

Lab 3: Gauge R & R Study

Assigned: October 27, 2022

Due: November 10, 2023

Lab objectives

Perform gauge R&R analysis to evaluate the capability of the measurement tools including a kitchen scale and a caliper.

Dataset

Task 1: Scale capability evaluation. The objective of this task is to evaluate the capability of a kitchen scale. The weight of four packs of cookies from one box is measured. Gram is used as the unit. Each operator measured each pack of cookies **three times**.

Task 2: Scale capability evaluation. The weight of four markers with different colors is measured. Gram is used as the unit. Each operator measured each marker **two times**.

Task 3: Caliper capability evaluation. The objective of this task is to evaluate the capability of a digital Vernier caliper. The diameter of four markers with different colors is measured. Millimeters is used as the unit. Each operator measured each marker **two times**.

The following procedure/notes apply to all three tasks.

- For each task, there are three operators.
- Each object is measured and recorded in the order from the provided experimental table.
- The experiment order is shuffled to mitigate the potential influence of operator bias on the measurements, ensuring a more robust assessment of the measurement tools' capabilities.

Data analysis and lab report

Repeat Steps 1–4 for all three tasks.

1. Use $\bar{X} - R$ charts to estimate the gauge capability.
 - a. Calculate σ_{gauge} , $\sigma_{repeatability}$, $\sigma_{reproducibility}$, σ_{part} , and σ_{total} .
 - b. What width of specification limits will make the gauge marginally capable (P/T ratio is equal to 0.1)?
2. Use software to perform ANOVA.
 - a. Start from a full ANOVA model. Use a reduced model if there is no significant interaction between operators and parts.
 - b. Calculate σ_{gauge} , $\sigma_{repeatability}$, $\sigma_{reproducibility}$, σ_{part} , and σ_{total} .
3. Compare your results from $\bar{X} - R$ charts and ANOVA.

4. Compare the production variation in the weight of markers and cookies. The weight of which product is better controlled? Justify your answer.

Additional requirements on the report:

1. Please attach your original worksheet to the report.
2. Report the contributions of each team member in the experiment, data analysis, and lab report writing.

Example:

\bar{X} -R	S	V	% total	% gauge	ANOVA	S	V	% total	% gauge
σ_{gauge}					σ_{gauge}				
$\sigma_{\text{repeatability}}$					$\sigma_{\text{repeatability}}$				
$\sigma_{\text{reproducibility}}$					$\sigma_{\text{reproducibility}}$				
σ_{product}					σ_{product}				
σ_{total}					σ_{total}				
SL									