AMS 5

MEASUREMENT ERROR
Measurement Error

- If you measure something more than once under what you think are identical conditions, you may well get a different answer each time.

- Why? **Measurement Error.**

- Observed value = true value + (observed value – true value).

- Measurement Error = (observed value – true value) = systematic error + random error.
Measurement Error Model

- Observed Value = (true value + bias) + random error.
- **Bias** = systematic error. If you ask the person who sells fish at your favorite market to weight a piece of fish several times for you, and he puts his thumb on the scale in a way that makes the fish seem 2 ounces heavier than it is, that’s bias- a systematic tendency to over or underestimate the true value. Notice that systematic error doesn’t move around from observation to observation- that’s what makes it systematic.
- **Random Error**. They have no patterns or trends and their average is close to zero. Weight you fish several times using different weights, you will get different answers because of the random errors. What is the true weight?
Measurement Error Model

- The population in measurement error models is infinitive (represent what you might get each time you repeat the process of interest).

- Sample → Randomness
  - The measurements are taken under essentially identical conditions
  - The quantity being measured doesn’t change over time while we are trying to measure it.

- IID (independent identically distributed) sample (random sampling with replacement).
Average

- Observation 1 = true value + random error 1
- Observation 2 = true value + random error 2
- Observation n = true value + random error n

Average of the n observations = true value + Average of the n random errors = true value

Numbers fluctuating around 0, averaging them involves adding a bunch of numbers, some of which are positive and some negative, and what happens is that they cancel each other.
Does taking repeated observations and averaging them produced a better answer?

Yes BUT

1. REMOVE BIAS FIRST
2. BE SURE ABOUT THE IID sample
3. REMOVE OUTLIERS (extreme measurements)