# Introductory Statistics Flexible Learning Project: Development and evaluation of statistics educational material

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## Introduction

Introductory statistics is taught in many UBC departments. Typically, instructional resources and expertise are not shared across units, resulting in duplication of efforts or underuse of valuable material. This project brings together instructors from Science, Arts, & SPPH, to develop instructional resources that address conceptually challenging topics in introductory statistics. The goal of the project is to provide resources that are open, adaptable, consistent in look and feel, and grounded in existing research on learning and statistics, for use at UBC and beyond.

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## Flexible Learning Team

### Science

- **Statistics**
  - Eugenia Yu
  - Bruce Dunham
  - Melissa Lee
  - Gaitri Yapa
  - Andy Leung
  - Mike Whitlock

- **Zoology**
  - Mike Whitlock

- **Physics & Astronomy**
  - Doug Bonn
  - Joss Ives

### Arts

- **Political Science**
  - Fred Cutler
  - Andrew Owen

- **Philosophy**
  - David Green
  - Leslie Burkholder

- **Economics**
  - Diana Whistler

### Other

- **School of Population & Public Health**
  - Mike Marin

- **CTLT and SCLT**
  - Gillian Gerhard
  - Noureddine Elouazzi

- **Learning Sciences**
  - Doug Bonn

### Project Lead

- Nancy Heckman – Statistics

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## Resources

<table>
<thead>
<tr>
<th>Resource &amp; Lead(s)</th>
<th>Description</th>
<th>Progress to date</th>
<th>Evaluation to date</th>
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| **Web Visualizations (WV)**
  - Mike Whitlock | Simulations (using HTML5 with JavaScript) to support visualization of abstract concepts, supporting learning wrappers | Four visualizations developed:
  1. Sampling means from a Normal distribution
  2. Confidence intervals of the mean
  3. Central Limit Theorem
  4. Chi-Square contingency test | • Beta-tested first two simulations via interviews with STAT200 (Nov 2015) and BIOL 300 students (Jan 2016)
  • Trialed WV in BIOL 300, SPPH 400 |
| **Activities**
  - Fred Cutler
  - Andrew Owen | Interactive engagement questions and activities to engage students & facilitate peer-instruction (in lectures/labs) | Four activities developed:
  1. Understanding confidence intervals
  2. Introduction to sampling distribution of the mean
  3. Population variance and sampling variability
  4. How likely is the sample statistic? | • Trialed first two activities in POLI SCI classes
  • Trialed “Understanding confidence intervals” activity in STAT200 labs |
| **Screencasts**
  - Mike Marin | On-demand access to explanations of challenging concepts via 6-10 min videos | Two screencasts in development:
  1. Sampling distribution of the mean
  2. Confidence intervals for a single population mean |
| **WeBWorKiR (WWR)**
  - Bruce Dunham | Individualized online homework questions with automatic feedback (open-source on-line HW system WebWork, enhanced by R functionality) | Draft of videos vetted by FL group and MedIT |
| **Interactive Engagement (IE) Questions**
  - Eugenia Yu | Questions administered via Personal Response Systems (<Clickers, etc.>) to provide immediate feedback, facilitate peer-instruction | Clusters of questions developed for topics:
  1. Sampling distribution of the mean
  2. Confidence intervals for means
  3. Hypothesis testing for means |

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## Resource Evaluation Process

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<tbody>
<tr>
<td>• Graphic design, programming and instructional design support</td>
<td>• Group discusses evidence-based literature on learning</td>
<td>• One-on-one student interviews</td>
<td>• Resource lead improves resource based on feedback from student testing</td>
<td>• Second round of student testing when necessary</td>
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<td></td>
<td>• Team members provide feedback on first and/or second drafts</td>
<td>• Observations in classes or labs</td>
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<td>• Resource lead makes changes based on feedback</td>
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## Milestone post-question

By now you should have calculated your confidence interval from your sample of 10 observations. How do you think your confidence interval compares to the one the person beside you?

- The two CIs have the same center but different width.
- The two CIs have different centers but the same width.
- The two CIs have different centers and different widths.

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## Special Thanks

The project would not have been possible without the generous support of the Teaching and Learning Enhancement Fund.

To find out more about the resources, please contact Nancy Heckman (nancy@stat.ubc.ca).

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## Ongoing Efforts

- Explore integrated IE questions and WWR into developed resources
- Learning wrappers to be developed for each resource, which will include lesson plans, learning outcomes and prerequisite knowledge
- Student testing of web visualizations, activities, and screencasts through focus groups, student interviews and in-class/in-lab observations in Summer and Fall 2016
- Additional topics to be decided for future resources