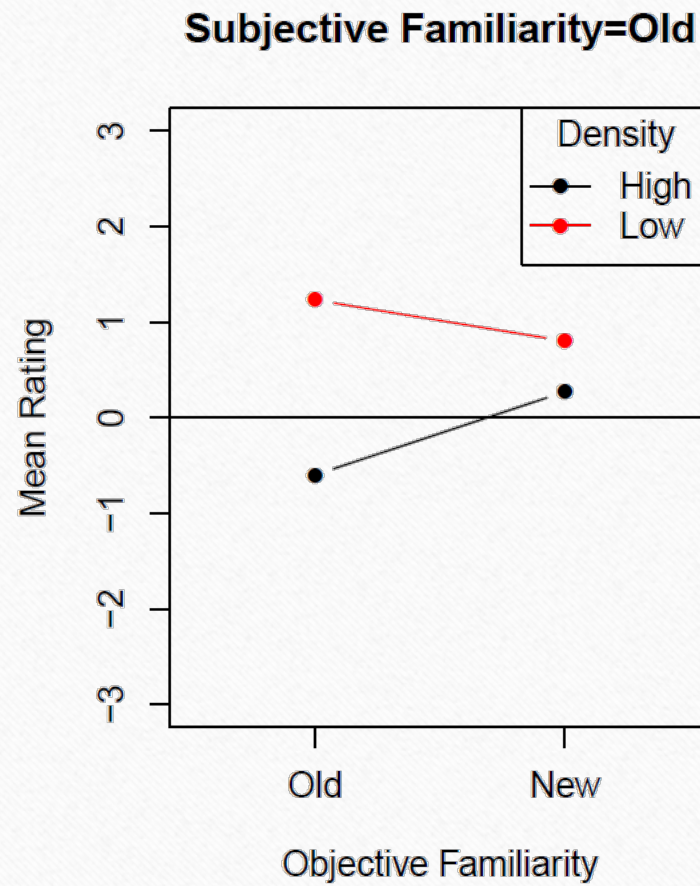
Experiments with Multiple Factors

Example – consumer preference

The original research questions were:

- Does the average rating of the pattern on the new card depend on whether or not the subjects have seen the pattern before? **Main effect (of OBJECTIVE)**
- Does the difference in the average rating for subjects who had and had not seen the card before depend on whether or not they believed the pattern was new? **Interaction effect (of OBJECTIVE on SUBJECTIVE)**
- Does the difference in the average rating for subjects who had and had not seen the card before depend on whether the pattern has a high or low density of points? **Interaction effect (of OBJECTIVE on DENSITY)**

Example – consumer preference



Example – consumer preference

