Kip Hodges

Monte Carlo Error Propagation

For three measurements (x_1, x_2, x_3) with assigned standard deviations (σ_1, σ_2, σ_3), we create three "bins" of data (B_1, B_2, B_3) that contain a large number (p) of synthetic data with

Mean (B_1) = x_1 Stdev (B_1) = σ_1
Mean (B_2) = x_2 Stdev (B_2) = σ_2
Mean (B_3) = x_3 Stdev (B_3) = σ_3

We then select one element at random from each bin (y_1, y_2, y_3) and calculate a **mean**

Mean (sample)$_1$ = (y_1 + y_2 + y_3)/3.

We repeat this procedure a large number of times (r) such that we have a population of synthetic means from which we can extract the mean,

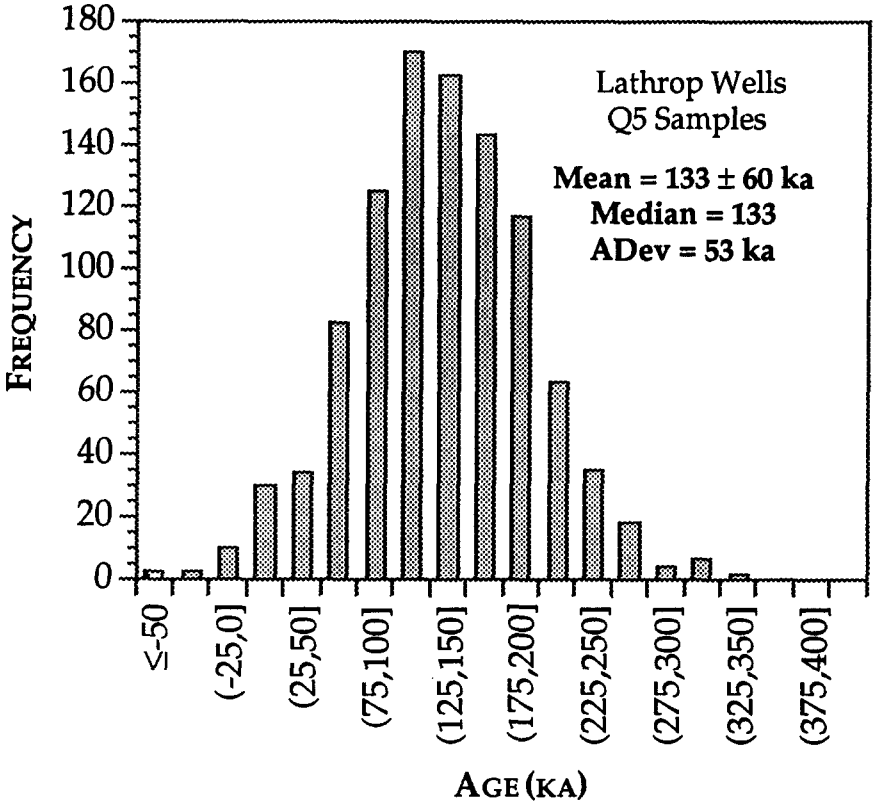
$$\text{Mean (population)} = \frac{\sum_{n=1}^{r} \text{Mean (sample)}_r}{r}$$

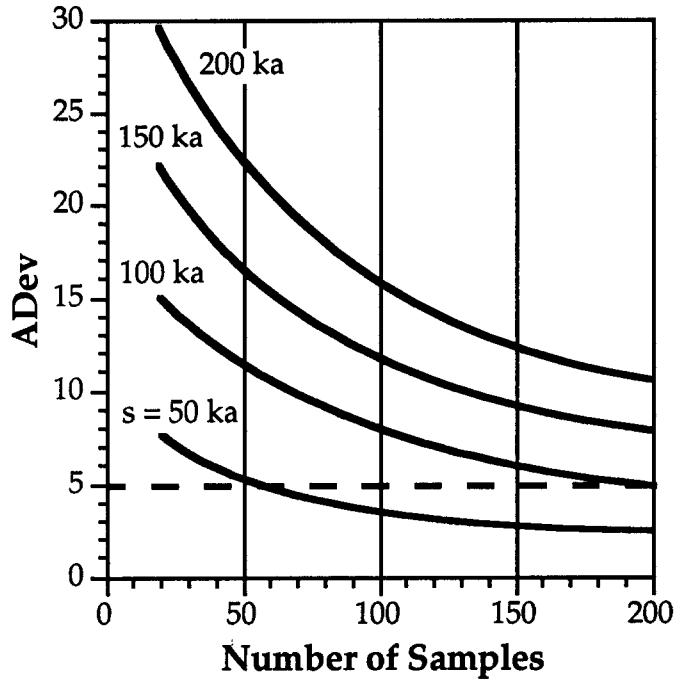
the **standard deviation,**

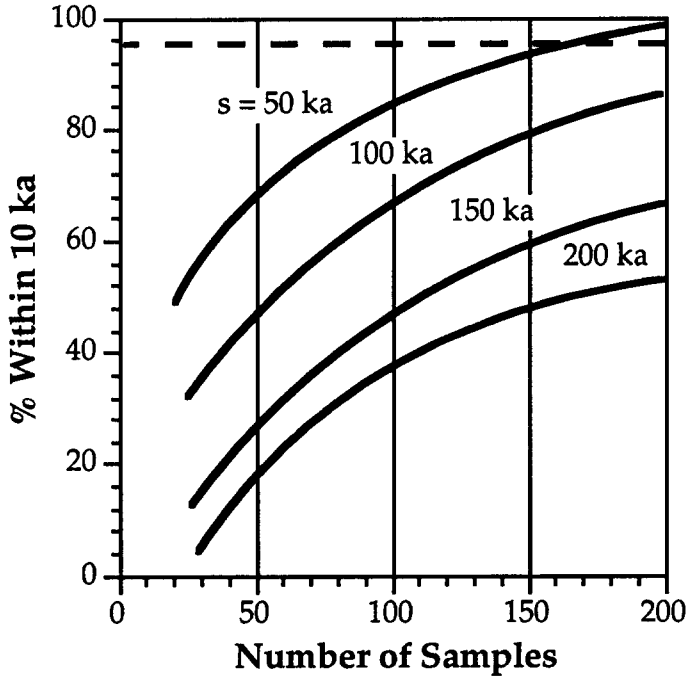
$$\text{SDev (population)} = \sqrt{\frac{\sum_{n=1}^{r} (\text{Mean (sample)}_r - \text{Mean (population)})^2}{(r-1)}}$$

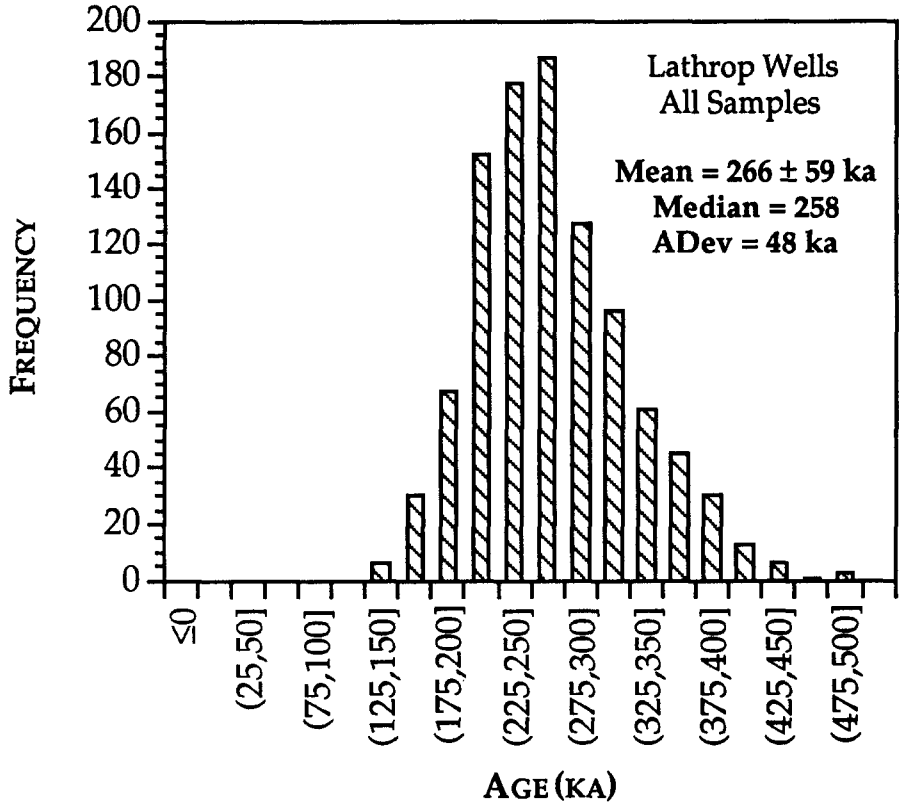
and the **mean absolute deviation**

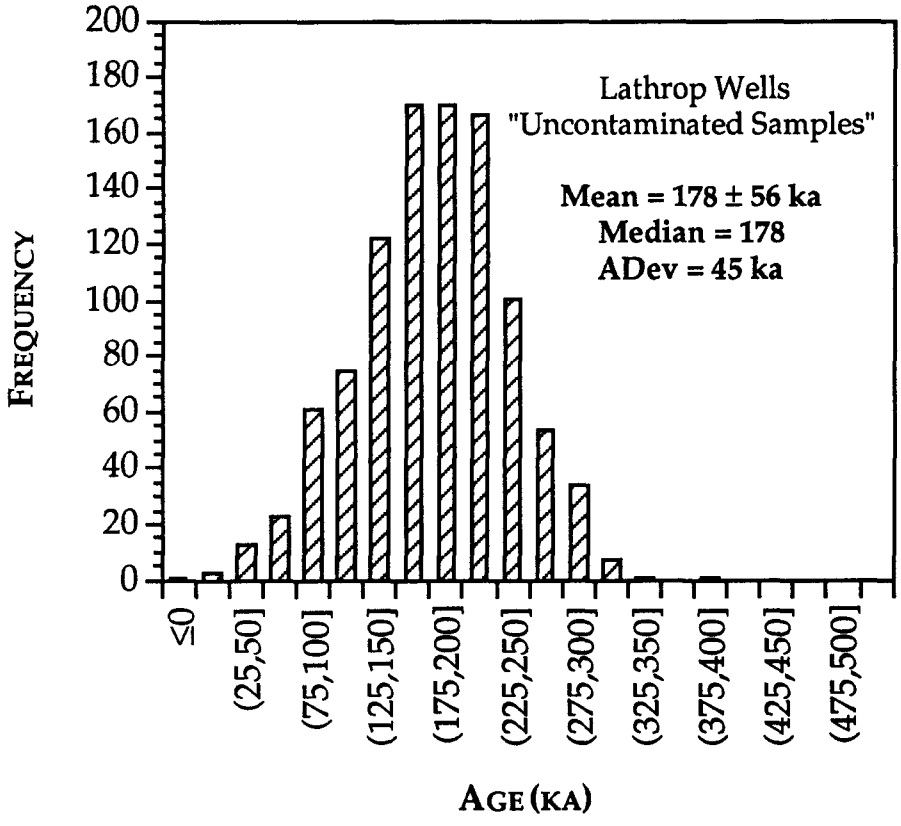
$$\text{ADev (population)} = \frac{\sum_{n=1}^{r} | \text{Mean (sample)}_r - \text{Mean (population)} |}{r}$$


Lathrop Wells
Q5 Samples
Mean = 133 ± 60 ka
Median = 133
ADev = 53 ka
FREQUENCY
AGE (KA)
180
160
140
120
100
80
60
40
20
0
≤-50
(-25,0]
(25,50]
(75,100]
(125,150]
(175,200]
(225,250]
(275,300]
(325,350]
(375,400]


30
25
20
15
10
5
0
ADev
200 ka
150 ka
100 ka
s = 50 ka
0
50
100
150
200
Number of Samples


100
80
60
40
20
0
% Within 10 ka
s = 50 ka
100 ka
150 ka
200 ka
0
50
100
150
200
Number of Samples


Lathrop Wells
All Samples
Mean = 266 ± 59 ka
Median = 258
ADev = 48 ka
FREQUENCY
AGE (KA)
200
180
160
140
120
100
80
60
40
20
0
≤0
(25,50]
(75,100]
(125,150]
(175,200]
(225,250]
(275,300]
(325,350]
(375,400]
(425,450]
(475,500]


Lathrop Wells
"Uncontaminated Samples"
Mean = 178 ± 56 ka
Median = 178
ADev = 45 ka
FREQUENCY
AGE (KA)
200
180
160
140
120
100
80
60
40
20
0
≤0
(25,50]
(75,100]
(125,150]
(175,200]
(225,250]
(275,300]
(325,350]
(375,400]
(425,450]
(475,500]