ESTEEM Modules Table of Contents

The following is a brief description of three online modules that can be used in mathematics teacher education courses. In the table below, click on a module or scroll down to see a description of all materials in each module.

Module 1: Foundation in Statistics Teaching
The focus of this module is the core ideas about teaching statistics and how to support students' investigations. It is highly recommended that teachers complete this module before being introduced to materials from either of the other two modules (Module A or Module B). Module 1 is organized into two parts.
Module 1.1 What is statistics and how should we teach it?
This module focuses on learning to engage in statistical investigations using technology (CODAP) and developing knowledge and skills for planning lessons for teaching statistics. The emphasis is on understanding how statistics is different from other areas in the mathematics curriculum and how students can develop statistical ways of reasoning.
Module 1.2 What is statistics and how should we teach it?
In this module, teachers will learn about a framework that can guide them in supporting students' statistical reasoning, including designing tasks and making sense of students' work. Teachers will also engage in a statistical investigation from the previous module, with a larger data set.
Module A: Teaching Inferential Reasoning
This module focuses on ideas around supporting the development of students' inferential reasoning. Teachers should be familiar with the ideas in Module 1 prior to being introduced to this module. Module A is organized into two parts:
Module A.1 Promoting and supporting inferential reasoning
The first part of module A focuses on developing essential understandings of how to support inferential reasoning. Materials will help teachers consider why it is important to teach students to reason inferentially and how questions, modeling processes, simulation tools, and tasks can support students' development of inferential reasoning.
Module A.2 Using models and repeated samples to develop inferential reasoning
The second part of module A focuses on how models and repeated sampling can be used to support inferential reasoning. Materials will delve deeper into critical understandings related to sampling distributions and how learning experiences can assist students in developing inferential reasoning.
Module B: Teaching Statistical Association
This module focuses on ideas around the teaching and learning of statistical association. Teachers should be familiar with the ideas in Module 1 prior to being introduced to this module. Module B is organized into two parts.
Module B.1 Statistical association of categorical variables
The first part of module B focuses on association of categorical variables. Materials assist teachers in developing critical understandings related to graphs and measures used to describe association between categorical variables and how learning experiences can assist students in developing reasoning about association.
Module B.2 Statistical association of quantitative variables
The focus of the second part of module B is association of quantitative variables. Materials assist teachers in developing critical understandings related to graphs and measures used to describe association between quantitative variables and how learning experiences can assist students in developing reasoning about association.
Screencast Assignment (link to pdf) (link to Word)
This assignment allows teachers to illustrate their ability to conduct a statistical investigation with larger, multivariate datasets in CODAP. Teachers record themselves with screencast software while conducting a statistical investigation and explain their thinking throughout the process. This assignment can be done after any of the modules. A scoring rubric is included (link to pdf) (link to Word).
Task Design Assignment (link to pdf) (link to Word)
*The purpose of this assignment is to design a task that illustrates how one can develop students' statistical thinking utilizing CODAP as a tool. This assignment can be completed **after** Module A and/or Module B. An example of possible student responses to the assignment is included. A scoring rubric is included (link to pdf) (link to Word).*

1.1.a How is Statistics Different from Mathematics?
- **Reading (~4 paragraphs)** - Key features of statistics that differentiate mathematical and statistical reasoning.

1.1.b Statistical Investigations and Habits of Mind
- **Video (~1 minute)** and **reading (~1 paragraph) -** Introduction to the statistical investigation cycle (posing a question, collecting data, analyzing data, and interpreting results).
- **Reading (~6 paragraphs)** - Statistical habits of mind students should develop when they engage with statistics.
- **Diagram -** How statistical habits of mind can be useful in different phases of the statistical investigation cycle.

1.1.c Considering the Importance of Teaching Statistics
- **Video (~15 minutes)** - Statistics education experts discuss statistics, why it should be taught, and why the use of real data is important.
- **Reading (~1 paragraph)** - Linked **curricular standards documents**, and **5 questions** for teachers to reflect on concerning the role of statistics in state curricular standards.

1.1.d Quiz on Read & Watch Material
- **Quiz** (**6 multiple-choice questions** & **2 free-response questions)** - Assessment of teachers' understanding of the essential materials in Parts 1.1a, 1.1b, and 1.1c.

1.1.e Teaching Statistics in the Mathematics Curriculum
- V**ideo (~10 minutes)** - Advice from a state leader for creating engaging statistics lessons and fitting statistics into a packed mathematics curriculum.

1.1.f Statistical Investigation Cycle in a Classroom
- **Video (~6 minutes)** - A classroom lesson involving students participating in the phases of a statistical investigation cycle.

1.1.g Investigating Older Roller Coasters in the US
- **Video (~7 minutes)** - A teacher launching a statistical task in a lesson.
- **Investigative task using CODAP (10 questions)** - Teachers engage in basic univariate and bivariate analysis of a dataset concerning roller coasters and consider the impact of different CODAP features on learning statistics.

1.1.h Discuss Learning Statistics through Investigations with Real Data
- **Discussion forum (1 post & 1 reply)** - Teachers reflect on how the material in this module compares with their own learning and/or teaching of statistics.

1.1.i Using an Online Data Analysis Tool
- **Discussion forum (1 post & 1 reply)** - Teachers consider how use of CODAP supported or hindered their statistical thinking while engaging in the statistical investigation in 1.1.g.

Module 1.2 Supporting Students' Statistical Investigations

1.2.a Supports for Learning to Do Statistical Investigations
- **Reading (~9 paragraphs)** - How posing different types of questions to students can impact their statistical thinking.
- **Reading (~5 paragraphs)** - The process of planning for and collecting data.
- **Video (~6 minutes)** - The different types of attributes that students can work with.
- **Video (~8 minutes)** - How a dataset can be analyzed with technology and interpretations can be formed.

1.2.b A Guiding Framework for Teaching Statistics
- **Reading (~2 paragraphs)** and **4 diagrams** - Framework describing the development of statistical sophistication in students.
- **Video (~13 minutes)** - Examples of students' reasoning at different levels of the framework.
- **Video (~22 minutes)** - Conversation between statistics education experts using the framework to discuss development of the concept of the mean.

1.2.c Tasks as Opportunities for Statistical Learning
- **Table** - List of questions to help guide teachers in considering four essential aspects of statistics tasks and important pedagogical decisions to consider when planning to implement a statistics task.
- **Video (~19 minutes)** - Statistics education experts discuss how they develop and implement statistics tasks.

1.2.d Read & Watch Quiz
- **Quiz (8 multiple choice questions)** - Assessment of teachers' comprehension of materials in parts 1.2.a-1.2.c.

1.2.e Expert Teacher Interview on Tools & Resources
- **Video (~8 minutes)** - Expert statistics teachers discuss their favorite tools and resources for teaching statistics.

1.2.f Teaching Statistics Using Multiple Technologies
- **Video (~12 minutes)** and **description (~3 paragraphs)** - Excerpts from a high school statistics lesson in which the teacher uses various technology tools to support students' learning.

1.2.g Investigating More Roller Coasters
- **Investigative task using CODAP (7 questions)** - Teachers investigate a larger dataset with more attributes concerning roller coasters. Teachers explore more features of CODAP and explore different types of bivariate association (qualitative/quantitative, quantitative/quantitative, and qualitative/qualitative).

1.2.h Examining Students' Work on the Roller Coaster Task
- **Video (~9 minutes)** - 6th grade, 7th grade, and AP Statistics students investigating the dataset used in 1.2.g.
- **Discussion forum reflection (1 post & 1 reply) -** Comparing students' reasoning during the investigation.

1.2.i Supporting Statistical Discourse with the Roller Coaster Task
- **Reading (~2.5 pages)** - The Five Practices model for productive classroom discourse.
- **Video (~11 minutes)** - A teacher implementing the five practices during a statistics lesson.
- **Reflection (2-3 pages)** - Applying knowledge gained from the module to assess the lesson in the preceding video.

1.2.j Analyze Tasks and Discuss

- **Discussion forum (1 post & 2 replies)** - Teachers compare pairs of statistical tasks in regard to their opportunities for statistical thinking.

Module A.1 Promoting and supporting inferential reasoning

A.1.a What is Inferential Reasoning?
- **Reading (~5 paragraphs)** - Explanation of inference and illustrations of the differences between descriptive statistical questions and inferential statistical questions.
- **2 reflection questions** - Considering the level of sophistication of various inferential investigative questions.

A.1.b Promoting Key Aspects of Inferential Reasoning
- **Video (~2 minutes)** - Some key aspects of inferential reasoning.
- **Reading (~7 paragraphs)** - Expounding on several of the key aspects and how they can manifest in the classroom.

A.1.c Using Models to Build Inferential Reasoning
- **Reading (~2 paragraphs)** - The utility of models in developing inferential reasoning.
- **Activity using the CODAP Sampler** - Teachers randomly generate data from a model and consider the implications of the generated data.
- **Reading (~3 paragraphs)** - Opportunities for inferential reasoning in curricular standards.
- **Video (~3 minutes)** and **reading (~1 paragraph)** - Summarizing importance of models for inferential reasoning.

A.1.d Considering the Importance of Inferential Reasoning
- **Interactive video (~8 minutes, 2 multiple-choice questions, 2 open-ended questions)** - Panel of statistics experts discussing the importance of inferential reasoning and types of questions that can be posed to students to promote inferential reasoning.

A.1.e Anchoring Inference in a Cycle of Investigation
- **Video (~4 minutes)** - Two classroom lessons in which teachers incorporate inferential reasoning concepts into the various phases of the statistical investigation cycle.

A.1.f Investigating Fairness of Dice
- **Statistical investigation using CODAP** - Teachers evaluate the validity of a theoretical model for various dice by generating empirical data.

A.1.g Comparing Use of Models in Tasks for Inferential Reasoning
- **Discussion forum reflection (1 post & 2 replies)** - Teachers compare the use and purpose of the models in the activities in A.1.c and A.1.f.

A.1.h Analyzing Students' Work on Schoolopoly
- **Two interactive animated videos (total ~11 minutes, 2 multiple-choice questions) -** Ways in which students have engaged in statistical investigations involving dice similar to that in A.1.f.
- **Discussion forum reflection (1 post & 1 reply)** - What teachers learned from these videos and how they might incorporate ideas into their own classrooms.

Module A.2 Using models and repeated samples to develop inferential reasoning

A.2.a Critical Role of Samples, Sampling, and Sampling Distributions
- **Reading (~5 paragraphs)** - The relationship between samples and populations and how teachers can develop the concept of a sampling distribution.
- **Video (~5 minutes)** - Two teachers describing strategies for teaching sampling distributions and promoting inferential reasoning.

A.2.b Attention to Sampling Variability and Sample Size
- **Reading (~4 paragraphs)** and **2 reflection questions** - Key underlying concepts when examining samples from a population.
- **Activity using CODAP** - Teachers examine the impact of sample size on inferences that can be made about a population.
- **Reading (~3 paragraphs)** and **2 reflection questions** - A visual aid to assist in developing the concept of sampling variability.

A.2.c Using Repeated Sampling to Introduce Sampling Distributions
- **Two videos (total ~12 minutes)** - Implementation and teacher's reflection on a statistics lesson involving students taking random samples of a population to estimate a population proportion.
- **4 reflection questions** - Teachers consider the impact of the decisions the teacher in the preceding video made during the lesson.

A.2.d Statistics Tasks to Promote Inferential Reasoning
- **Video (~14 minutes)** - Statistics teachers discuss their favorite tasks for promoting inferential reasoning.

A.2.e Investigating the Success of Paul the Octopus
- **Investigative task (17 questions) using CODAP** - Examining the unusualness of an event. Teachers use CODAP to build a model and collect data to assess how likely an observed event would be given assumptions of the model.

A.2.f Investigating Carbon Dioxide Emissions in Vehicles
- **Investigative task (19 questions) using CODAP** - Making inferences about a population of passenger vehicles by taking samples. Teachers examine variability within and between samples and build a sampling distribution.

A.2.g Discussing Launching a Task to Support Inferential Reasoning
- **Discussion forum activity (1 post & 1 reply)** - Teachers choose a statistical task and design a plan for launching the task.

A.2.h Applying Modeling and Simulation to a Probability Comparison Task
- **Written response task (2-3 pages)** - Teachers create a simulation to model a probability scenario. Teachers consider how their simulation supports students' thinking and the ways that students might reason about the scenario with and without the simulation.

Module B.1 Statistical association of categorical variables

B.1.a Investigating Categorical Variables in CODAP
- **Reading (~2 paragraphs)** - Defining categorical variables and their use.
- **2 videos (total ~16 minutes)** - How to examine bivariate categorical data in CODAP and how to investigate whether there is an association between the two variables.

B.1.b Common Student Approaches when Analyzing Bivariate Categorical Data
- **Reading (~3 paragraphs)** - Two tasks for analyzing bivariate categorical data.
- **A series of videos and descriptions (total ~3 minutes, 10 paragraphs)** - Common student approaches, both incorrect and correct, when investigating bivariate categorical data.

B.1.c Quiz on Read & Watch material
- **Quiz (7 multiple choice and 1 open-ended questions)** - Assessing teachers' comprehension of the materials in parts B.1.a and B.1.b.

B.1.d Student-created Graphs of Bivariate Categorical Data
- **Video (~13 minutes)** - Middle school students creating their own representations to depict the relationship between two categorical variables.
- **Discussion forum (2 posts)** - Examining the students' reasoning and their creations.

B.1.e Investigating Data about Granola Bars
- **Investigative task using CODAP (12 questions)** - Examining a dataset concerning the nutritional value of granola bars. Teachers examine associations between categorical variables and make conclusions about whether granola bars are healthy.

B.1.f Discuss Representations of Bivariate Categorical Data
- **Discussion forum (1 post & 1 reply)** - Teachers compare the affordances for statistical reasoning of the different types of representations that can be used to depict bivariate categorical data.

B.1.g Students' Reasoning about a Segmented Bar Graph
- **Activity (3-5 sentences)** - Teachers interpret a two-way graph and table.
- **5 videos (total ~5 minutes)** - Students reasoning about the graph and table. For each student, teachers answer **3 questions (total 15 questions)** to describe and interpret students' thinking and formulate a teacher's response.

Module B.2 Statistical Association of Quantitative Variables

B.2.a Introducing Students to the Topic of Statistical Association
- **Activity (~20 questions total)** - Teachers first complete and then analyze a statistical task involving using bivariate quantitative data to make a prediction.
- **Videos (~7 minutes total)** - The task being used in a classroom, asking teachers to interpret and assess the implementation and students' reasoning.

B.2.b Measures of Association and Lines of Best Fit
- **Video (~11 minutes)** - A statistics education expert discussing how students develop their understanding of statistical association for two quantitative variables across their elementary, middle and high school experiences.

B.2.c Distinguishing Between Correlation and Causation
- **Reading (~5 paragraphs)** - Why variables that are correlated do not necessarily have a causal relationship and why it is important for students to understand this difference.

B.2.d Quiz on Read and Watch Materials
- **Quiz (6 multiple-choice and 1 open-ended questions) -** Assessing teachers' understanding of the materials in modules B.2.a, B.2.b, and B.2.c.

B.2.e Considering Student Approaches to Placing the Informal Line of Best Fit
- **Activity (~5 questions)** - Teachers watch **2 videos (~8 minutes total)** depicting students' approaches to locating a line of best fit. Teachers analyze students' approaches and describe how they would respond as a teacher.

B.2.f Investigating Data about Vehicles
- **Investigative task (~9 questions)** - Involves a data set containing information about 300 vehicles. Teachers investigate scatter plots, lines of best fit, residuals, sums of squared residuals, and correlation coefficients.

B.2.g Teaching Statistics with CODAP
- **Video (~10 minutes)** - Students engaging in a statistics lesson centered around investigating attributes of vehicles, along with the teachers' reflections on how the use of CODAP impacted their students' learning and suggestions for pedagogical approaches when using CODAP.

B.2.h Discuss Differences between Mathematics and Statistics in the Study of Association
- **Discussion forum (2 posts & 2 replies)** - The differences between mathematics and statistics in regard to various concepts concerning lines and bivariate data.

B.2.i Investigating Data from the Census at School Random Sampler
- **Reading (~5 paragraphs)** - Summarizing the different types of association.
- **Reading (~7 paragraphs)** - Description of a data set and why and how the data set may need cleaning for use in a classroom.
- **Activity using CODAP** - Teachers pose and investigate three questions with different types of association.