# Measuring a Table

Abstract

This experiment was conducted to determine the accuracy and precision of using a wooden stick to measure the area of a table. Measurements of length and width were taken with a 20 cm wood stick, then using Graphical Analysis software, the mean, and standard deviation were determined. With these statistics the area of the table ($1.4x10^4 \pm 300$) $cm^2$ was determined with pencil and calculator. The measurement of the tables area was determined to be inaccurate by comparing the measured area of the table and the expected value of the table. The measurements using the stick as were determined to be precise, since the standard deviation of mean for length and width were both small.

Objective

The objectives of this experiment were to learn the following concepts: mean value, standard deviation, standard deviation of the mean, and significant figures. The practice of propagation of errors, and determining the difference between precision and accuracy, were also undertaken in this experiment.

Procedure

Rough measurements of the length and width of a table were taken using a 20 cm wooden stick as a gauge. The Graphical Analysis software was used to generate graphs, as well as the statistics of mean and standard deviation. The standard deviation of the mean, area of the table, and the discrepancy of the area were determined with paper and calculator.

Results

| | |
|---|---|
| Mean Length | 182.2 cm |
| Mean Width | 75.92 cm |
| Standard Deviation Length | 1.184 cm |
| Standard Deviation Width | 1.104 cm |
| Standard Deviation of Mean Length | 0.1674 cm |
| Standard deviation of Mean Width | 0.1561 cm |
| Area | ($1.4x10^4 \pm 300$) $cm^2$ |
| Discrepancy of area | 0.719 |

Data Analysis

Mean values

length 182.2 cm

width 75.92 cm

Standard deviation

length 1.184 cm

width 1.104 cm

Standard deviation of mean

$std_{mean}$ = standard dev/$\sqrt{n}$

$std_{mean}$ lenth = (1.184cm)/( $\sqrt{50}$)

$std_{mean}$ length = (1.184cm)/(7.071)

$std_{mean}$ length = 0.1674 cm

$std_{mean}$ width = (1.104cm)/( $\sqrt{50}$)

$std_{mean}$ width = (1.104cm)/(7.071)

$std_{mean}$ width = 0.1561 cm

Area = (Length)(Width)

Area = (182.2 cm)(75.92 cm)

Area = 13,832.624 $cm^2$

Area = $1.380 \times 10^4$ $cm^2$

$\Delta A/A = \Delta L/L + \Delta W/W$

$\Delta A = [(\Delta L/L) + (\Delta W/W)]A$

$\Delta A = [(1.184cm/182.2cm) + (1.104cm/75.92cm)]\ 1.380 \times 10^4\ cm^2$

$\Delta A = [(.00649) + (.01454)]\ 1.380 \times 10^4\ cm^2$

$\Delta A = 290.2\ cm^2$

$\Delta A = 300\ cm^2$

Area = $(1.380 \times 10^4 \pm 300)\ cm^2$

Area = $(1.4 \times 10^4 \pm 300)\ cm^2$

Discrepancy of area

$discrep = (A_{measured} - A_{expected})/A_{expected} \times 100\%$

$discrep = (1.4 \times 10^4 \pm 300\ cm^2 - 1.39 \times 10^4 \pm 100\ cm^2)/(1.39 \times 10^4 \pm 100\ cm^2) \times 100\%$

$discrep = (100 \pm 100\ cm^2)/(1.39 \times 10^4 \pm 100\ cm^2) \times 100\%$

$discrep = (0.00719) \times 100\%$

$discrep = 0.719$

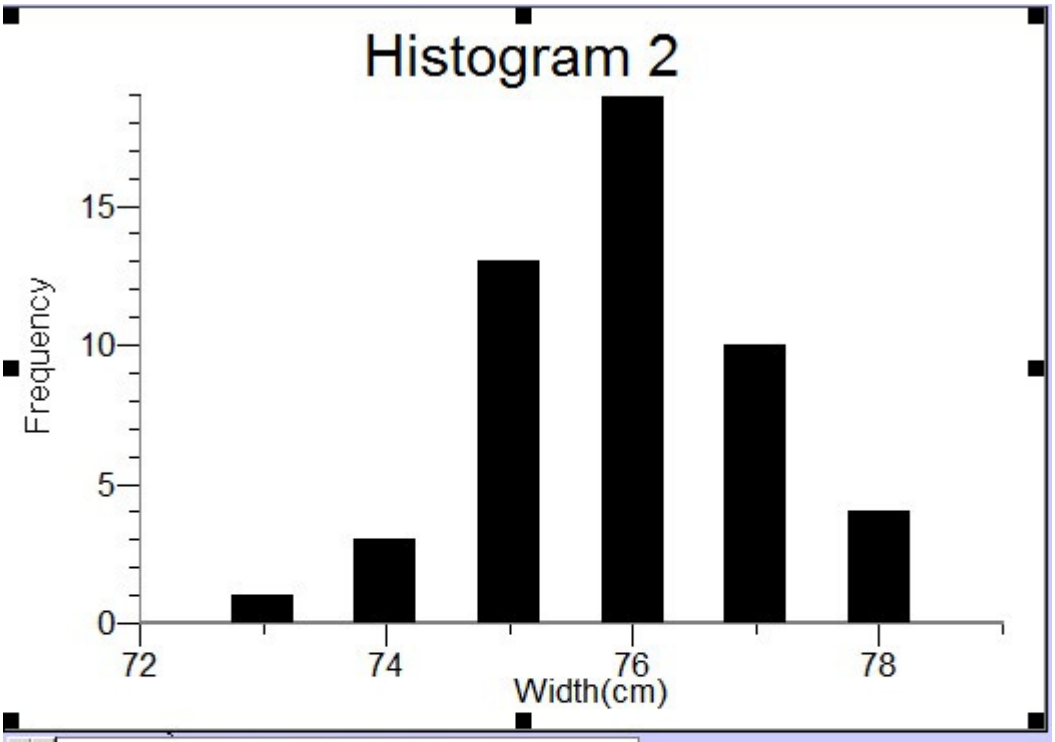
## Discussion

This experiment was conducted to determine the accuracy and precision of using a 20 cm wood measuring stick to measure the area of table. The measured area of the table was determined to be $(1.4x10^4 \pm 300)$ $cm^2$, and with the known area of 13,900±100 $cm^2$, the discrepancy of the area was determined to be 0.719. This value indicates that the measured are was not accurate. A discrepancy close to 1.0 would have indicated that the area measurement was accurate. Using the 20 cm stick to take measurements of the length and width of the table, caused a 28% decline in accuracy, compared to using a meter stick accurate to 1mm. The standard deviation of mean for length (0.1674 cm), and the standard deviation of mean for width (0.1561 cm) indicate that the measurements collected were precise. Higher values, closer to 1.0, would indicate that the measurements of length and width were not precise.

The histogram of the data collected for width shows a bell curve. The bell curve indicates that the measurements collected are of normal distribution.

## Conclusion

The objectives of the lab were met. Practice was gained in determining standard deviation, standard deviation of mean, error propagation rules, and the use of significant figures. The difference between accuracy and precision was identified by completing the experiment. Accuracy was determined by comparing the measured value of area against the excepted area of the table. Precision was determined by finding the standard deviation of mean of the measurements of length and width.




Statistics for: Data Set | Width
min: 73.00 at 73.00 max: 78.00 at 78.00
mean: 75.92 median: 76.00
std. dev: 1.1036 samples: 50

Statistics for: Data Set | Length
min: 179.0 at 179.0 max: 184.0 at 184.0
mean: 182.2 median: 182.0
std. dev: 1.1843 samples: 50

# Lab1 Data

| Width | Length |
|---|---|
| cm | cm |
| 77 | 180 |
| 76 | 183 |
| 76 | 184 |
| 77 | 183 |
| 77 | 183 |
| 76 | 182 |
| 76 | 181 |
| 76 | 184 |
| 76 | 184 |
| 77 | 184 |
| 76 | 184 |
| 75 | 182 |
| 76 | 182 |
| 75 | 183 |
| 75 | 182 |
| 75 | 182 |
| 77 | 183 |
| 76 | 183 |
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| 76 | 181 |
| 74 | 181 |
| 75 | 182 |
| 78 | 180 |
| 78 | 181 |
| 77 | 181 |
| 74 | 182 |
| 75 | 182 |
| 75 | 184 |
| 76 | 183 |
| 75 | 183 |
| 74 | 182 |
| 75 | 182 |
| 78 | 181 |
| 76 | 180 |
| 76 | 181 |
| 75 | 179 |
| 73 | 181 |
| 76 | 182 |
| 75 | 183 |