COURSE DESCRIPTION
This is a professional-level, moderated online course in the use of Fathom Dynamic Data software for teaching statistics at the high school or introductory college level. In addition to instruction in how to use the software, the course will offer pedagogical guidance on how to integrate use of Fathom in classrooms.

The course runs for six weeks with a scheduled start and end date and is structured into six week-long units. While participants have flexibility within each week, the course is synchronous, meaning that participants are expected to begin and complete the activities for each week during the week they are assigned. This course is primarily intended for teachers.

COURSE OBJECTIVES
After participants complete this course, they will be comfortable using Fathom both as an investigation tool and as a demonstration tool. Participants will be able to:

- Import data into Fathom from various sources, including web pages, spreadsheets, and the IPUMS census microdata server.
- Conduct exploratory data analysis using the full range of Fathom’s graphical and numerical capabilities.
- Make use of the Fathom Surveys service to collect data using online data entry forms.
- Construct probability simulations based on randomization formulas, sampling, scrambling, and collecting measures.
- Incorporate sliders as parameters for simulations and models.
- Use Fathom’s resampling capabilities to test hypotheses and estimate population parameters.
- Make appropriate use of statistical tests, estimates, and models available within Fathom to analyze experimental results.
- Incorporate Fathom into an introductory statistics course.
- Use visualization and simulation capabilities within Fathom to help students gain a conceptual understanding of a variety of data analytic and statistical concepts.
- Devise teaching strategies for dealing with conceptual hurdles students face in learning statistics.

INTENDED AUDIENCE
This course is intended for secondary school mathematics and statistics teachers, college-level instructors of introductory statistics, and college-level instructors of pre-service teachers.

PREREQUISITES
Participants should be comfortable using computers and must have access to the Internet and Fathom software (Version 2.1 or better). They should have an understanding of the concepts contained in an introductory statistics course.
METHODS OF INSTRUCTION
Each week follows the same structure in which participants complete these activities:

- Explore one or more Fathom sample documents that introduce the week’s statistics focus.
- Watch several videos (total runtime each week approximately 30 to 45 minutes) – an interview with someone who has been part of the Fathom development process, an interview with an instructor who uses Fathom, and one or more screen-capture demonstrations of Fathom features.
- Enter data into one or more online data forms and use Fathom to analyze the results from the entire class.
- Read six PDFs of student blackline masters of Fathom activities.
- Complete these six activities offline using Fathom.
- Participate in an asynchronous discussion forum (as well as an optional scheduled chat).
- Complete a project.
- Reflect by responding to specific prompts in an online journal.

GRADE BREAKDOWN
In order to receive credit for the course, participants must complete all Fathom activities, turn in all six projects, respond to all six journal prompts, and participate in the discussion forums at least twice each week. Assessment is project-based. All six weeks are weighted equally.

The two units offered for this course are based upon the expectation that each week will require about five hours of work (at least two hours for online activities – visual media, discussion forums, and the journal – and at least three hours for offline Fathom activities and the project).

Participants will do a weekly self-evaluation to determine their score for working on Fathom activities and participating in discussion forums. The moderator will evaluate and provide feedback for projects and journal entries. Grades will be assigned on a standard percent scale based on the following breakdown:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fathom activities</td>
<td>20%</td>
</tr>
<tr>
<td>Discussion forums</td>
<td>20%</td>
</tr>
<tr>
<td>Journal entries</td>
<td>20%</td>
</tr>
<tr>
<td>Weekly projects</td>
<td>40%</td>
</tr>
</tbody>
</table>

REQUIRED TEXTS AND MATERIALS
All written material will be Fathom activities provided as PDFs. These activities come from the books listed below. Participants do not need to purchase these books.

- *Data Are Everywhere*, Key Curriculum Press, 2005
SESSION-BY-SESSION SUMMARY

Week 1: Data Exploration

Participants use graphs and summary tables to engage in exploratory data analysis. They learn how to plot values and functions on data, and try out various ways to drag data to examine the impact of changing data on different statistics.

Visual Media:
- Interview with Cliff Konold, *Exploratory Data Analysis*
- Interview with Cliff Konold, *Challenges for Students Learning Data Analysis*
- Video demonstrations: *Entering Data and Making a Graph, Four Basic Objects—Collections, Case Tables, Graphs, and Summary Tables, Conserving Screen Space, Rescaling Axes, Zooming in Graphs, and Internet Import by Dragging the URL*. Additional optional demonstrations are also provided.

Sample Documents:
- Getting Started
- Minimize Sum of Least Absolute Values
- Moving To The Mean

Fathom Surveys:
Participants complete a survey about their teaching experience.

Activities:
- Tour: Exploring Data—Census at Schools
- Tour: Data and Prediction—Arm Span
- Summary Measures—CensusAtSchool
- Box Plots and Transformations—CensusAtSchool
- Mean and Median
- What Do Normal Data Look Like?

Teaching Experience Project:
Participants explore the teaching experience survey data.

Journal Prompts:
Participants are asked to use Fathom Help to list two capabilities of Fathom graphs they were not previously aware of, and to consider your efforts this week to learn (more about) how to use Fathom to do data analysis.

Week 2: Probability Simulations

Most of the week’s work centers on methods for creating probability simulations in Fathom and ways to use these in teaching. Building such simulations can be both challenging and fun. Probability simulations provide a foundation for the study of sampling distributions in statistical settings, which begins in Week 3.

Visual Media:
- Interview with Bill Finzer, *Statistical Simulation*
- Interview with Corey Andreasen, *Getting Starting in the Statistics Classroom with Fathom*
- Video demonstrations: *Plotting Values in Graphs, Movable Lines in Scatter Plots, Determining a Best Fit by Minimizing the Sum of Squares of Residuals, Creating a Measure to Find the Sum of Three Dice, Collecting Measures to Build Up a Distribution, and Taking a Sample*. Additional optional demonstrations are also provided.

Sample Documents:
- Anscombe
- CorrelationPlay
- CorrSlider
- RegressionSimulation
- RegressionTransformation
Syllabus for Teaching Statistics with Fathom Dynamic Data™ Software

Fathom Surveys:
Participants collect and enter data on the number of handfuls of water it takes them to fill a cup, and spinning pennies.

Activities:
- Handfuls of Water
- Standard Scores
- Constructing a Probability Model—Spinning Pennies
- The Law of Large Numbers
- Building the Binomial Distribution
- Probability Models

Birthday Project:
Participants build and use a Fathom simulation of a classic probability problem.

Journal Prompts:
Participants are asked to work through a simulation example and reflect on their experience, and to choose one sample document that was suggested for this week and describe something students might learn from it.

Week 3: Sampling Distributions
Understanding where sampling distributions come from and how to work with them is a prerequisite for understanding statistical inference. Participants will work with Fathom's simulation environment to generating sampling distributions and experience a number of learning situations in which these simulations are useful.

Visual Media:
- Interview with Tim Erickson, Sampling Distributions
- Interview TO COME
- Video demonstrations: Creating and Publishing a Survey, Creating Pop-up Menu Responses, Taking the Survey, Getting Results, and Uploading by Students

Sample Documents:
- A Weird Distribution
- Binomial and Normal Distributions
- DepthFunction
- DistributionFAQ
- Normal Distribution
- P-Value Calculators
- Proportions
- Three Distributions
- Various Distributions
- Normal Density Exploration
- P Value Distributions
- T vs Normal Distributions

Fathom Surveys:
Participants complete a survey about teaching statistics and collect data on the number of pennies in their pockets.

Activities:
- Ethics of Classroom Surveys
- Introduction to Sampling Distributions—Random Rectangles
- Sampling Distributions of the Sample Mean—Pocket Pennies
- Sampling Distributions of the Sample Proportion—Seat Belts
- German Tanks
- Using Sampling Distributions—By Chance or By Design

Fathom Surveys Project:
Participants create and administer an online survey, then analyze the results.
Journal Prompt:
Participants are asked to describe the Fathom process of generating a sampling distribution in their own words.

Week 4: Confidence Intervals
Participants develop the concept of a confidence interval using Fathom’s Estimate object and simulation tools. Computer intensive methods like bootstrapping are paired with use of parametric methods. The final activity turns away from confidence intervals to inventing a measure to test for fairness of a die.

Visual Media:
• Interview with Rob Gould, Experiences Using Fathom Surveys
• Interview with Bill Finzer, Confidence Intervals
• Video demonstration: Estimating Confidence Intervals

Sample Documents:
• Capturing Proportions with CI
• Confidence Interval and Binomials
• Confidence Interval Demo
• Confidence Intervals
• Algorithm to Estimate Proportions

Fathom Surveys:
Participants collect data on their eye dominances and sleep times.

Activities:
• Capturing with Confidence Intervals
• The Confidence Interval of a Proportion
• Exploring the Confidence Interval of the Mean
• Reasonably Likely Values and Confidence Intervals
• Sleeping Times
• Measuring Fairness—Constructivist Dice

Sample Size Project:
Participants create a Fathom document to estimate confidence intervals for a given situation.

Journal Prompt:
Participants are asked to reflect on their comfort level with simulation and how it has changed of the four weeks of the course so far, as well as strengths and weaknesses in using simulation as a teaching tool in statistics.

Week 5: Hypothesis Testing
Participants use Fathom’s sampling and collecting measures capabilities to explore the framework that underlies statistical inference in general and hypothesis testing in particular.

Visual Media:
• Interview with Josh Zucker, Experiences with Fathom
• Interview with Sharon Lane-Getaz, Using Fathom for Research on Student Performance
• Video demonstration: Constructing a Scrambling Simulation for Inference

Sample Documents:
• US Draft Lottery 70-71
• Compare Means
• CompareMeansDemo
• Difference Of Means
• ChiSquareSim

Fathom Surveys:
Participants collect data on their hand spans and contribute projects they’ve used in the statistics classroom.
Activities:
- Data Are Everywhere
- Friendly Observers
- Inference for the Difference of Two Means: Paired—Hand Spans
- Tour: Testing a Hypothesis—Plant Growth
- Tour: Testing for Independence—Pets and Sports
- Scrambling to Compare Means

Steady Hand Project:
Participants design an experiment, carry out the experiment, and analyze the results.

Journal Prompt:
Participants are asked to react to the interview with Sharon Lane-Getaz and reflect on research they think should be done to find out more about Fathom as a teaching tool.

**Week 6: Regression Models**
This last week’s statistical content centers on building linear models. Participants work with simulations that facilitate conceptual understanding and built-in methods that quickly give results.

Visual Media:
- Interview with Robin Lock, *ANOVA and Multiple Regression*
- Interview with the Fathom development team, *Creating Software for Learning Statistics*
- Video demonstration: *Regression Models*

Sample Documents:
- Exponential Growth
- Swing Trigonometry
- Two Groups Regression
- Predictions
- Sampling Slopes

Fathom Surveys:
Participants collect data on Wikipedia and on their heights.

Activities:
- Analysis of Variance
- The Burden of Bears
- Sampling Distribution of the Slope—How Fast Do Kids Grow?
- Inference for a Slope—How Tall Are You Kneeling?
- Transformations to Improve Linearity
- Variation in the Slope

Final Project:
Participants model an aspect of Wikipedia using regression.

Journal Prompt:
Participants are asked to react to the week’s video interviews.