SCHOOL OF INFORMATION
UNIVERSITY OF MICHIGAN

Learning Analytics (680)

Office Hour 2

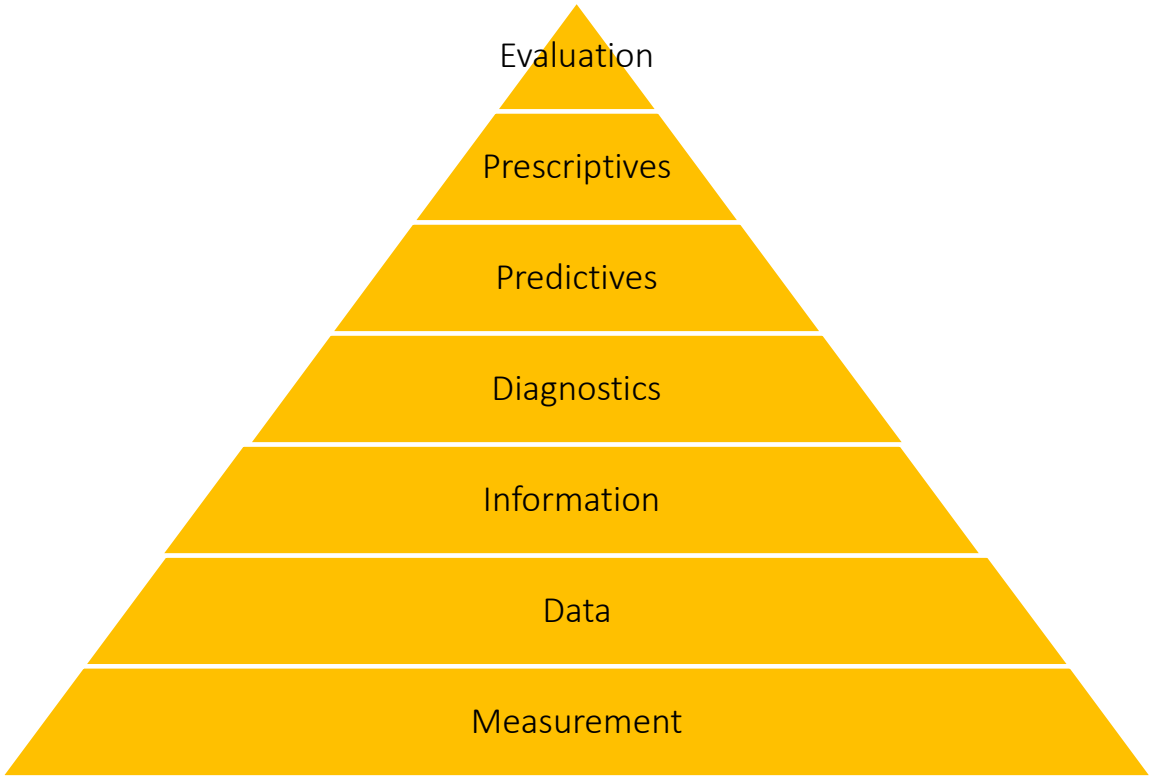
N. Sheltrown


Pie I have eaten
Pie I have not yet eaten

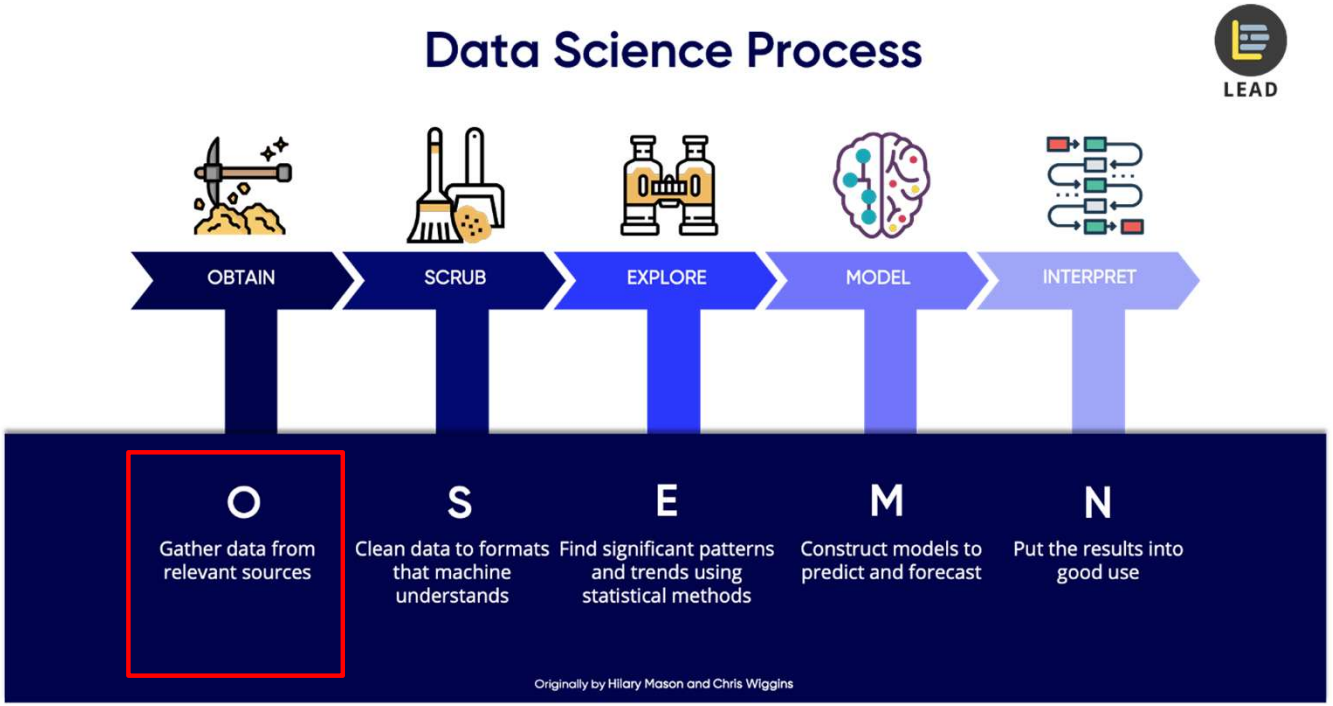
Learning Analytics:

The importance of learning measurement

The Analytics Pyramid



What we do vs. what we learn



The focus of data science courses

https://towardsdatascience.com/5-steps-of-a-data-science-project-lifecycle-26c50372b492

Measurement

"…if I had to reduce all of educational psychology to just one principle,
I would say this: 'The most important single factor influencing learning
is what the learner already knows. Ascertain this and teach him accordingly."

- Professor David Ausubel
Thorndike Award Winner
from the American Psychological Association

Agree or disagree?

Anything you need to quantify can be measured in some way that is superior to not measuring it at all.

- Gilb's Law

Book recommendation

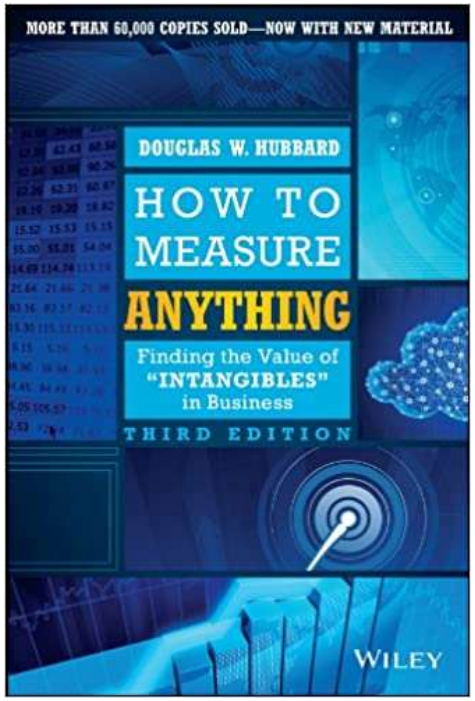
There are a few books that I highly recommend for anyone who wants to dedicate their professional life to analytics.

How to Measure Anything: Finding the Value of Intangibles in Business.

Douglas W. Hubbard

Available at:

https://onlinelibrary-wiley-com.proxy.lib.umich.edu/doi/pdfdirect/10.1002/9781118983836



"Why do we care about measurements at all? There are just three reasons. The first reason – and the focus of this book – is that we should care about a measurement because it informs key decisions. Second, a measurement might also be taken because it has its own market value (e.g., results of a consumer survey)…Third, perhaps a measurement is simply meant to entertain or satisfy a curiosity (e.g. academic research about the evolution of clay pottery)."
- D. Hubbard, *How to Measure Anything*

More from *How to Measure Anything:*

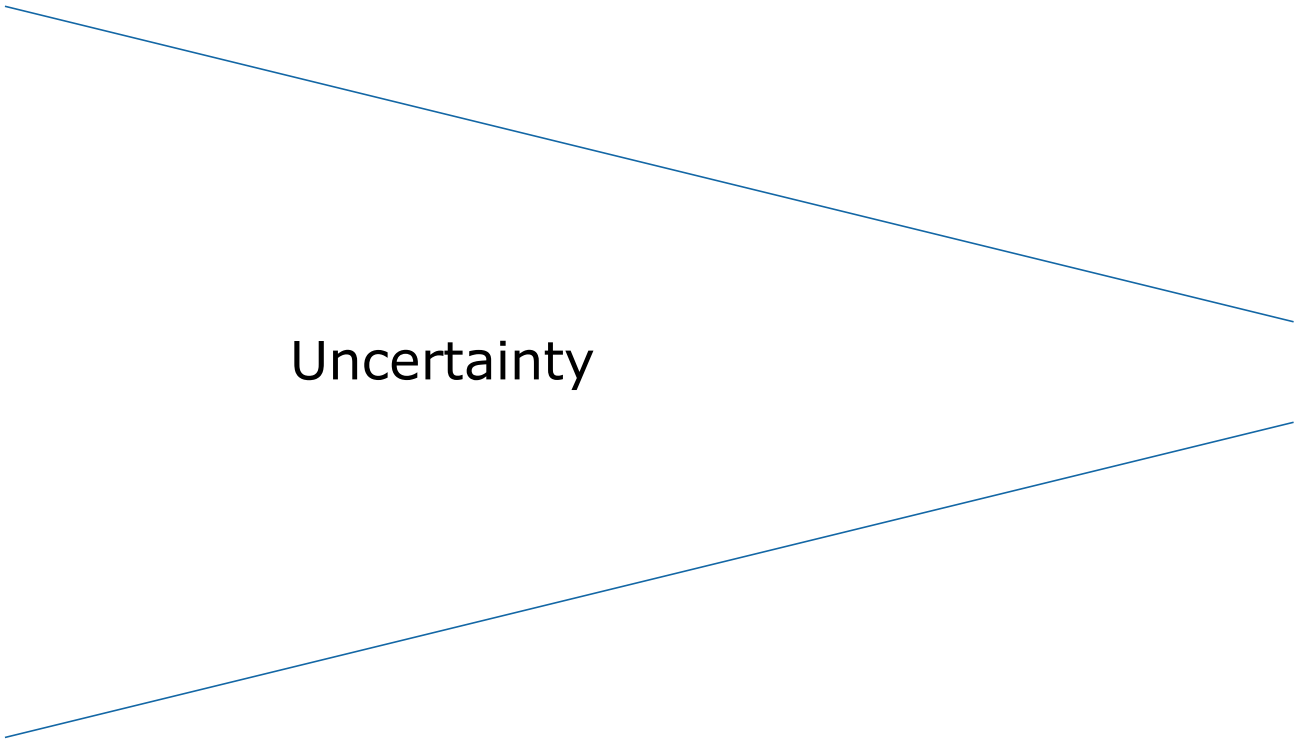
1. Decision makers usually have imperfect information (i.e., uncertainty) about the best choice for a decision.

2. These decisions should be modeled quantitatively because (as we will see) quantitative models have a favorable track record compared to unaided expert judgment.

3. Measurements inform uncertain decisions.

4. For any decision or set of decisions, there is a large combination of things to measure and ways to measure them—but perfect certainty is rarely a realistic option.

The goal of good measurement should narrow but not likely eliminate decision uncertainty (524).



The importance of measurement

Measurement is the foundational layer of analytics pyramid, the fundamental activity to all analytical work, whether it is in business, government, healthcare, military, or education. Just a chef must start with good ingredients, learning analytics begins with its foundational ingredient, measurement. Few phenomenon can be measured perfectly, however, measurement is not about acquiring perfect information. *It is about reducing uncertainty*.[1] In measurement, we would rather be approximately right than precisely wrong.[2]

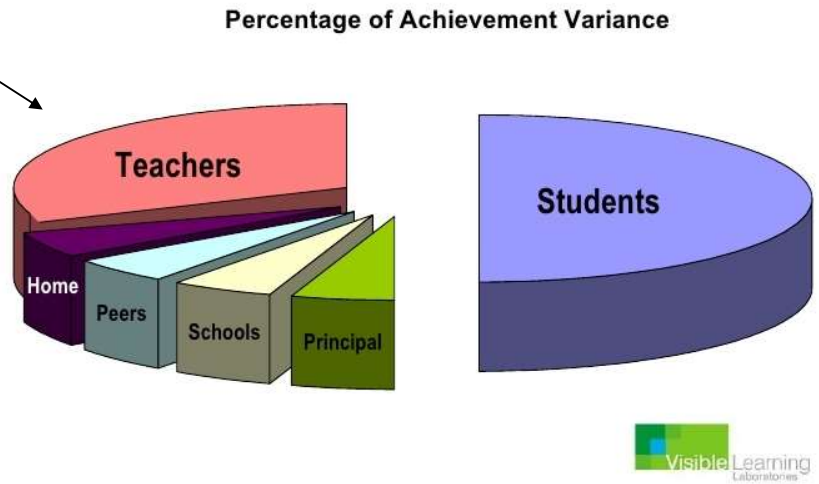
[1]Douglas Hubbard. (2010). *How to measure anything: Finding the value of intangibles in business*. John Wiley & Sons.
[2]This is a paraphrase of British philosopher Carveth Read, "It is better to be vaguely right than exactly wrong."

It is not so easy.

How do you measure good teaching quality?

Reliability issues

- *Administrator Observation?*
- *Peer Observation?*
- *Test scores?*
- *Student evaluations?*

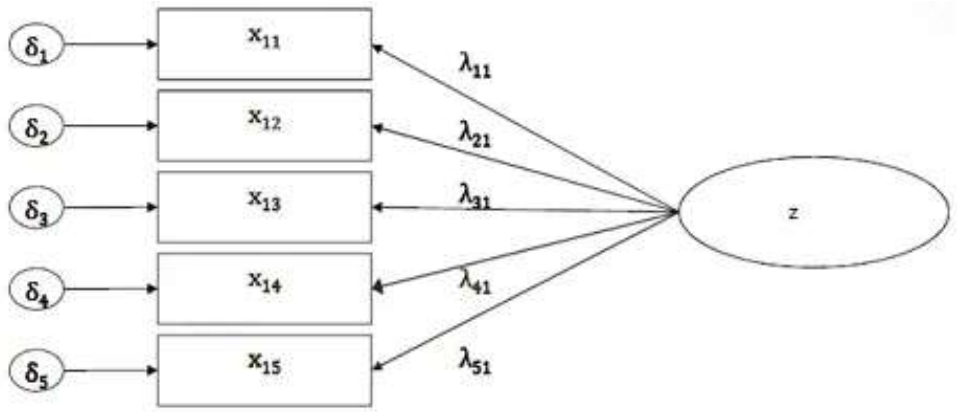


What is the minimum talent threshold?

Measurement Problem 1: Latent Variables

What we are interested often not directly measurable. For example, suppose you want to measure *happiness* across 9 regions. How do you measure happiness?

Latent constructs are not directly measurable (they are unobserved, hidden), but are what we are ultimately interested in.



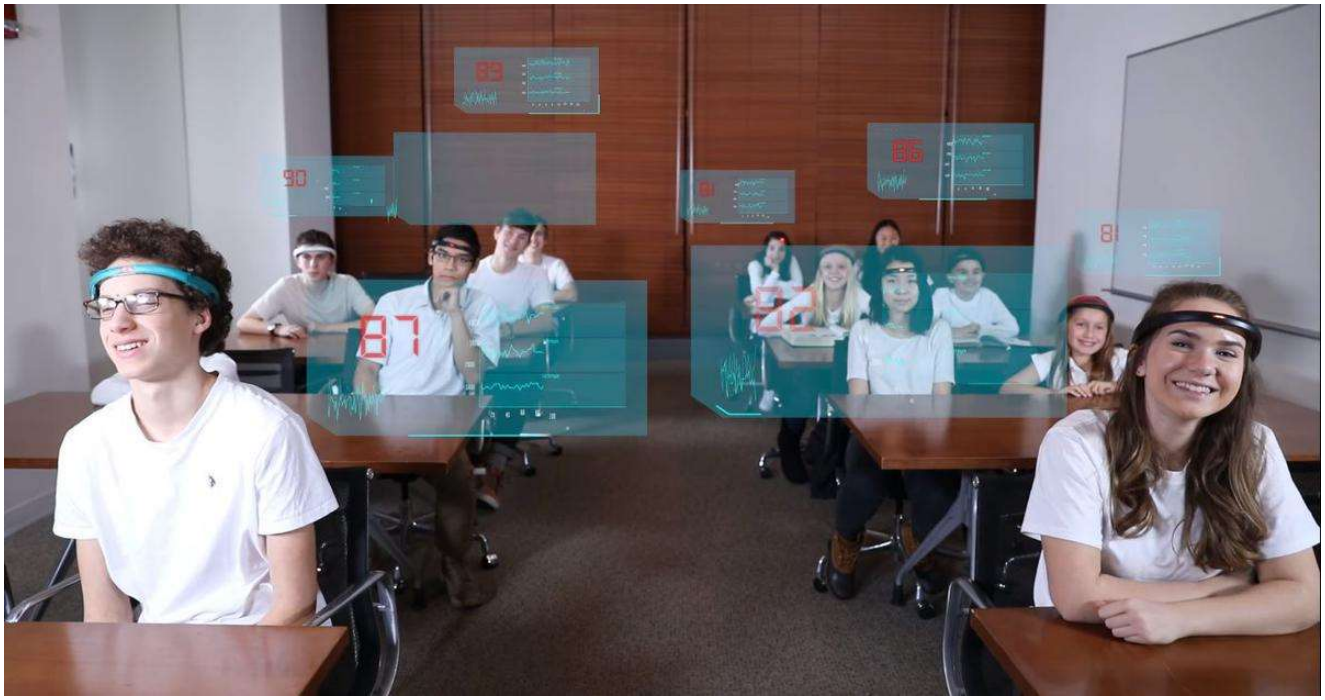
One common way to explore latent constructs is through structural equation modeling.

Learning is a Latent Variable

Measuring learning is complicated for several reasons. First, let's begin with a somewhat counterintuitive, philosophical idea: learning is a difficult thing to measure because we lack direct measures of learning. As Dan Koretz writes:

> "Of the many complexities entailed by educational testing, the most fundamental, and the one that is ultimately the root of so many misunderstandings of test scores, is that test scores usually do not provide a direct and complete measure of educational achievement. Rather, they are incomplete measures, proxies for the more comprehensive measures that we would ideally use but that are generally unavailable to us."
> (Dan Koretz, *Measuring Up)*

We cannot actually measure thinking process directly (yet).



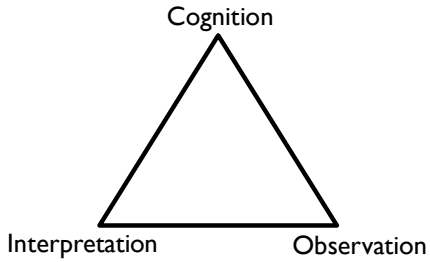
https://scroll.in/article/946204/in-a-chinese-school-a-mind-reading-headband-tells-teachers-when-their-students-are-distracted

What we try to measure in schools.

Latent Construct	Measurement	Issue
Content knowledge mastery	Tests	What content? What format?
Critical thinking	Tests	What content? Reliability issues?
Engagement	Survey/Observations	Point-in-time, variable
Behavior	Discipline incident tracking	Qualitative or reductionistic
Academic behaviors (grit)	Surveys, GPA	Validity?

In the National Research Council's monograph on assessment and measurement, the editors provide a useful dissection of educational measurement:

"Every assessment, regardless of its purpose, rests on three pillars: a model of how students represent knowledge and develop competence in the subject domain, tasks or situations that allow one to observe students' performance, and an interpretation method for drawing inferences from the performance evidence thus obtained." (p. 2).



Measurement Problem 2: Students

Testing is always an exercise of cooperation.

map GROWTH™

New: Remote Testing Support

–See Other School or District Level Reports–

More help: NWEA Support

Retest Recommended—Rapid Guessing

Includes whatever schools, grades, subjects you choose

Includes measurement of rapid guessing

Student First Name	Student Middle Initial	Term Tested	Term Rostered	School	Grade	Subject	RIT Score	Rapid-Guessing %
Brookkit		Winter 201	Winter 2018-2019	Foxcroft Elem	2	Mathematics	134	31
Ciara		Winter 201	Winter 2018-2019	Foxcroft Elem	12	Mathematics	155	35
Ciara		Winter 201	Winter 2018-2019	Foxcroft Elem	K	Mathematics	141	36

Description

Provides a spreadsheet showing students who completed testing but exceeded the rapid-guessing threshold, so you can consider whether to retest.

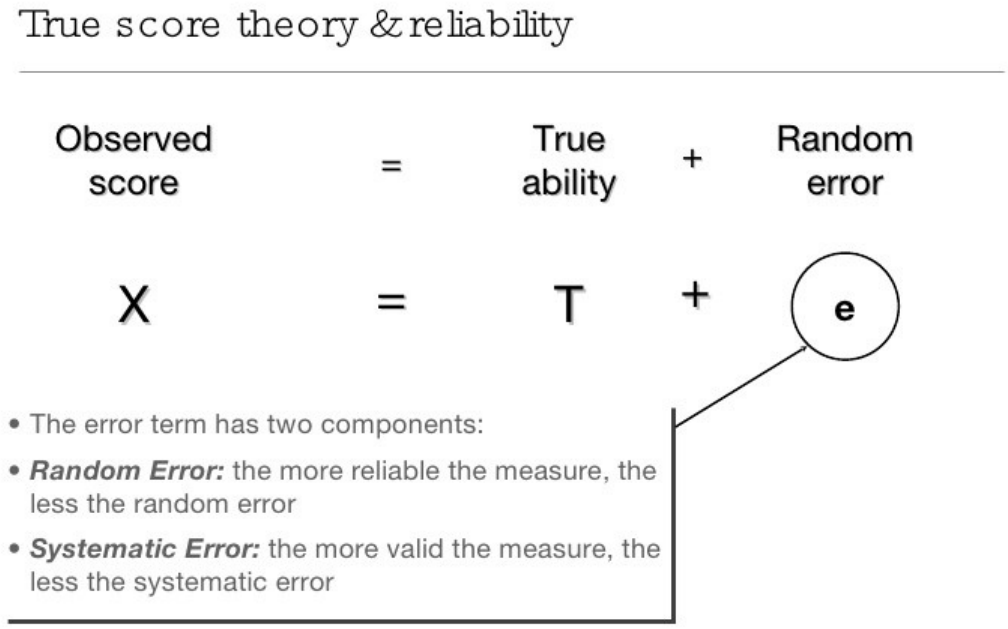
See also:

- Student Profile Report—shows estimated impact on a student's score from rapid guessing
- Test History Search (under Manage Test Sessions > Find Students to Test)—searches for students with suspended tests or with completed tests that reached the rapid-guessing threshold

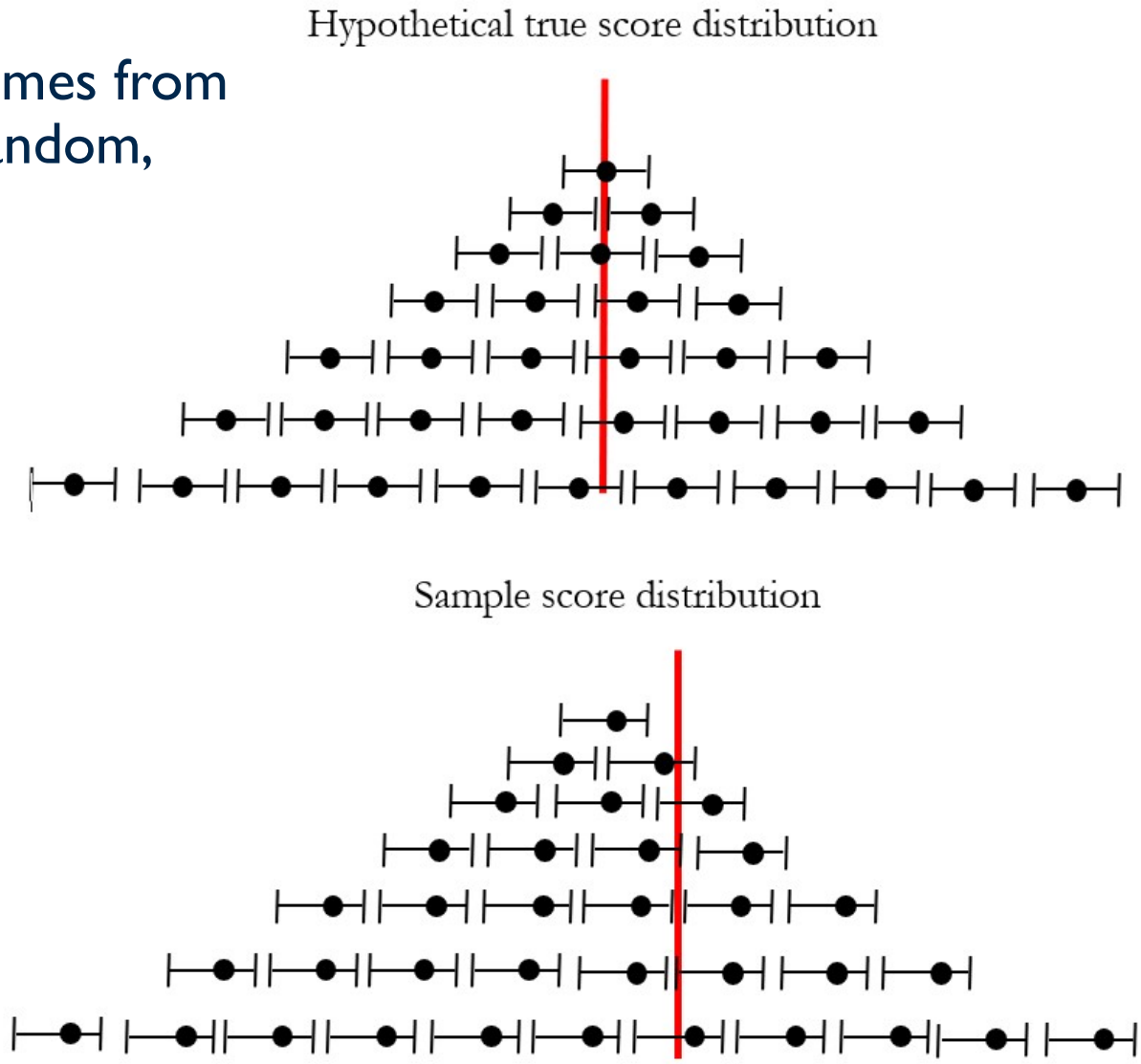
Measurement Problem 3: Unavoidable error

The error is fundamental to the measurement process.

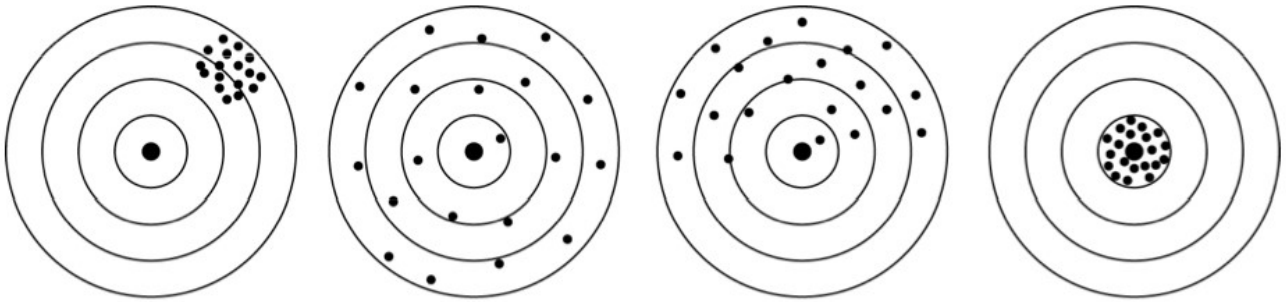
All measures of learning should be taken as estimates, given the variability introduce by item design, item selection, student performance, and standard sampling



Sometimes uncertainty comes from measurement itself. It is random, irreducible, and influential.



Measurement error can be described in terms of validity and reliability.



Measurement in learning is a complex domain.

			What you measure	
			Content Knowledge	Growth
How you measure	Frame of reference	criterion	knowledge relative to standards	expected growth/gts
		normative	knowledge relative to others	typical growth
	form of assessment	fixed form	same questions for all students	
		computer adaptive	custom configuration of questions	
		item types	closed response vs. open response	
Why you measure	Intended action	placement	appropriate placement	
		diagnostic	diagnose needs	
		predictive	forecast outcomes	
		formative	adjust instruction	
		summative	evaluate knowledge	evaluate learning

Measurement in learning is a complex domain.