STA 674

Regression Analysis And Design Of Experiments

Experiments with Multiple Factors – Lecture 2

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Experiments with Multiple Factors

- Last time, we began our exploration of experiments with multiple factors by examining their cell means model and looking at the first of their effects, the simple and main effects.
- This time, we will look at the remaining effect, interaction, and start implementing analysis in SAS.

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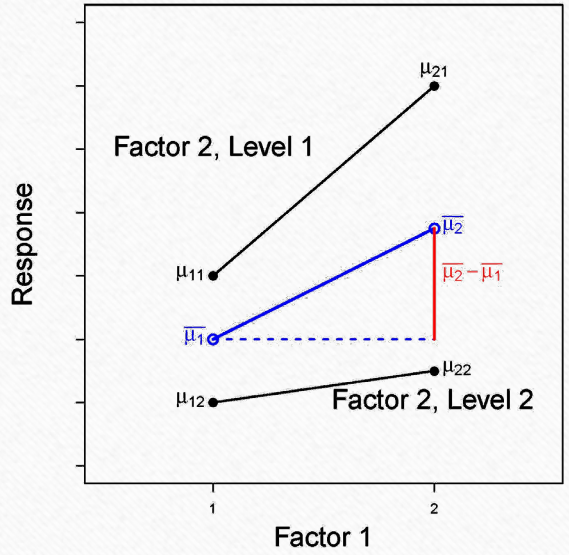
Main Effects

- Main effect are differences between the overall means of two columns or the overall means of two rows.
- Main effect of Factor 1:

$$\frac{\mu_{21}+\mu_{22}}{2} - \frac{\mu_{11}+\mu_{12}}{2}$$

	Factor 2	
Factor 1	Level 1	Level 2
Level 1	μ_{11}	μ_{12}
Level 2	μ_{21}	μ_{22}



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Interaction

put simply, an interaction is a difference of the difference

- Interactions measure differences in the effect of one factor changes as another factor changes.
- Example: the interaction between type of plane and use of flaps is:

  the change in the difference between the mean flying distance for the two types of planes between the planes with and without flaps, - or -

  any difference, on average, flaps make to the average flying distance ***effect of the type of plane***

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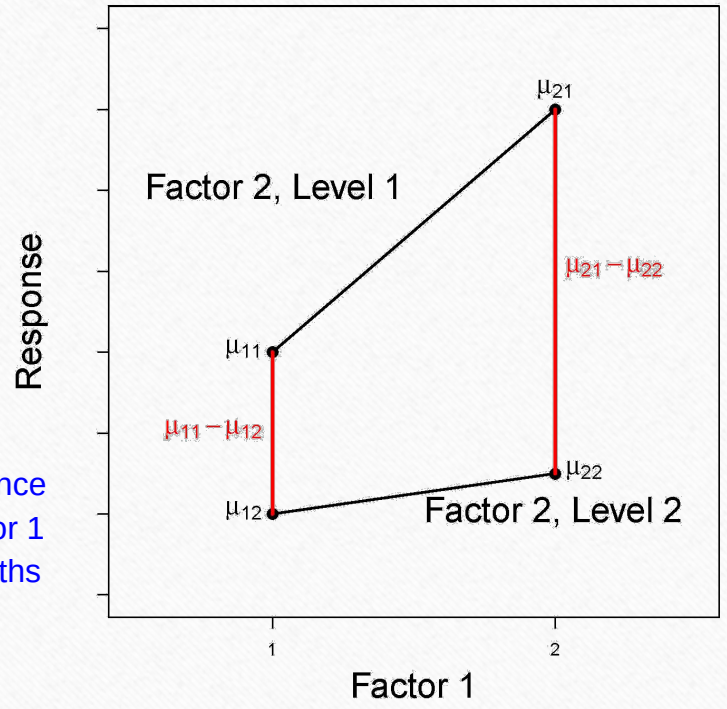
Interaction

- Interaction between Factor 1 and Factor 2:

$$(\mu_{22} - \mu_{12}) - (\mu_{21} - \mu_{11})$$

	Factor 2	
Factor 1	Level 1	Level 2
Level 1	μ_{11}	μ_{12}
Level 2	μ_{21}	μ_{22}

here, the interaction is the difference of the factor 2 difference minus the difference of the factor 1 difference...subtracting the lengths of the two vertical red lines



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Example – sweet potato weevils

- As part of their goal to eradicate this pest from southern Japan, researchers tried to determine if West Indian sweet potato weevils could adapt to new food sources by comparing the reproductive ability of female from a population fed only sweet potato roots for 14 generations (the SP strain) and females fed only an alternative diet for 14 generations (the AD strain). After the 14th generation, multiple females of each strain were placed on both the artificial diet and sweet potato root. The researchers then counted the number of eggs each female laid over a 28-day period and compared the reproductive ability across the different treatments.

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Example – sweet potato weevils

Which of the following differences represent simple effects:

A. The difference in the mean number of eggs laid by females of the two strains.

B. The difference in the mean number of eggs laid by females of the two strains fed sweet potato.

C. The difference in the mean number of eggs laid by females fed the two diets.

D. The difference in the mean number of eggs laid by females of the SP strain fed the two diets.

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Example – sweet potato weevils

Which of the following differences represent main effects:

A. The difference in the mean number of eggs laid by females of the two strains.

B. The difference in the mean number of eggs laid by females of the two strains fed sweet potato.

C. The difference in the mean number of eggs laid by females fed the two diets.

D. The difference in the mean number of eggs laid by females of the SP strain fed the two diets.

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Example – sweet potato weevils

Which of the following describes an interaction between strain and diet::

A. The difference between the mean number of eggs laid by females on the two diets depends on their strain.

B. The simple effect of diet is not the same for the two strains.

C. The difference between the mean number of eggs laid by females of the two strains depends on the diet they are fed.

D. The simple effect of strain is not the same for the two diets.

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Example – sweet potato weevils

SAS Code:

```
/* Two-Way ANOVA -- Estimates of Least Squares Means */;
PROC GLM DATA=WEEVILS;
    CLASS food strain;
    MODEL lneggs=food strain food*strain;
    LSMEANS food*strain / CL ADJUST=BON;
RUN;
```

factors are significant in predicting number of eggs

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	26.19717639	8.73239213	102.08	<.0001
Error	117	10.00826167	0.08554070		
Corrected Total	120	36.20543807			

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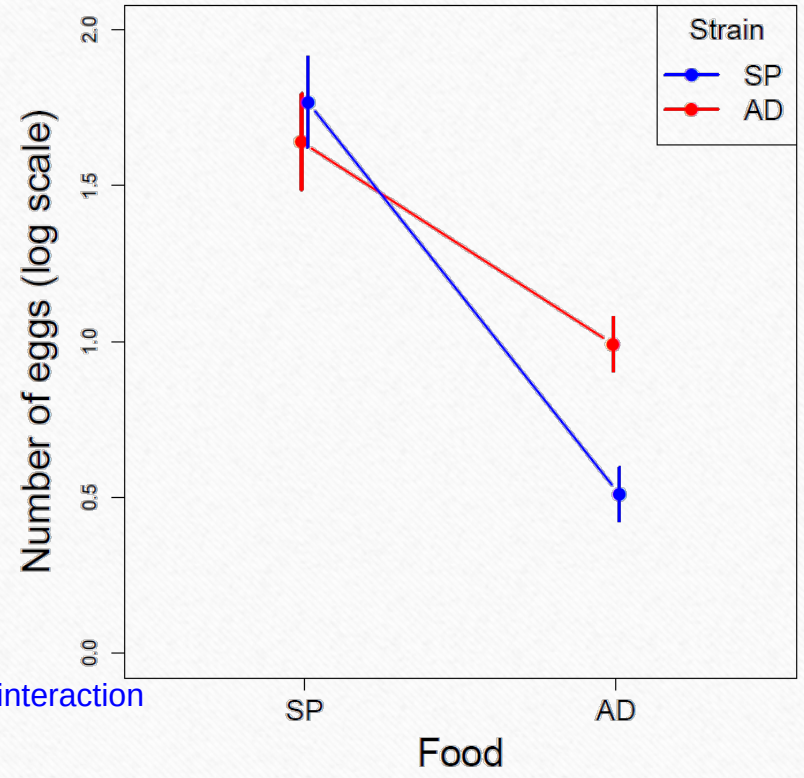
Example – sweet potato weevils

Least Square Means:

Least Squares Means
Adjustment for Multiple Comparisons: Bonferroni

food	strain	lneggs LSMEAN	LSMEAN Number
AD	AD	0.99155785	1
AD	SP	0.51077759	2
SP	AD	1.64073106	3
SP	SP	1.76886139	4



The magnitude of change between the two strains ("slope" of line) indicates an interaction