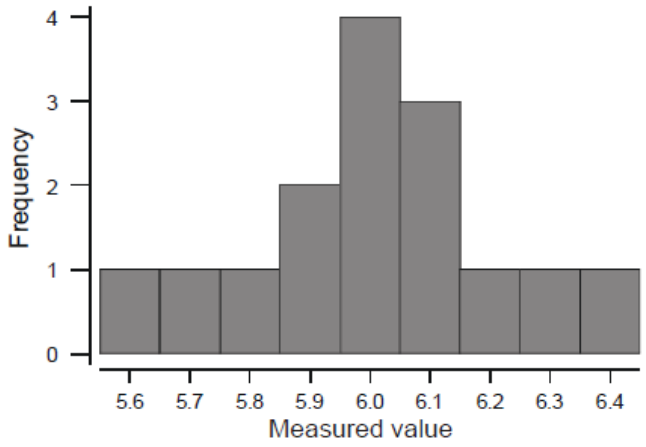
Example – Determining Bias by Independent Sample Method

A manufacturing engineer was evaluating a new measurement system for monitoring a process. An analysis of the measurement equipment indicated that there should be no linearity concerns, so the engineer had only the bias of the measurement system evaluated. A single part was chosen within the operating range of the measurement system based upon documented process variation. The part was measured by layout inspection to determine its reference value. The part was then measured fifteen times by the lead operator.

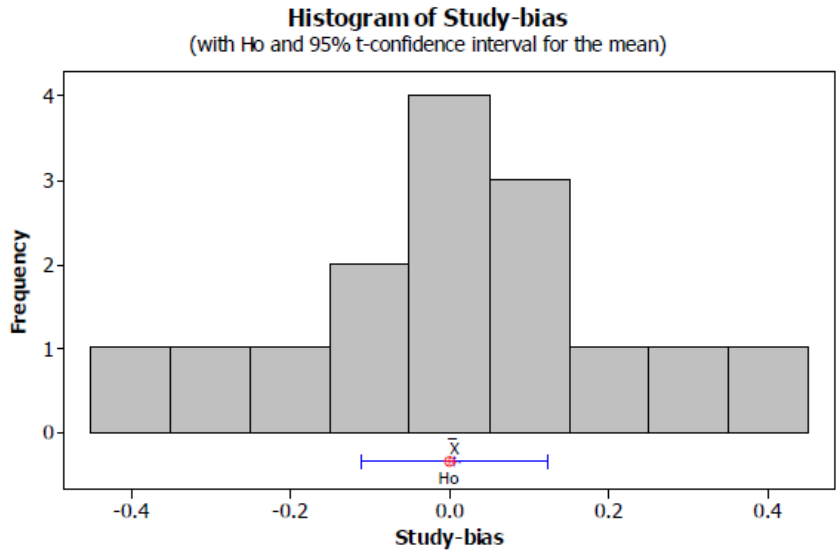
		Reference Value = 6.00	Bias
	1	5.8	-0.2
	2	5.7	-0.3
	3	5.9	-0.1
T	4	5.9	-0.1
R	5	6.0	0.0
I	6	6.1	0.1
A	7	6.0	0.0
L	8	6.1	0.1
S	9	6.4	0.4
	10	6.3	0.3
	11	6.0	0.0
	12	6.1	0.1
	13	6.2	0.2
	14	5.6	-0.4
	15	6.0	0.0

Bias Study Data

Using a spreadsheet and statistical software, the supervisor generated the histogram and numerical analysis.



Example – Determining Bias by Independent Sample Method



Histogram of Bias study

The histogram did not show any anomalies or outliers requiring additional analysis and review. The repeatability of 0.2120 was compared to an expected process variation (standard deviation) of 2.5. Since the $\%EV$ = 100(.2120/2.5) = 8.5%, the repeatability is acceptable and the bias analysis can continue.

Since zero falls within the confidence interval of the bias (– 0.1107, 0.1241), the engineer can assume that the measurement bias is acceptable assuming that the actual use will not introduce additional sources of variation.

	n	Average	Standard Deviation, σ_r	Standard Error of Mean, σ_b
Measured Value	15	6.0067	0.2120	0.0547

	Reference Value = 6.00, α = .05					
	t statistic	*df*	Significant *t* value (2-tailed)	Average Bias	95% Confidence Interval of the Bias	
					Lower	Upper
Measured Value	0.12	14	2.14479	.0067	-0.1107	0.1241

Analysis of Bias Study