

## 1. N-way ANOVA (N factors + 1 response)

- Used when there are more than one categorical factors
- First consideration is whether or not there is interaction between the factors
  - no interaction – can delete the interaction term and analyze main effects
  - with interaction – tests for main effects may be misleading due to masking of these effects by the interaction
- Assumptions:
  - the observations are normally distributed for a given group
  - variations within a group is the same across all the groups
  - the error terms have a mean value of zero and occur independently of each other

Example data: Car Physical Data.jmp (In JMP home window → help → sample data)

- Analyze → Fit Model
- choose Weight → Y
- choose Country, Type → Macros → Full Factorial
- click Run Model
- ▼ Red Triangle next to the two-way interaction → LSMeans

Plot

- $p$ -values for the interactions is smaller than 0.05; not all the lines in interaction plots are parallel - conclude there is significant interaction between the factors

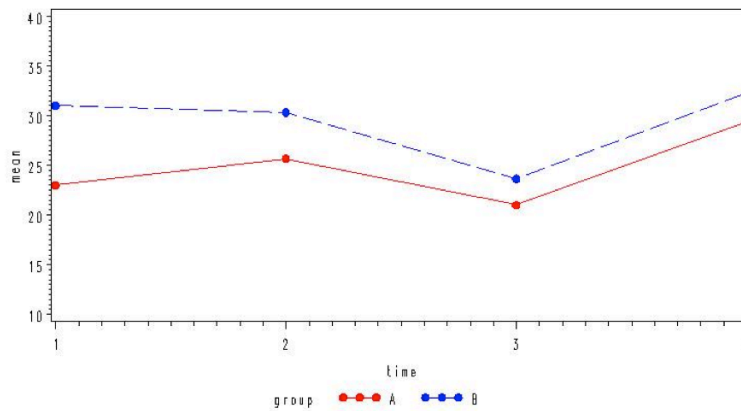
Build Contrasts

- ▼ Red Triangle next to Country\*Type → LSMeans Contrast
- select the plus sign for USA, Compact; the minus sign for USA, Sporty → Done
- Prob > F is 0.03 – A US made sporty car is heavier than a US made compact car
- ▼ Red Triangle next to Country\*Type → LSMeans Contrast
- select the plus sign for Japan, Sporty; the minus sign for USA, Sporty → Done
- Prob > F is 0.01 – A US made sporty car is heavier than a Japanese made sporty car

## 2. Repeated measures

Two treatment groups with four measurements taken over equally spaced time intervals (e.g., A = treatment B = placebo) (dataset: repeated.jmp)

id	group	time1	time2	time3	time4
1	A	31	29	15	26
2	A	24	28	20	32
3	A	14	20	28	30
4	B	38	34	30	34
5	B	25	29	25	29
6	B	30	28	16	34



Mean profile plots by group

**Questions of interests:**

**1. Overall, are there significant differences between TIME points?**

- From plots it looks like some differences over time, in particular times 3 and 4 look different.

**2. Do the two groups differ at any time points, i.e. is there a TREATMENT effect?**

- From plots it looks like the groups differ at baseline and there are some difference everywhere else.

**3. Do the two groups differ in their responses over time, i.e. is there a TIME\*TREATMENT interaction?**

- Their response profiles look similar over time, though A and B are closer by the end.

## Two methods:

- Option 1: Use repeated-measures ANOVA using the “Univariate” approach (restrictive assumptions)
- Option 2: “Multivariate” ANOVA approach, i.e. MANOVA (less restrictive assumptions)

### ✓ MANOVA:

Fit model -> Put the columns of repeated measurements in the Y box; Put treatment effect “Group” in the model effects box.-> Be sure to change Personality to MANOVA

=> check “repeated measures” in choose response

### ✓ Univariate approach: repeated measure with ANOVA

same as above, but check “univariate test also”. The Mauchly’s Sphericity Test result yields ( $p = .2967$ ) which does not suggest a problem with sphericity.

## Conclusions:

1. Overall, are there significant differences between TIME points? **NO**  
-- From MANOVA results the time effect was not significant ( $p = .3287$ ).
2. Do the two groups differ at any time points, i.e. is there a TREATMENT effect? **NO**  
-- From MANOVA or Repeated Measures ANOVA the treatment effect ( $p = .1408$ )
3. Do the two groups differ in their responses over time, i.e. is there a TIME\*TREATMENT interaction? **NO**  
-- From MANOVA the time\*treatment effect is also not significant ( $p = .8932$ ).

## Practice:

- 1) use the dataset `prac_repeated.jmp` to check whether there is a difference between first and second joints for the flea beetles.
- 2) use the dataset `ex1614.jmp` to check whether there is a difference among the phases.