ANOVA

HYPOTHESIS TESTING

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TOPIC OUTLINE

Bartlett’s Test

One-Way ANOVA

Welch’s ANOVA

BARTLETT'S TEST

BARTLETT'S TEST

Bartlett's Test is a statistical test used to assess whether **multiple groups** have equal variances.

Hypothesis

$H_o: \sigma_1 = \sigma_1 = \sigma_3 = \cdots \sigma_n$

H_a: at least one $\neq$ (p-value $< \alpha$)

Assumptions

- Continuous data
- Normal data

syntax

```
from scipy import stats
b_stat, p_value = stats.bartlett(
    sample_1 data,
    sample_2 data,
    sample_3 data,...sample_n data)
```

ONE-WAY ANOVA

ONE-WAY ANOVA

One-Way ANOVA is a statistical test used to compare the means of **three** or **more** independent groups to determine if there is a statistically significant difference among them.

Hypothesis

$\boldsymbol{H_o}: \boldsymbol{\mu_1 = \mu_1 = \mu_3 = \cdots \mu_n}$

$\boldsymbol{H_a}$: at least one ≠ (p-value < α)

Assumptions

- Continuous data
- Normal data
- Equal variances

syntax

```
from scipy import stats
f_stat, p_value = stats.f_oneway(
    sample_1 data,
    sample_2 data,
    sample_3 data,... sample_n data)
```

WELCH'S ANOVA

WELCH'S ANOVA

Welch's ANOVA is a variation of the classic one-way ANOVA that does **not** assume equal variances across groups.

Hypothesis

H_o: $\mu_1 = \mu_1 = \mu_3 = \cdots \mu_n$

H_a: at least one $\neq$ (p-value $<$ α)

Assumptions

- Continuous data
- Normal data
- **Unequal** variances

syntax

```
import pingouin as pg
result = pg.welch_anova(
    dv = 'data_values column',
    between = 'group_column',
    data = df)
p_value = result['p-unc'].values[0]
```

note: stuck dataset

EXERCISE

The dataset contains power output measurements from **three hydroelectric** power plants. Verify the maintenance department claim that one of the plants is **underperforming**.

dataset

"**hydroelectric-sample.csv**"

Solution

Let $\alpha = 0.05$

Hypothesis

$\boldsymbol{H_o: \mu_1 = \mu_1 = \mu_3 = \cdots \mu_n}$

$\boldsymbol{H_a}$: at least one $\neq$ (p-value $< \alpha$)

LABORATORY