Intermediate Laboratory – PHX 3870
Lecture Two

Error Analysis
Uncertainties

Enter reduced data:

$N := 10 \qquad n := 0 .. (N - 1)$

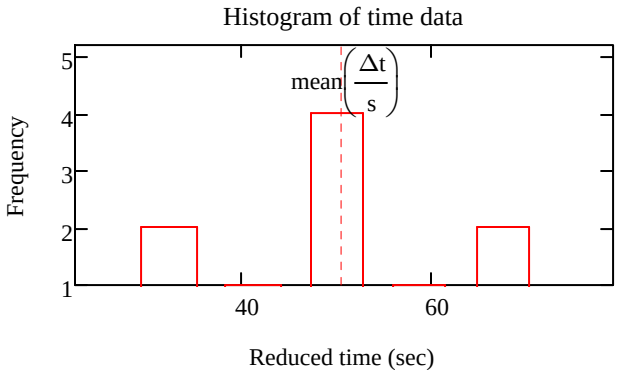
N is number of data points:

$\Delta t_n :=$

35
47
66
72
46
28
45
53
62
52

Find the "best guess":

Method 1: Center of histogram



Method 2: Average (mean) Value

Longhand : $\frac{1}{N} \cdot \sum_n \Delta t_n = 50.6\,s$

Shorthand : $\text{mean}(\Delta t) = 50.6\,s$

What is the uncertainty?

Calculate deviations from the mean

$Dev := \Delta t - mean(\Delta t)$

$n =$	$\Delta t_n =$		$Dev_n =$	
0.0	35.0	s	-15.6	s
1.0	47.0		-3.6	
2.0	66.0		15.4	
3.0	72.0		21.4	
4.0	46.0		-4.6	
5.0	28.0		-22.6	
6.0	45.0		-5.6	
7.0	53.0		2.4	
8.0	62.0		11.4	
9.0	52.0		1.4	

Method 1: Range of deviations

$mean(\Delta t) = 50.6\,s$

\+ $max(Dev) = 21.4\,s$

\- $min(Dev) = -22.6\,s$

Method 2: Standard (RMS) Deviation

$$\sqrt{\frac{\sum_n \left(Dev_n\right)^2}{N-1}} = 13.5\,s$$

$Stdev(\Delta t) = 13.5\,s$

Method 3: Standard Deviation of the Mean

$$\sqrt{\frac{\sum_n \left(Dev_n\right)^2}{(N-1)\cdot N}} = 4.3\,s$$

$$\frac{Stdev(\Delta t)}{\sqrt{N}} = 4.3\,s$$

$$\Delta t := \Delta t \cdot s$$

$$N_{bins} := floor\left(\frac{N}{2}\right)$$

$$h := \left(\frac{ceil\left(max\left(\frac{\Delta t}{s}\right)\right) - floor\left(min\left(\frac{\Delta t}{s}\right)\right)}{N_{bins}}\right) \cdot s$$

$$j := 0 .. \left(N_{bins}\right)$$

$$int_j := floor\left(min\left(\frac{\Delta t}{s}\right)\right) + \frac{h}{s} \cdot (j)$$

$$F := hist\left(int, \frac{\Delta t}{s}\right)$$