Factorial Experiment Design

Objective: Determine whether there is statistical evidence that factors (independant variables) have a cause & effect relationship with a response (dependant variables) – and do it with a minimum amount of data

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Example from text ~ pg 220 "2^k factorial design"
2 factors & 3 replicaters

Design matrix: Factor A	Factor B	Response: Replicate I	Replicate II	Replicate III	notation
−	−	28	25	27	1·1 = 1
+	−	36	32	32	a·1 = a
−	+	18	19	23	1·b = b
+	+	31	30	29	a·b = ab

− = low factor
+ = high factor

above is a 2-level, 2-factor 3-replicater

Hint: Can download Minitab – excellent stat software!
30 day trial, can continue to download & instal

k = # factors n = # replicaters

$n \cdot 2^k$ = # experiments for full design

Factorial Experiment design

for 3-factor, 2 level

design matrix = $2^k = 2^3 = 8$

	A	B	C
1	−	−	−
2	+	−	−
3	−	+	−
4	−	−	+
5	+	+	−
6	+	−	+
7	−	+	+
8	+	+	+

Initial Analysis Phase - use data to find main effects & interaction effects

Main Effect A (ME A)

$$ME A = \left[\frac{a-(1)}{n} + \frac{ab-b}{n}\right] \cdot \frac{1}{2}$$

$$ME A = \left[\frac{(36+32+32)-(28+25+27)}{3} + \frac{(31+30+29)-(18+19+23)}{3}\right] \cdot \frac{1}{2}$$

effect of A @ low B; effect of A @ high B; average

ME A = 8.33 average effect of raising A

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Main Effect B

$$MEB = \left[\frac{b-(1)}{n} + \frac{ab-a}{n}\right] 1/2$$

MEB = -5.0 average effect of increasing B

Interaction Effect AB

$$= \left[\begin{matrix}\text{Effect of} \\ \text{A @ high B}\end{matrix}\right] - \left[\begin{matrix}\text{Effect of} \\ \text{A @ low B}\end{matrix}\right]$$

$$= \left[\frac{ab-b}{n} - \frac{a-(1)}{n}\right] 1/2$$

= 1.67 small relative to two main effects