

Bonjour à tous. Good day everybody

[92/92]

I am very happy to see such interest in the topic of teaching.

I congratulate the Society for recently setting up the two awards that promote and recognize the importance of education and learning.

Un grand merci à ceux qui m'ont nommé pour la version 'senior'

I would like to acknowledge the mentors and others I 'learned' from and tried to emulate.

I especially thank all the students who took courses from me: it's because of them that I'm here today.

I am dedicating this talk [24/116]

. to my family, for their support for the last 50 years → . → . → .

Before we get going, ... !!! [69/185]

if you're willing, → here's a short anonymous survey

It takes about 30 seconds on your phone

→ [-> QR code]. It's just a few simple questions on height and family -- fill in what you can.

And don't worry about precision -- approximate answers are fine I'll leave that up for a few seconds as I begin.

Thanks. Now to the topic of this session [80/265]

➔ It is all about one question... [SLIGHT PAUSE]

How do we make a large collection of teaching materials actually usable by other teachers? [PAUSE]

To get there, I'll briefly give you ➔ .

- a quick sense of where the material comes from,

- what it looks like as a collection,

and then address the CORE issue: how someone might actually find and use it?

Let me start with a very brief sense of where I – and this collection – came from [79/344]

In small classes, I used a simple 'break-the-ice' exercise.

Each student would give a short show-and-tell about themselves.

It gave them practice presenting... and confidence, because they were talking about something they knew

well.

At the first class, I would show my own bio as a template.

Here's some images of where → I grew up.

and [7/351]

. → went to school and

and here's [11/362]

the → trajectory of my career in North America.

Seeing those early pictures reminds me of one of my first teaching experiences. [56/418]

. At age 8, I was an informal TA in this → single room where one teacher taught several grades

I would lead the younger students through their addition tables while the teacher worked with another grade.

I remember ENJOYING it.

BUT, at age 21, [210/628]

, → when doing my Master's,

I had a VERY DIFFERENT experience.

I was asked -- rather unexpectedly -- to give the compulsory statistics lectures to the medical students.

I had no experience teaching statistics... and I was the same age as them.

they were not especially interested. All they wanted to know was: what's on the exam?

When I wouldn't tell them, they started to interrupt and show me they knew more about statistics than I did -- and to make wise-cracks.

When teaching the bell curve, I used people's white blood cell counts as an example. They rightly told me that it would have a MUCH LONGER RIGHT TAIL

-- and when I was illustrating the 2-sample t-test, the smart aleck up at the back embarrassed me even more. He told everyone what my pair of 'overlapping bell curves' looked like to him.

It wasn't a auspicious introduction to my teaching of statistics. Teaching statistics in compulsory courses is challenging... and sadly it's often relegated to inexperienced instructors.

The material I'll talk about today is for busy teachers of all ages -- but it may be especially useful to those of you starting out.

I was an early adopter of computers in teaching, [161/789]

and once the internet came along, I created my own website [→](#). and began putting all my course materials on there [→](#).

Over time, it grew... course by course... year by year.

Course Management Systems came later, but they tend to keep material private, and tied to a particular semester.

I share all my materials with everyone. I put in a search box and I often use it myself to locate things

Many people suggested I turn the material into a book... but I tried that and found it quite constraining.

This award prompted me to think again about a way to LEAVE IT WHERE IT IS it, but somehow share it, but without having to upload each item to some central repository

The PROBLEM is that is so extensive -- and scattered between courses -- that it's not that easy to find anything.

Before I show you what's behind this collection, [97/886]

let me say one thing about how I approached teaching
 ➔ .

If I had to summarize it in one sentence, it would
 be this: ➔ .

start with the QUESTION, not the method.

That idea runs through everything that follows.

I try to build exercises around real studies -- not
 textbook data, but real research contexts, with the
 full text reports of the studies

And I try to keep the focus on understanding and on
 the bigger picture, and not just technique.

So [79/965]

This ➔ is what the collection actually looks like.
 ➔ . It's grown over many years... course by course...
 example by example.

Because I try to start with real questions, it's a
 very RICH collection...

But... it's not organized in a way that other teachers
 can actually use.

. ➔ . It's essentially UN-CATALOGUED.

Some of us remember when catalogs meant drawers
 of index cards. This is the same problem -- just

digital.

So the question becomes: — If you were teaching next week [123/1088]

how would you find useful material in this collection?

So that you can appreciate the challenge as it stands now,

for example 1 I have selected some exercises from the notes for one topic. [→](#) .

. They are all based on a story to do with OCEANOGRAPHY.

-- It has a STATISTICAL HERO, (a pioneering 19th-century Canadian-born scientist!)

-- a SIMPLE MODEL,

-- AND a lovely 21-century big-data VALIDATION.

The full story is in a link inside the notes, so I won't say more about it right now.

Here's a bird's-eye view [→](#) of some of the exercises I built around it .

and [23/1111]

here are the rest [→](#) You can see that the story has LOTS of statistical angles, --

and mathematical levels.

Let's just zoom in on the [75/1186]

. → first 2 parts of Question 1 . Gelman and Nolan's 'Bag of Tricks' book suggests an in-class exercise where students toss a globe from one to another to create some datapoints. Think of mine as a → Big Data variation on the data gathering, and also getting into the details of the estimation. It's a formidable sampling task, and brings in several statistical concepts, procedures and principles.

Now imagine you're teaching next week... [109/1295]

and you're looking for THIS KIND of material

How would you check whether there was something like this in the collection ?

So I started by imagining → --- how would you describe what you were looking for ?

You might say ...

I → NEED ...

an example about sampling... → .

It had to be at the right level for my students...

→ .

Maybe something I can use in class discussion... or homework... → .

Ideally in a real-world setting... → .

And something that actually grabs attention... → .

You should be able to land on it [167/1462]

- . → from several different directions
- . → CONCEPTUALLY, it's about sampling, variability...
- . → it works in an intro course, but you could push it further...
- . → you could use it in class, or as an assignment...
- .
- . → climate models depend on accurate estimates of ocean volume -- which is a product of area and average depth
- . → And the HOOK, it's the SCALE... people don't expect that.

So depending on what I'm looking for... I could find this in five different ways. --- and that's the point,

So if we want a collection like this to be usable...

we have to build these KEYS or entry points into it.

Unfortunately, I didn't catalog them prospectively -- or upload them as I went along to an organized repository, such as Statspace at UBC. So I am essentially developing a catalog after the fact.

But if I can get the keys right... and build a catalog !!! [135/1597]

then a collection like this becomes searchable.

Now, of course... one example is easy. Even ten examples are manageable.

But once I get to a few hundred items...

things start to fall apart unless I'm very deliberate.

So the key issue becomes CONSISTENCY.

If when cataloguing one item I called it 'sampling'

...and another 'estimation'...

and yet another 'variability'...

the, YOU've already lost the ability to search reliably.

So → to have a usable system, we need a small number of stable dimensions... → or 'facets' ... → , each with a limited number of values or options. The aim → is NOT to get this perfect It's to get it CONSISTENT

The ultimate goal here is to filter down [26/1623]

to a manageable list of hits and move quickly from finding.... [PAUSE]

...to actually using... [PAUSE]

Here, for your feedback, [61/1684]

are the small sets of values I am proposing for each of these keys I will leave the CONCEPT one to the last, and start with the easiest one:

- . ➔ what's the example all about?

Despite the temptations -- I think it would be good to keep the number of categories under ten.

Now to describe how a [89/1773]

- . ➔ . a teacher could put it to use

I realize that there are MANY ways to use something

- . ➔ It could be a way to start a class, like I used to do with those clippings from the Montreal Gazette.

It could illustrate a concept, or be the basis for an exercise, etc. But in this case,

in the interests of parsimony, at the 30 thousand feet level, I prefer to be a 'lumper' rather a 'splitter'.

As for what LEVEL [46/1819]

- . ➔ of course it could be used in,
- . ➔ I again tried to keep it simple

As I begin cataloguing for real, I may also add a separate descriptor example, or something that assumes calculus or computing

As for what makes the item ENGAGING [67/1886]

- . ➔ or worth using
- . ➔ Here are a few broad categories

users needn't filter on it. As you will see later, they would simply see it when they drill down on an interesting item that the other filters produce. At that stage they would also see a second-level hook that is specific to that one item.

Now to the most important key [115/2001]

- . ➔ what I have -- for now -- called the concept (or Topic)

There are SEVERAL good reasons to keep to a few broad upper-level categories . ➔ with maybe subcategories --

but it shouldn't become like the INDEX TO A TEXTBOOK.]

Also, IF I set up the search using drop down menus, the list of options should not be long:

You might well be doing the preliminary searching on your phone in the train on the way home

and hoping to get to the nitty gritty after supper
 when the kids are in bed,
 or your NSERC grant is finished

I'm not designing a system that AUTOMATICALLY [72/2073]

finds you the BEST item or CLOSEST match. . ➔ It's
 something much simpler..

. ➔ YOU make choices from some/all of the search
 categories ...

to filter the collection down to a small number of
 candidates.

. ➔ For each candidate, YOU look at the title and
 quickly decide whether you want to dismiss it or
 look closer at it !

Here's how I imagine you would use it

[67/2140]

. ➔ this Thursday... (or the week before NSERC
 deadline)

. ➔ As an exercise in your intro course

. so that students are conscious of sampling variation,
 you would like each student to take their own sample
 from a big database

You pick the descriptors you care about -- and ignore the rest

. What you [26/2166]

. → get back

is not ONE BEST item...

. . → It's a small set

that you'd scan

Say ... , [17/2183]

THIS ONE

→ , which determines the volume of water, looks interesting...

So you CLICK ON IT [74/2257]

. → and get to see the details (and the values for any facets you ignored) → You now see what materials are available,

how they could be used,

AND the specific hook of this example.

So → you can quickly decide whether it would suit --- or whether you adopt and adapt it, or dismiss it and move on to the next promising one

Just to give you a further sense of what ELSE is in the collection — [120/2377]

-- and how I am trying to make it findable: let me come back to the heights you filled in at the outset. and to the question:

Can a LARGE sample size compensate for NOISY measurements?

OR → , as with a lot of Big Data --

can we just be MORE PRECISELY WRONG?

.

MEASUREMENT is a topic I have taught in the first week of this core course in our biostatistics program for almost 20 years

and for many years before that, as a guest lecturer in a measurement course for grad students in the health sciences.

So, by now, I have a large collection

[51/2428]

. → of homegrown exercises of different types, just on measurement: . → PRACTICAL ones on the reliability and validity aspects when measuring readability

and on the EFFECTS of measurement error, I have:

MATH-STAT ones, SIMULATION-BASED ones, and REAL-LIFE demonstrations

Let me zoom in on the real-life one in Question 6 !!! [107/2535]

. → It concerns data on the heights of family members, collected, at considerable expense, in the late 1800s

. → Notice at the bottom that the correlations involving mothers and daughters are lower...

Most students initially give biological explanations for this ...

until I ask them to look carefully at the raw data...

I also refer them to another study from the same era. It used a protocol to carefully measure university students and their parents

-- and produced 4 correlations that were all very close to 0.5.

I've used these patterns, and the ones when the measurements were NOT self-reported, [121/2656]

to show the real-world implications of those math-stat results the students derived.

And so, THIS

. → is how I have characterized this example in the catalog . . .

Notice again that it sits in more than one category -- that's intentional.

You would also land on it if you were just looking for an example for regression, -- and used the 'Modelling and Relationships' category.

[BTW I envisage having at least 2 entries for some facets:

a primary one, and a secondary one]

And if you drill down, you will see the example-specific -- and quite valuable -- hooks.

This NEXT ILLUSTRATION [83/2739]

. → is from a 1/2 day workshop I gave to medical residents, Some of them had never had lectures on statistics

. → but the program director insisted I cover all the way up to P-values and confidence intervals.

One year I used a video clip from the Against All Odds series

and other years I used this homegrown material.

I started with a legal definition; TODAY, I would put the legalese AFTER my example.

My EXAMPLE [124/2863]

. → ... is a visual version .

of Fisher's delightful textbook experiment about

→ a lady who claimed → she could tell if the milk was added to the tea, or vice versa.

Iv'e used the simpler and less powerful triangle-taste-test to do some food and drink taste-testings in small classes.

Fisher's more powerful version is not easy to run. So I ran this one instead, and I would like to repeat it here today.

.

Here in the blue box are 8 words from the Irish language,

! four spelled correctly and four not.

So, I will give you a few seconds to decide which four you think are spelled correctly.

Are you done? [106/2969]

To count your successes, I am going to tell you the four that are spelled correctly are

They are

number 1. madra (dog);

number 5. doras (door);

number 7. féar (grass) and

number 8. bóthar (road).

So, how many of your guesses were successful?

By a show of hands, how many had → .

0 successes?

1?

2?

3?

4?

BTW Today we would have to add yet another explanation (H) for a good result.

Interestingly, Google AI only got 3/4, and made stuff up about word number 2.

I found this to be a simple-to-run and multi-purpose example [72/3041]

that I could catalogue

. → under both:

Distributions and


Inference.

.

You don't have to limit yourself to the dry examples of the hypergeometric distribution that textbooks and Wikipedia use.

Why not start with the less powerful triangle taste test (the binomial is a limiting case), then move up to the more powerful Fisher designs.

And why not end with a REALLY BIG test, [219/3260]

namely of one's ability with the 6/49? --- or the game of Keno? .  where you get a payout if NONE of your 20 picks matches/catches ANY of the 20 numbers drawn from the 80.

You could teach a whole course around this distribution, and even use a discrete mixture model to estimate how many were GUESSING and how many KNEW.

The NON-CENTRAL hypergeometric distributions have a lot more interesting applications, especially if you are pushing estimation rather than testing.

I know this isn't a talk on how to teach, but I cant resist one small 'sermon'

This example got me thinking that if I were teaching today, I might put INFERENCE in the beginning of the course, as a way to MOTIVATE sampling distributions.

In most courses, we still cover all these 'prerequisites' first.

When I ask people to remember their first exposure to a p-value or confidence interval, it is often conflated with the z-distribution and the t-distribution,

and with degrees of freedom etc.

We might be better off, when teaching the core inference concepts, to keep the technical calculations out of sight, and stick to the essential concepts.

And, as I said, this might motivate the theoretical distributions.

My **LAST** illustration [51/3311]

. ➔ also spans the generations, and falls squarely in the math-stat category.

And it's especially fitting that I showcase it here today.

The idea came from a beloved and distinguished SSC member and teacher who passed away recently.

. ➔ For those younger people

who might have missed the
'TRANSPARENTLY EASY' phrase in
 his title, [89/3400]

. ➔ here is the PROJECTOR.

And here is his TRANSPARENCY,

made from two sheets of transparent flexible material,
 and some dividers.

It had two sets of pockets

One set held the sand -- the source distribution of the probability mass.

The other, shaped by the transformation, was the transformed space.

By tipping the frame, you could POUR the mass from one set to the other and see the new shape.

Twenty years ago [48/3448]

. → a student and I wrote a first draft of → this piece.

We noted that the teaching of the topic of transformations is still not where it could be,

and we were suggesting some ways and some imagery to improve matters.


That first draft referred to children playing with water, [61/3509]

-- pouring it from one container to another. A colleague we shared the draft with pointed out that our 'pouring probability' imagery was not new and pointed us to the Watts paper.


This was OUR rendition, in what was eventually published,


. → of what Watts' analog device does.

Just this year, [67/3576]

.  was I able to move up from the static page and get the sand moving again...


! I've just set up this


.  YouTube channel to share some of my material

 So, here is Watts' idea -- adapted to today's technology. .

And a DISCLOSURE: no smoking materials were used in the making of this video.

Here is how I catalogued [90/3666]

.  this math-stat example

.  This example has no dataset as such

-- other than the original sand -- but it still fits into the catalog structure.

I haven't yet added a 'readings' TYPE -- but the 2 articles could also be used as readings about transformations.

BTW, I never liked that word 'change of variable.' It doesn't matter whether you record temperatures in Celsius or Fahrenheit, it's still the SAME random variable (TEMPERATURE), just on a different SCALE.

Where does this leave us ? [148/3814]

- . ➔ I THINK I have a
 - ➔ workable structure...
 - a small number of dimensions
 - a consistent way to describe each item
 - and a way to narrow down the large collection to a manageable list a teacher can quickly scan and decide if there is one they could use.
 - . ➔ But to make sure it would work for you when you're preparing a class?
 - I would really value your input. . ➔ There are a number of still-to-be-finalized design choices,
 - For example: . ➔ .
 - Do these categories fit the way you think?
 - Are the terms clear... or do they get in the way?
 - What's missing... and what's unnecessary?
 - . ➔ With your collaboration, this could also go well beyond MY collection
-

So I'm [84/3898]

- . ➔ inviting you ..
- . not to help build a perfect system, or a repository
-
- but to

. → stress-test a modest proposal

Imagine your OWN teaching material in front of you...
could you describe it *quickly and consistently*
using this structure?

If we could agree on a CATALOG LAYER, we could quickly
make collections of good material easier to scan...

so that they can be adapted... and improved by many
others.

Before I stop – if you're willing, [133/4031]

here's one way you can → help me stress-test this
right away . → What's something you would like to
use for a class ? ...

You suspect it might already exist -- but is hard to
locate.

. → Could you think about that for a few seconds?

Now, instead of ME guessing what YOU would like, YOU
can . → use this QR code to tell ME.

you can just put in the key phrase(s)

-- I'll try to map those into this structure -- and
see where it works... and where it doesn't.

And if you'd like to stay in touch or help shape
this catalog, you can leave your email -- but that's
completely optional.

I'll STOP here. [8/4039]

.  .

.

**And I look forward to your questions
and further input.** [15/4054]

.  .

.

– 4054 words –