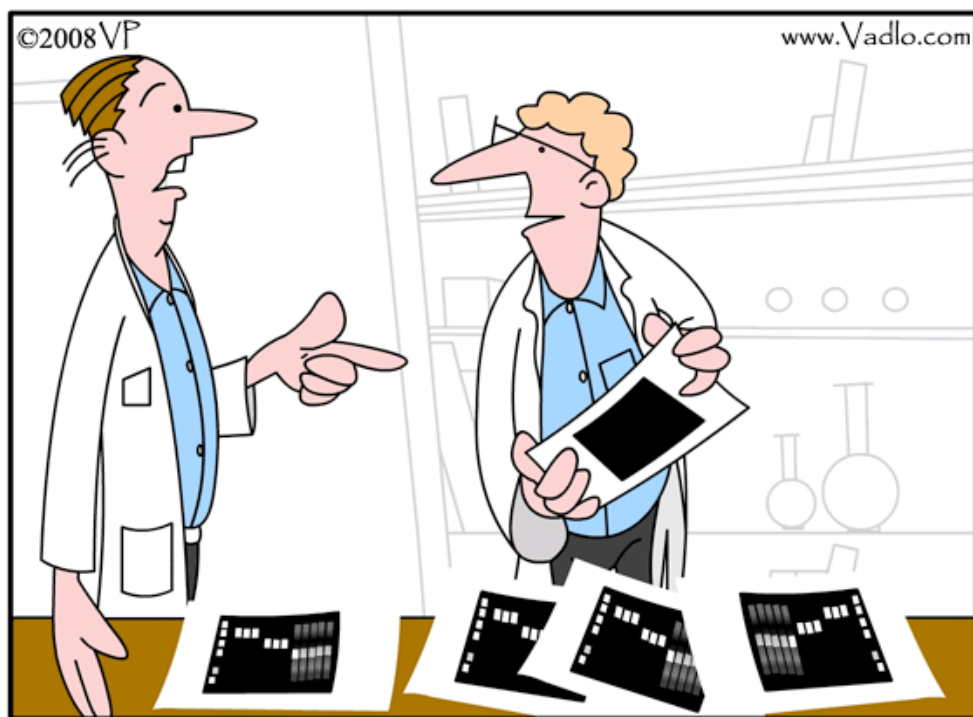


# Other Statistical Calculations

- *Comparison of Two Experimental Means*
- *Q-Test for the Rejection of Data Points*
- *Propagation of Errors*



*Data don't make any sense, we will have to resort to **statistics**.*

*Robert Corn - Chem M3LC  
UC Irvine*

## Comparison of Two Experimental Means

*Used to determine whether two experimentally measured values are statistically different.*

*Experiment A:*

*Number of data points:  $N_A$*

*Mean:  $x_A$*

*Std. Dev :  $s_A$*

*Experiment B:*

*Number of data points:  $N_B$*

*Mean:  $x_B$*

*Std. Dev :  $s_B$*

*Are  $x_A$  and  $x_B$  statistically different?*

*i) Calculate the pooled standard deviation ( $s_P$ ):*

$$s_P = \sqrt{\frac{\sum_{i=1}^{N_A} (x_i - x_A)^2 + \sum_{j=1}^{N_B} (x_j - x_B)^2}{N_A + N_B - 2}}$$

*Note that the total DOF is  $N_A + N_B - 2$*

## Comparison of Two Experimental Means

*Used to determine whether two experimentally measured values are statistically different.*

*ii) Calculate a t-value ( $t_{calc}$ ) using the equation:*

$$t_{calc} = \frac{|x_A - x_B|}{s_P} \sqrt{\frac{N_A N_B}{N_A + N_B}}$$

*iii) Compare  $t_{calc}$  with the t-value in the 95% table for the total DOF ( $t_{table}$ ):*

*If  $t_{calc} > t_{table}$ , then the two numbers are statistically different.*

*(95% Confidence Level)*

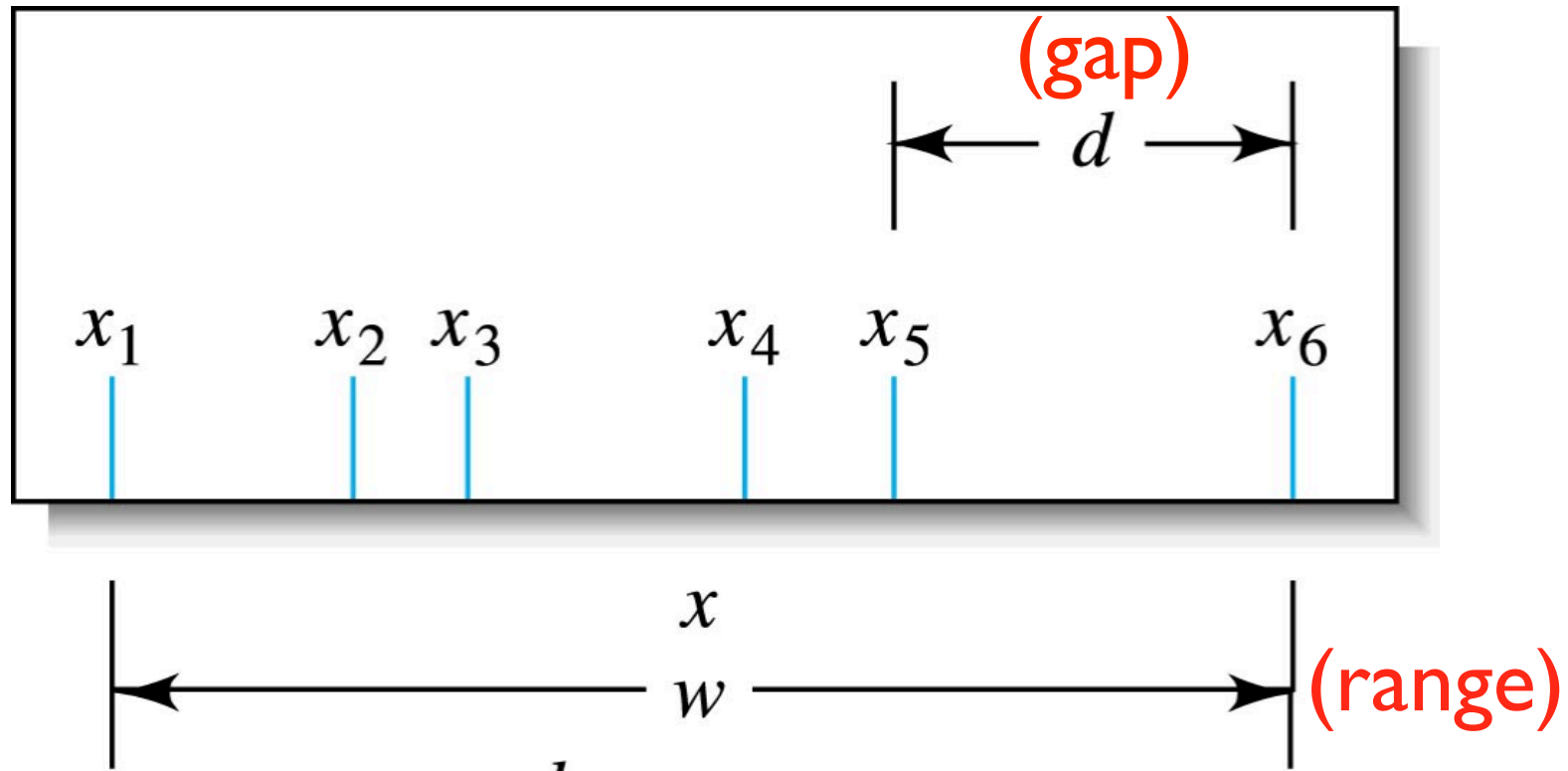
## *Q-Test for the Rejection of Data Points*

*Used to determine whether a data point can be rejected on the basis of determinate error.*

$$Q = \frac{\text{gap}}{\text{range}}$$

Compare to the  
tabulated value of  $Q_{\text{crit}}$   
reject if  $Q > Q_{\text{crit}}$

## Example of a Q-test:



$$d = x_6 - x_5$$

$$w = x_6 - x_1$$

$$Q = d/w$$

If  $Q > Q_{\text{crit}}$ , reject  $x_6$

**TABLE 7-5****Critical Values for the Rejection Quotient,  $Q^*$** 

Number of Observations	$Q_{\text{crit}}$ (Reject if $Q > Q_{\text{crit}}$ )		
	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

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*At a 95% Confidence Level,  $Q$  must be greater than 0.625 to reject the data point.*

# Propagation of Errors

*If you have multiple sources of error, you calculate the Standard Deviation using the method of "Propagation of Errors."*

Propagation of Errors.  
R. Corn - Chem M3LC.

Addition and Subtraction: sum of the squares of the absolute standard deviations:

$$y = a + b - c$$

$$s_y^2 = s_a^2 + s_b^2 + s_c^2$$

Multiplication and Division: sum of the squares of the relative standard deviations:

$$y = a b / c$$

$$\left(\frac{s_y}{y}\right)^2 = \left(\frac{s_a}{a}\right)^2 + \left(\frac{s_b}{b}\right)^2 + \left(\frac{s_c}{c}\right)^2$$

*Please see my handout on "Propagation of Errors for more information.*