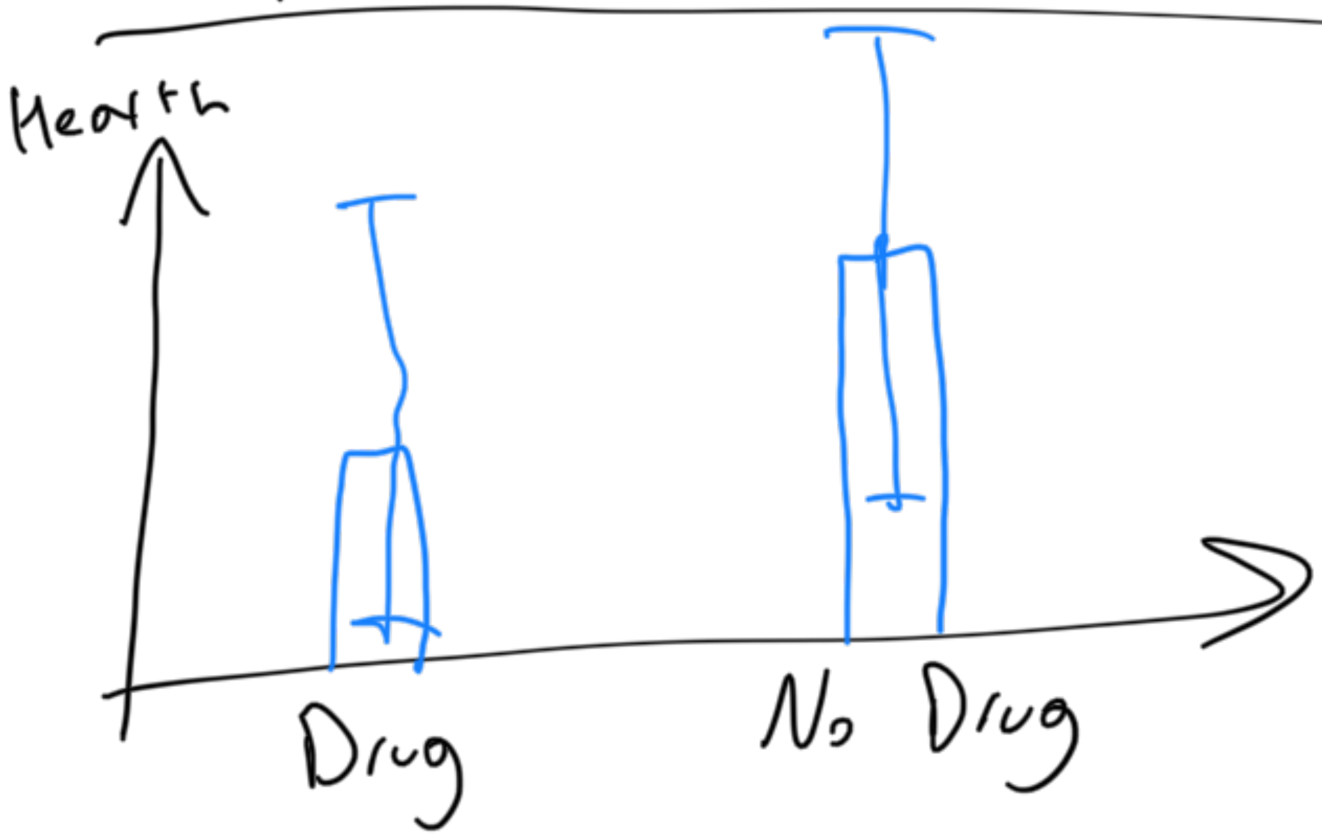
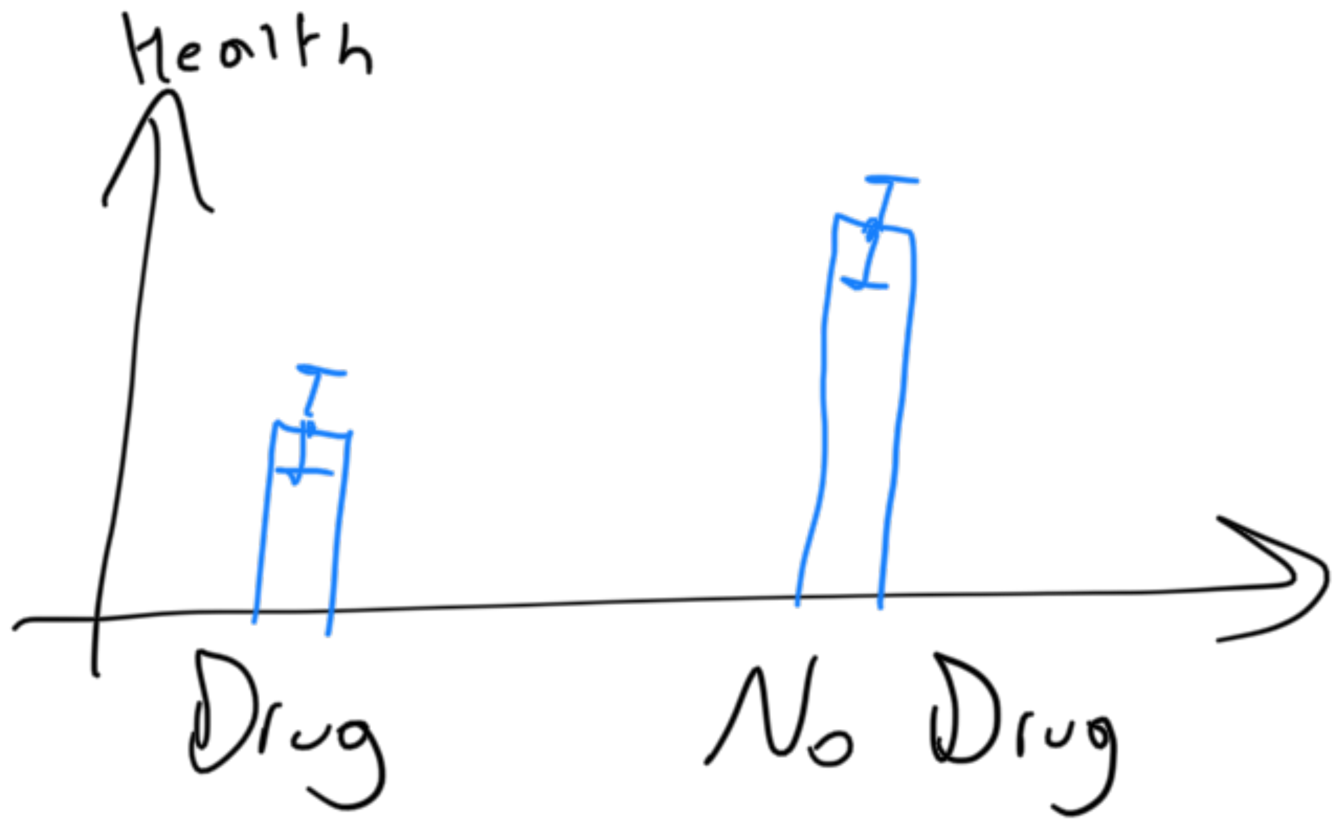
Error and Hypothesis Testing

Importance of Error Bars

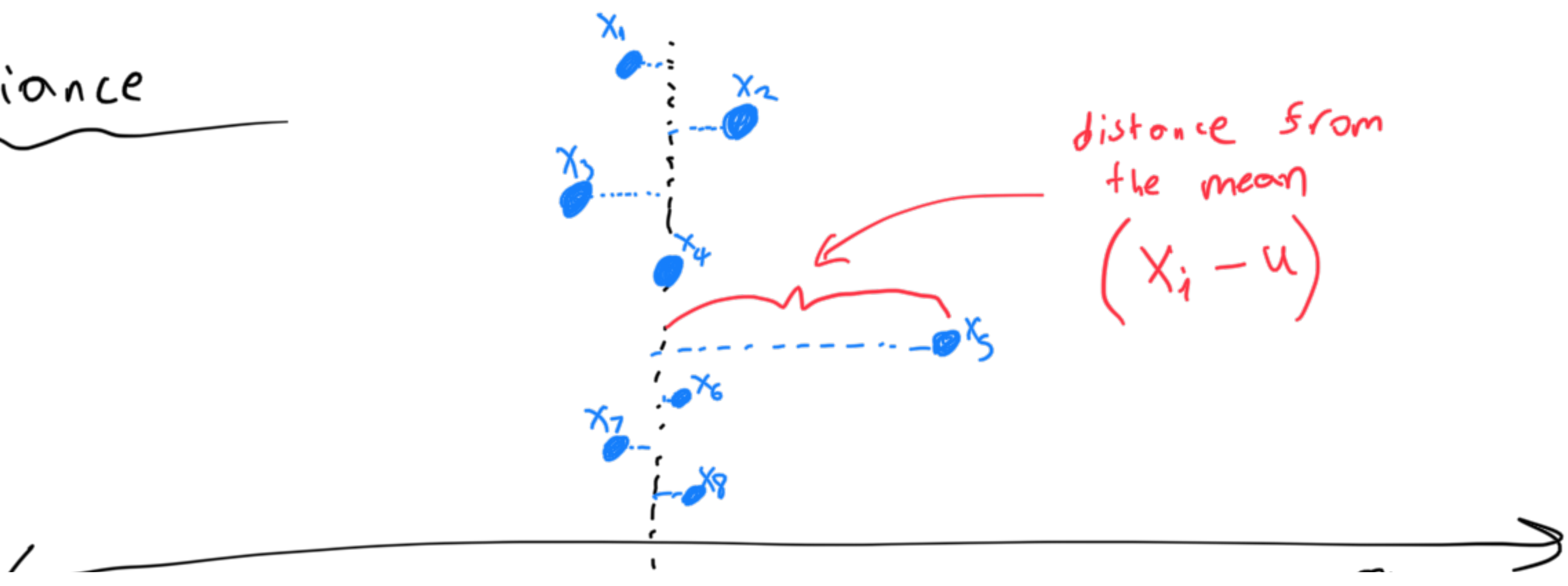


vs.



Ways to Measure Error

Variance



glucose measurements

mean

(u)

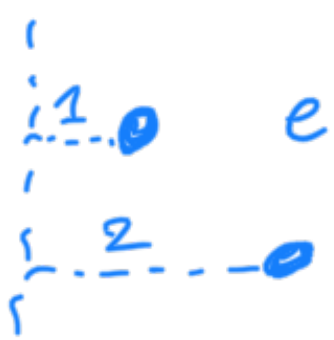
"Average" in math $= \dfrac{\text{sum of values}}{\text{number of values}}$

$= \dfrac{\sum_i}{n}$

"almost" Variance $= \frac{1}{n}\sum_i (x_i - u)$

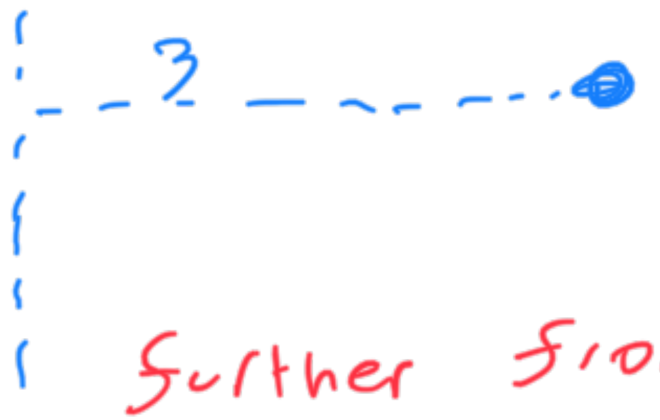
average — distances from the mean

Variance $= \frac{1}{n}\sum_i (x_i - u)^2$



error $= 1^2 = 1$

error $= 2^2 = 4$



error = $3^2 = 9$

further from mean

→ exponentially more error

Confidence Interval

Sorted list of glucose measurements:

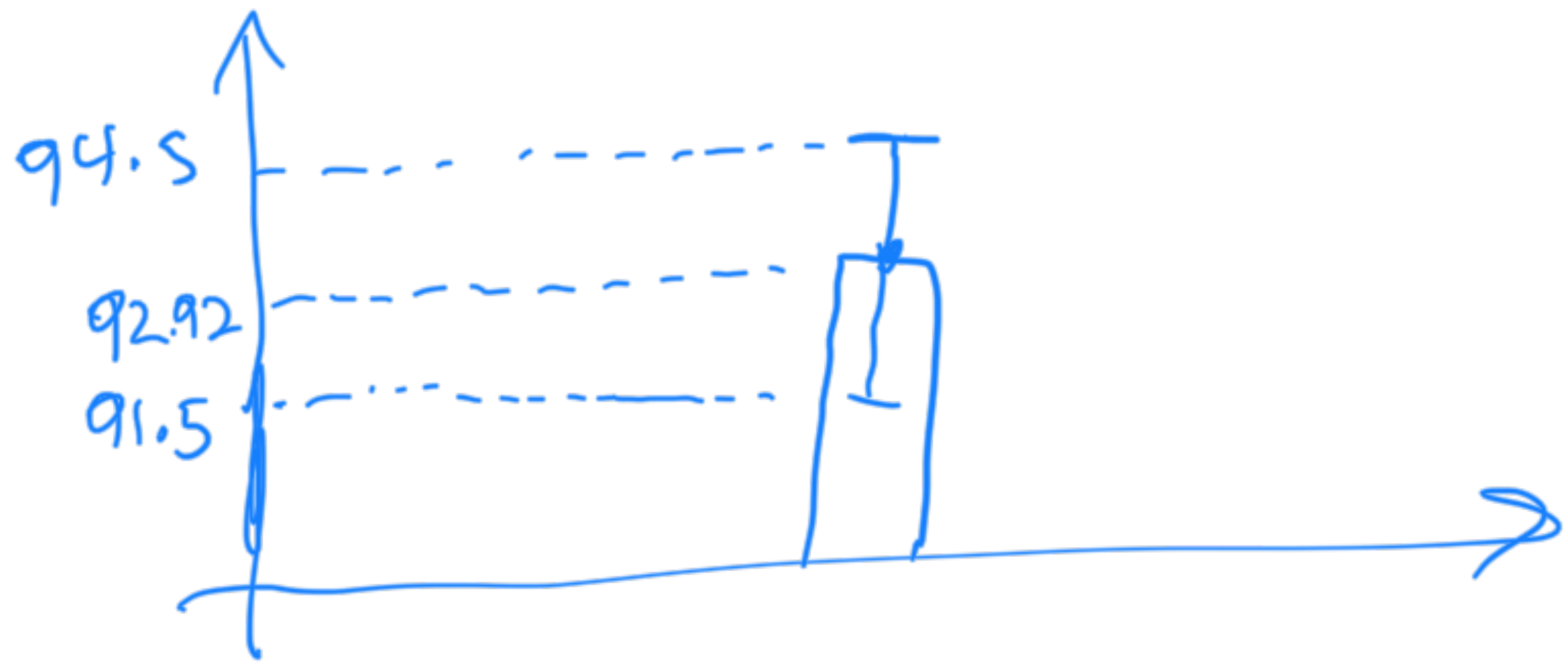
[91, 91.5, 92, 92, 92, 93.5, 93.7, 94, 94.5, 95]

(91.5 … 94.5): 80% of the data

mean = 92.92

80% confidence interval = (91.5, 94.5)

80% Confidence



Hypothesis Testing

Goal: test whether 2 sets of data are significantly different

Output: p-value

P-value: probability that any observed difference between 2 groups is due to random chance

Statistically Significant: p-value < threshold

Commonly: 0.05, 0.01, 0.001 depending on the application

T-Test

Goal: Test whether means of two groups are statistically significant.

One-Sample T-Test: test against a pre-specified mean

Example: government reports mean selenium value of

water is 0.05 mg/L.
You want to test if this correct!

You take some measurements:

data { 0.051, 0.0505, 0.049, 0.056,
0.052, 0.0508, 0.0506

"Null Hypothesis": mean = 0.05

"Alternate Hypothesis": mean > 0.05

one-sample
T-test(expected mean, list of observations)