A New Blend:

An introductory statistics course combining materials from a MOOC and active learning sessions with seasoning from the students' areas of study

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SSC 2015

The Evolution of eLearning in Introductory Statistics at the University of Toronto

Spring 2013

MOOC on Coursera

Statistics: Making Sense of Data

Alison Gibbs and Jeffrey Rosenthal

Fall 2013 & 2014

- On campus introductory statistics course is flipped
- Two discipline-specific sections

Fall 2015

- Online modules openly available
- Fully online University of Toronto course

The Motivation

2012: New program in Environmental Sciences considering developing it's own statistics course

Existing introductory statistics courses in other departments:
Ecology and Evolutionary Biology, Human Biology, Geography, Pharmacology, Political Science, Psychology, Sociology, . . .

Lots of interest in flipped (a.k.a. inverted) classroom from campus leadership

Our approach:

- students use eResources to cover the common core of statistical content
- discipline-specific sections engage students in discussion points, problems and case studies from their area of study

What is a flipped classroom?

Traditional classroom:

time →

Homework from previous class

First exposure to new material via lecture

CLASS

Deeper understanding via homework

Flipped classroom:

time →

First exposure to new material via videos or readings

Deeper understanding via activities such as discussion, problem solving, active learning

CLASS

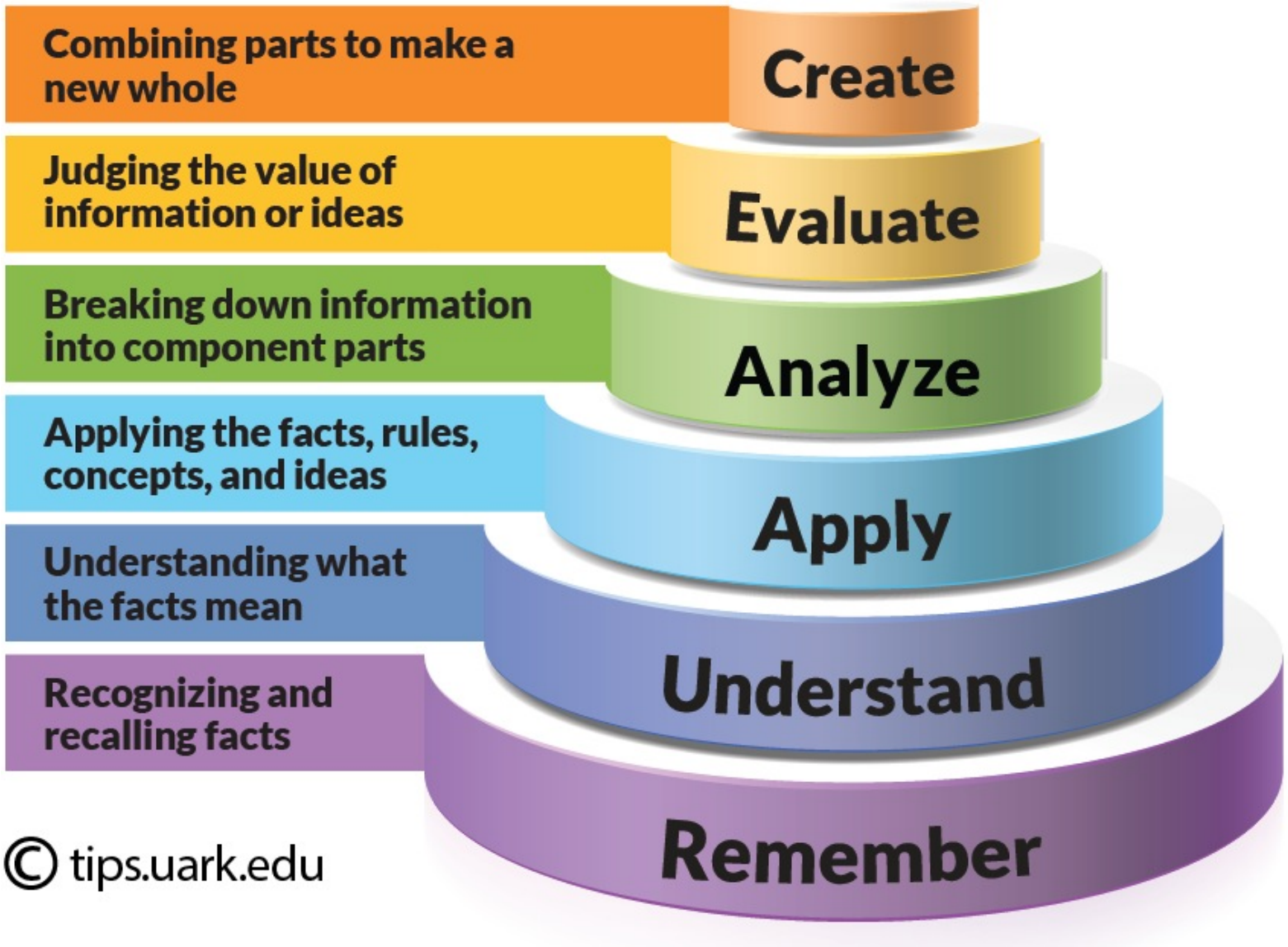
Homework to consolidate learning plus preparation for next class

(Adapted from Bruff, 2012)

Why flip your classroom?

- Create class time for problem solving and meaningful discussion without sacrificing content.
- Encourage the development of learners' self-direction:
  Dependent $\rightarrow$ *Interested* $\rightarrow$ *Involved* $\rightarrow$ *Self-directed* (Grow, 1991)
- Create opportunities for the presentation of content in a variety of formats for different learning styles and abilities.
- Instructor gets a better understanding of how students are thinking about concepts.
- Research evidence:
  - Engages a wide spectrum of learning styles (Lage et al., 2000)
  - Learners become more aware of how they learn (Frederickson et al., 2005)
  - Improves cooperation, innovation, and task orientation (Strayer, 2012)
  - An upper-division engineering course: covered more material, students had higher test scores and reported that they studied less (Mason et al., 2013) and first year computer science: 8% higher exam grades (Horton et al., 2014)

Why flip your classroom?



When do your students need your guidance?

Source: http://tips.uark.edu/using-blooms-taxonomy/

eResources

The textbook of 2015?

- Videos – archived lectures which students can review all they want
- R Shiny applets
- Quizzes - instant feedback and multiple attempts
- Discussion forums
  - The Muddiest Point
- Traditional textbook

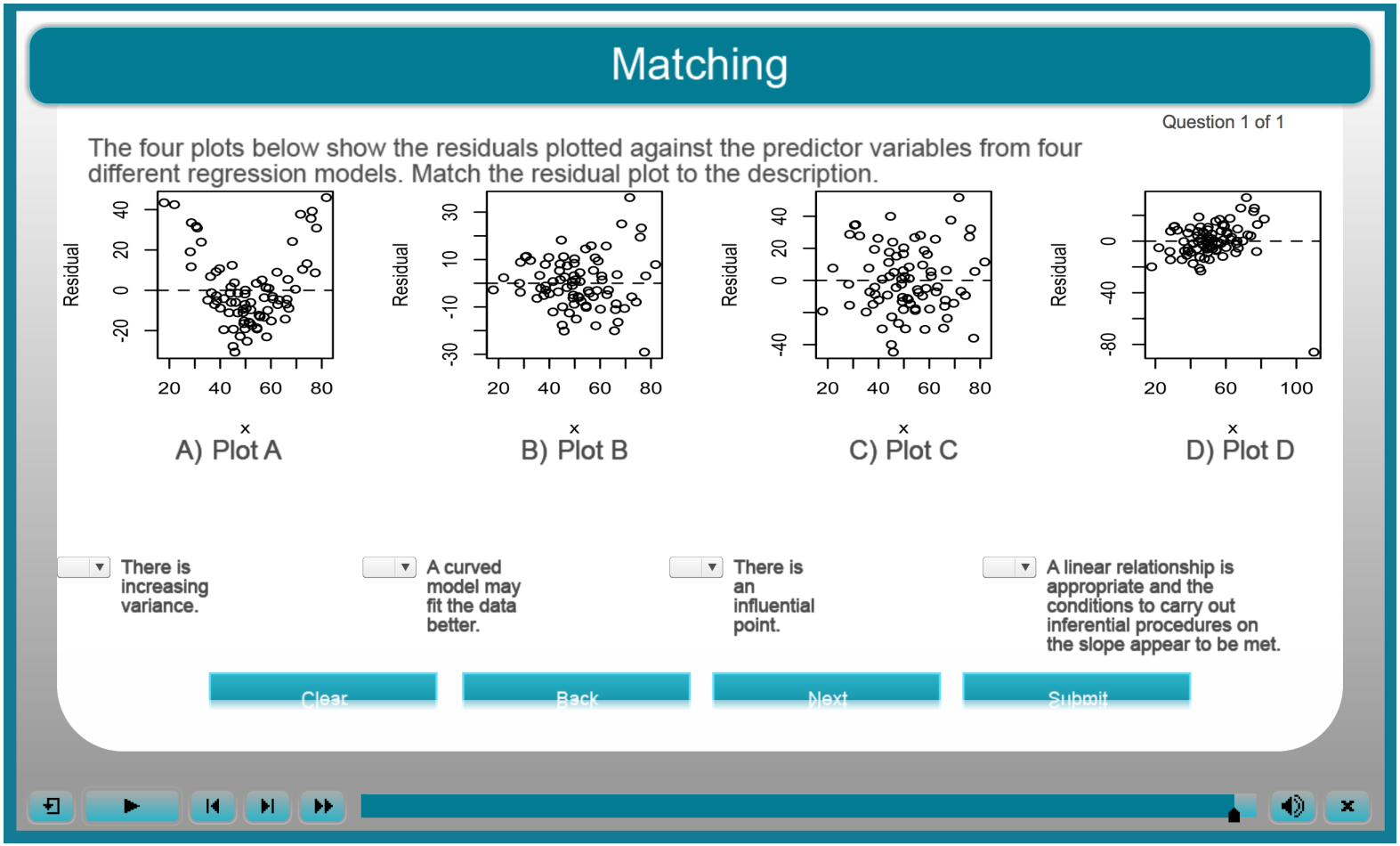
eResources

Video best practices

- Students *learn better* with videos that are *interactive* (Zhang et al., 2006)
  (1) interactive video
  (2) non-interactive video
  (3) no video
  (4) traditional classroom
- More *engaging* videos (Guo et al., 2014)
  - Are *shorter* (6 minutes)
  - Intersperse the instructor's *talking head* with slides
  - Are *informal*
  - Use *tablet drawing* rather than slides
  - Instructor speaks fairly fast with *high enthusiasm*

eResources: *Our videos*

- *Interactive:*
  - Divided content into short chunks
  - Embedded quiz questions



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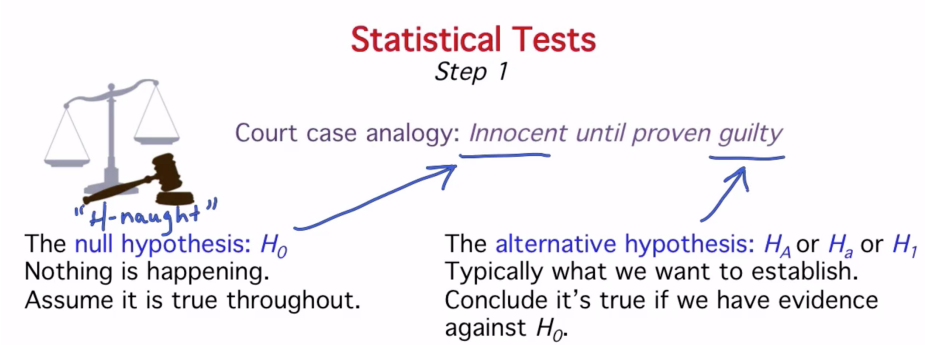
- *Engaging:*
  - talking heads

eResources: *Our videos*

- *Interactive:*
  - Divided content into short chunks
  - Embedded quiz questions
- *Engaging:*
  - talking heads
  - annotated slides



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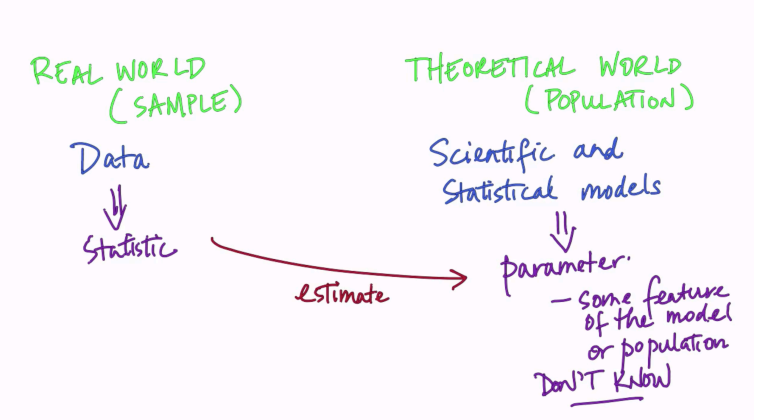

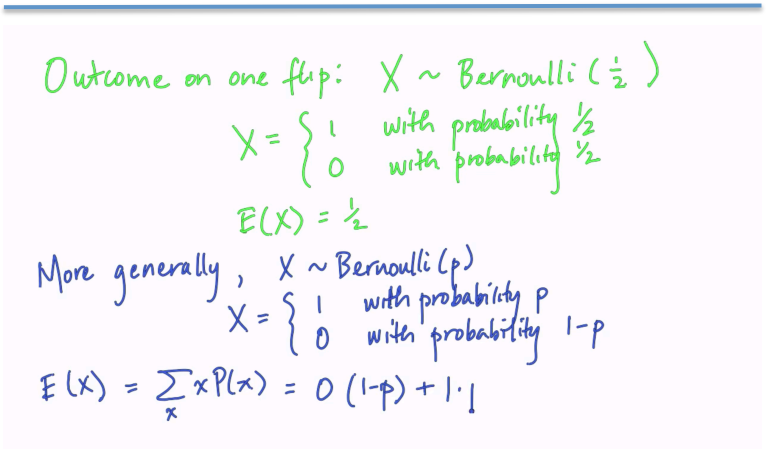

eResources: *Our videos*

- *Interactive:*
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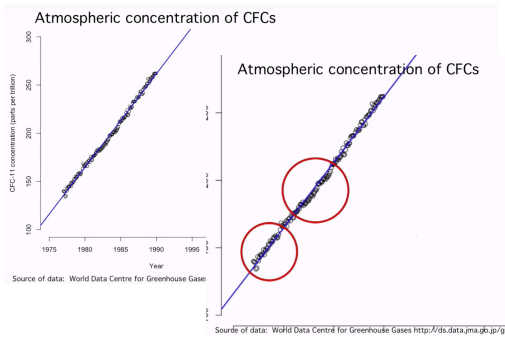
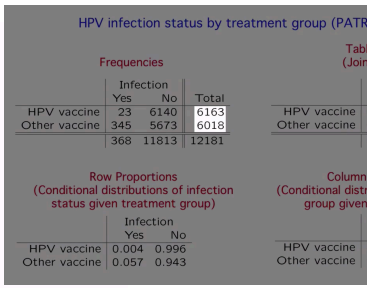
  - Embedded quiz questions
- *Engaging:*
  - talking heads
  - annotated slides
  - tablet drawing
  - callouts to highlight features





eResources: *Our videos*

- *Interactive:*
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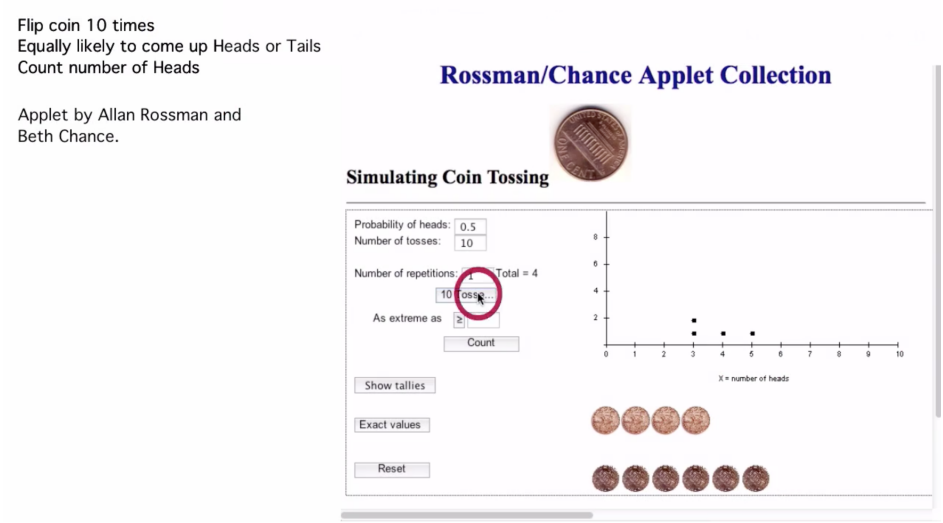
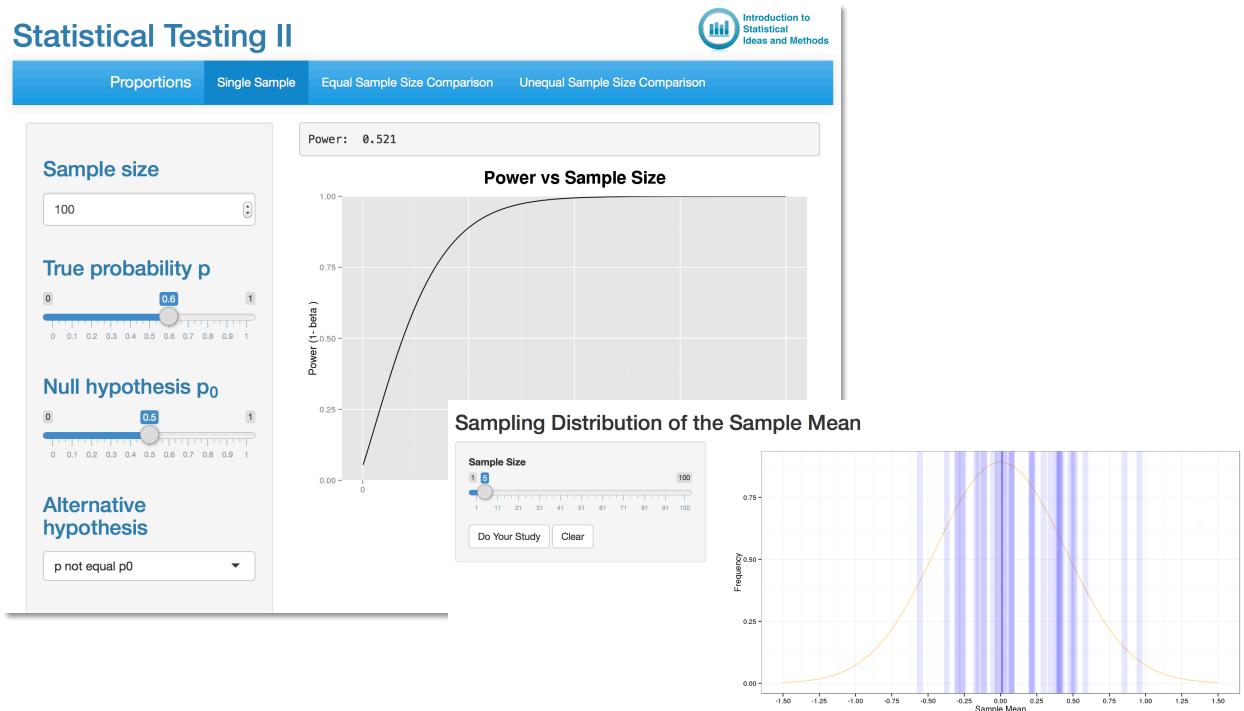
  - Embedded quiz questions
- *Engaging:*
  - talking heads
  - annotated slides
  - tablet drawing
  - callouts to highlight features
  - demos of apps



Other eResources

- Online quizzes (for credit)
  - randomly chosen from a large bank of questions
  - immediate feedback and multiple attempts
  - mastery and accountability
- Discussion forums
  - the Muddiest Point thread
- R Shiny apps and accompanying learning resources (coming soon!)



The Class Time

- Sections of 150 to 400 students, one with a Environmental Sciences focus and one with a Health & Life Sciences focus
- Mini-lectures to address muddy points
- Use Peer Instruction to build conceptual understanding (Crouch & Mazur, 2001)
  1. Instructor poses question
  2. Students reflect briefly and commit to an answer, usually with a personal response system
  3. Instructor reviews responses
  4. Students discuss their answer with their peers, and then commit again to an answer
  5. Instructor reviews responses, explains as necessary
  6. Can also ask students about their level of confidence in their answer
- Problem solving
- Eliminated tutorials. TAs circulate during class sessions.
- Discipline-specific sections focus on problems and guests from those disciplines

Is it working? The student perspective

- The Survey of Attitudes Towards Statistics (SATS-36)
  (`http://www.evaluationandstatistics.com`)
  - Year 1: Significant increase in *Affect* and significant decrease in *Effort*
  - Year 2: Significant decrease in both *Effort* and *Interest*
    Weak evidence of increase in *Value* for students in discipline-specific sections
- Course evaluations
  - Better in Year 1 than Year 2
- Three key differences between Year 1 and Year 2:
  - Novelty
  - Used Blackboard (LMS) rather than Coursera to host online materials
  - All sections were flipped
- Did the students learn better?
  We don't have clear evidence either way

Is it working? The student perspective

I really like the online format of this course. The textbook readings give me a basic understanding ... the video lectures are flexible because I can speed up, slow down, and pause to work at my own pace and the inserted questions test my understanding of material... The lectures feel like tutorials, and it reinforces my understanding of the material... (2013)

The new format was interesting, and I think it helped foster a better understanding of certain concepts. The environment felt less informal during in-person lectures, and you are given a chance to make mistakes without reprimand to improve your understanding. (2013)

I enjoyed the style of the course much more than I thought I would. Certainly much more time consuming, but very helpful for stats. (2014)

Is it working? The student perspective

I would STRONGLY prefer proper lectures instead of watching videos online... (2013)

Flipping back and forth between video lectures and in-class lectures is really confusing. (2013)

Learning a very difficult, new, and confusing subject matter such as statistics is best learned face to face with an instructor, not by watching a computer screen and teaching it to yourself. Although the examples in class were helpful, I would have much rather appreciated being taught the material in a classroom. (2014)

Is it working? This instructor's perspective

- Liberation from content
- Enjoyed the high level of discussion
- Engaged directly with many more students

- It can be difficult to let go of lecturing
- There was a big time investment in creating and organizing materials
- Students must buy in and be motivated

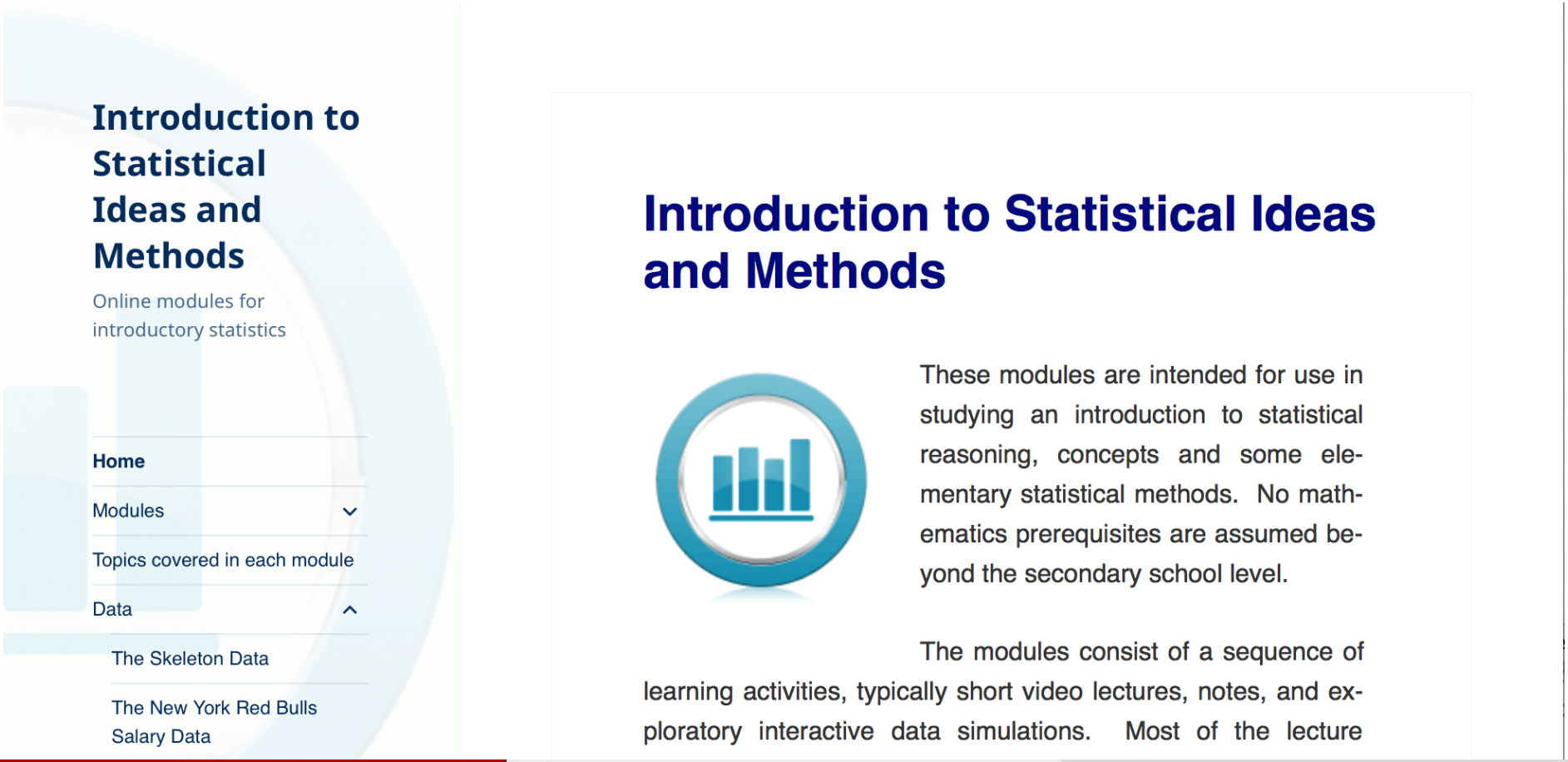
What's next?

- Fully online course
- Special online section for incoming graduate students of the Faculty of Social Work
- Use of materials for review and remediation by graduate students of the Faculty of Nursing
- Repackaged modules for sharing

Open Online Modules

Funded by the Government of Ontario Ministry of Training, Colleges and Universities through the Shared Online Course Fund

Coming: September 1, 2015 at `stats.onlinelearning.utoronto.ca`



Your muddy points?

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