CONCEPT: DETECTION OF GROSS ERRORS

Grubbs test is used to detect a single outlier in a single variable data set that follows some type of normal distribution.

Grubbs Test

$$G_{Calculated} = \frac{\left|\text{Questionable value} - \bar{x}\right|}{s}$$

$G_{Table} < G_{Calculated} \quad \therefore$ Disregard Value

$G_{Table} > G_{Calculated} \quad \therefore$ Hold Value

Number of Observations	(G_{Table} or $G_{Critical}$) (90% Confidence)	(95% Confidence)	(99% Confidence)
3	1.153	1.154	1.155
4	1.463	1.481	1.496
5	1.671	1.715	1.764
6	1.822	1.887	1.973
7	1.938	2.020	2.139
8	2.032	2.127	2.274
9	2.110	2.215	2.387
10	2.176	2.290	2.482

The Q-Test is another method used in finding outliers in very small, normally distributed, data sets.

- The number of measurements is normally between 3 to 7 values.

Q-Test

$$Q_{Calculated} = \frac{Gap}{Range} = \frac{\left|x_1 - x_{n+1}\right|}{r}$$

x_1 = _____

x_{n+1} = _____

r = range (largest – smallest value in data set)

$Q_{Table} < Q_{Calculated} \quad \therefore$ Disregard Value

$Q_{Table} > Q_{Calculated} \quad \therefore$ Retain Value

Number of Observations	(Q_{Table} or $Q_{Critical}$) (90% Confidence)	(95% Confidence)	(99% Confidence)
3	0.941	0.970	0.994
4	0.765	0.829	0.926
5	0.642	0.710	0.821
6	0.560	0.625	0.740
7	0.507	0.568	0.680
8	0.468	0.526	0.634
9	0.437	0.493	0.598
10	0.412	0.466	0.568

PRACTICE: DETECTION OF GROSS ERRORS CALCULATIONS 1

EXAMPLE 1: Wishing to measure the amount of caffeine in a cup of coffee you pour ten cups. From the data provided perform a Q-test to determine if the outlier can be retained or disregarded.

Caffeine per cup of coffee										
Cup of Coffee	1	2	3	4	5	6	7	8	9	10
ppm of coffee	81	83	78	82	72	79	77	81	82	78

EXAMPLE 2: White blood cells are the defending cells of the human immune system and fight against infectious diseases. Provided below is the "normal" white blood cell counts for a healthy adult woman. Determine if the current white blood cell count is reasonable by Grubbs test.

"Normal" Days	Today
5.1×10^{6} cells / μL	
5.4×10^{6} cells / μL	
4.9×10^{6} cells / μL	6.1×10^{6} cells / μL
5.2×10^{6} cells / μL	
5.3×10^{6} cells / μL	
5.0×10^{6} cells / μL	