# Comparison of location parameters among 3 or more groups of identical individuals

- Comparison of location parameters among 3 or more groups of different individuals → One-way ANOVA or Kruskal-Wallis test

- If all groups are composed of the same individuals?
  → Repeated-measures ANOVA or Friedman's test

- Data should be given as wide-format for EZR
  (Data at different times → Different variables
  *1 line means 1 individual)
  Names of time-dependent variables must be given as alphebetical order.  If not, rename using [Active data set] [Variables] [Rename variables]

- Flow: Read data → Draw graph → Statistical analysis
  See, (1) The effects of Group(s), Time, Interaction from ANOVA table, (2) Check sphericity (Null-hypothesis: equal variances among time), (3) If (2) is significant, see G-G or H-F adjustment

# Example 1. Skin electric potential (mV) after various stimuli in 8 individuals

- Read data from:
  http://minato.sip21c.org/hypno-psycho01.txt

- Draw graph of raw data:
  [Graphs][Line graph (Repeated measures)]
  select → calmness, despair, fear, happiness

- Looks not normally distributed.  Values are not independent (→ One-way ANOVA is not appropriate). And, the intra-individual factor is not "time".

- Null-hypothesis: Skin electric potentials are not different by the kind of psychological stimuli

- Statistical analysis:
  [Nonparametric tests] [Friedman test]
  select → calmness, despair, fear, happiness
  Friedman chi-squared = 6.45, df = 3, p-value = 0.09166 (NS)

# Example 2. Changes of plasma inorganic phosphate after OGTT for 33 individuals

- Reading data: [File][Import data][Read Text Data From Flie, Clipboard, or URL]
  Name: ogtt02, From: URL, Delimiter: tabs
  URL: http://minato.sip21c.org/ogtt02.txt

- Draw graph of raw data:
  [Graphs] → [Line graph (Repeated measures)]
  Repeatedly measured data: T.0, T.0.5, …, T.5
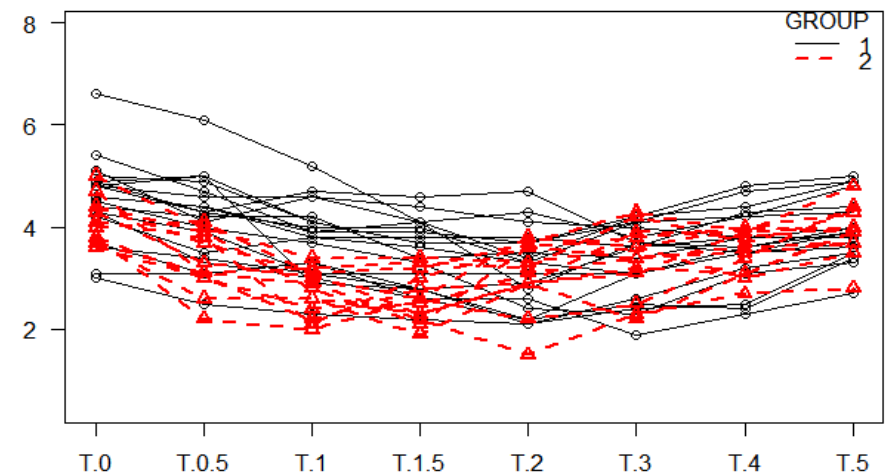  Grouping variable: GROUP

- 2 GROUPs
  1: Control
  2: Obesity

- Checking the effect of TIME, GROUP, and interaction



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# Example 2. (cont'd)

- [Statistical analysis] [Continuous variables] [Repeated measures ANOVA]

- Repeatedly measured data: T.0, T.0.5, …, T.5
  Grouping variable: GROUP

- Univariate Type III Repeated-Measures ANOVA Assuming Sphericity

```
                     SS num Df Error SS den Df        F      Pr(>F)
(Intercept)        3173.3      1  73.581     31 1336.9260 < 2.2e-16 ***
Factor1.GROUP        13.2      1  73.581     31    5.5464   0.02503 *
Time                 42.3      7  36.438    217   35.9602 < 2.2e-16 ***
Factor1.GROUP:Time    9.4      7  36.438    217    7.9881 1.255e-08 ***
---
Signif. Codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```
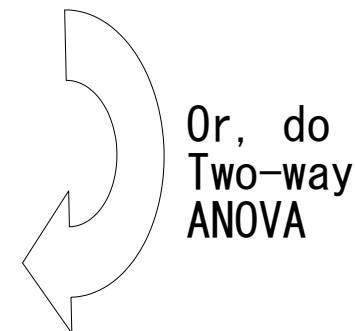
-  Mauchly Tests for Sphericity

```
                    Test statistic     p-value
Time                      0.05137 9.4322e-08
Factor1.GROUP:Time        0.05137 9.4322e-08
```

- Greenhouse-Geisser and Huynh-Feldt Corrections
   for Departure from Sphericity

```
                   GG eps Pr(>F[GG])
Time              0.57374  < 2.2e-16 ***
Factor1.GROUP:Time 0.57374  8.868e-06 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Or, do
Two-way
ANOVA

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# Example 2. (cont'd)

- Non-parametric test is still possible

- [Statistical analysis] [Nonparametric test] [Friedman test]
  Select variables: T0, T0.5, …, T5

- Friedman chi-squared = 114.8377, df = 7,
  p-value < 2.2e-16

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# Example 3. Change of systolic blood pressures (mmHg) after drug admin.

- Read data: http://minato.sip21c.org/sbp01.txt
- Rename the name of variable from T.1 to S1
- Draw graph of raw data
  Repeatedly measured data: S1, T0, T1, …, T8
- Friedman test: p=0.029 → SBP significantly changes by time after drug administration.
- Repeated measures ANOVA:
  [Statistical analysis] [Continuous variables] [Repeated measures ANOVA]
  Repeatedly measured data: T0, T1, …, T5
  * More variables than subjects are not allowed