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The SOMAS/DS Family of Instruments to Measure Students, Instructors and Learning Environment

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Project Description

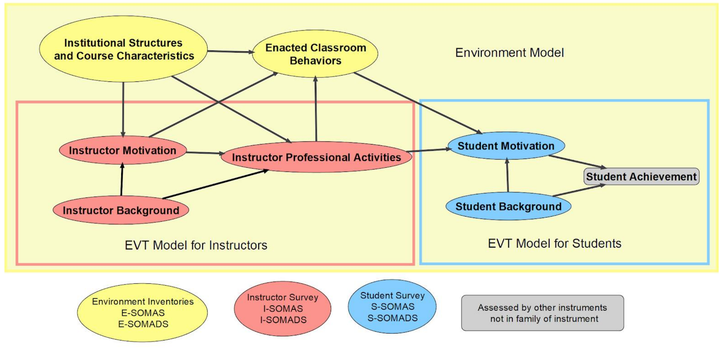
- Statistics and Data Science are two of the fastest growing fields in academia and industry. Students must be prepared for the data deluge.
- Attitudes matter in education: Student's attitudes are associated with future choices, content retention, and ability to master statistical and data science skills.

- Project Goals
  - Develop instruments that measure undergraduate **student attitudes** towards statistics and data science.
  - Develop instruments that measure undergraduate **instructor attitudes** toward teaching statistics and data science
  - Develop inventories that measure the **learning environment**, and **pedagogical practices** that may impact students' attitudes, engagement, and/or achievement
  - The long-term goal is to **identify evidence-based best practices** for teaching data science and statistics

- Project Methods
  - Start with a strong **theoretical framework -** expectancy-value theory (EVT)
  - Create a **family of instruments** to understand the complete learning environment
  - Follow a **rigorous validation process** including expert reviews, pilot surveys, instrument revision, measures of validity and reliability
  - Conduct a **nationally representative sample** of statistics and data science classrooms
  - Create a **sustainable infrastructure** to facilitate data collection and dissemination (website development, customized reports, etc)

Theoretical Framework

- Student and Instructor models based on Expectancy-Value Theory (EVT)
- All three components impact student achievement



Family of Instruments

	Student Instrument	Instructor Instrument	Environment Inventory
Statistics	S-SOMAS*	I-SOMAS	E-SOMAS
Data Science	S-SOMADS	I-SOMADS	E-SOMADS

*For example, S-SOMAS: Student **S**urvey **o**f **M**otivational **A**ttitudes toward Statistics

S-SOMAS Constructs

Construct	S-SOMAS Definitions
Goal Orientation	What drives the students to learn statistics
Academic Self-Concept	Student perceptions about the academic achievement (general and statistics)
Utility Value	How much the student values statistics for serving or achieving their goals.
Attainment Value	How important success in statistics is to the student
Interest / Enjoyment Value	The interest a student has in statistics, or their enjoyment from it.
Costs and Benefits	Factors that deter from learning statistics, or benefits of learning statistics
Perception of Difficulty	How difficult the student perceives statistics to be
Expectancy	How the student thinks they will perform in the field of statistics

Examples of Utility Value Items

S-SOMAS	S-SOMADS	I-SOMAS
I need to know statistics to satisfy employers.	Being good at working with data is a valuable skill.	Teaching statistics helps to create informed citizens.
I will use statistics in my career.	I will use data science in my career.	I teach statistics to keep my job.
No one in my career field uses statistics.	I will rarely use data science in the future	Teaching statistics is necessary for my career.
I need to know statistics because it is required of me.	There is no reason to learn data science.	I value statistics to help my students better understand the world.

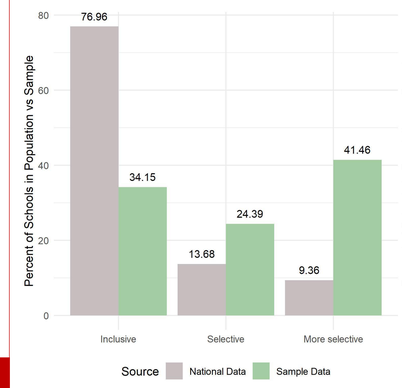
S-SOMAS Data Collection

Study	Data Collected	Items and Constructs	Sample Size
Pilot 0	Fall 2017 - Summer 2018	Form A: 49 items measuring 6 constructs Form B: 50 items measuring 6 constructs (92 total items measuring 11 constructs)	Form A: 1189 Form B: 1192
Pilot 1	Spring 2021	66 items measuring 8 constructs (Form-5 used a 5-point Likert-type scale; Form-7 used a 7-point Likert-type scale)	Form-5: 136 Form-7: 452
Pilot 2	Fall 2021	88 items measuring 8 constructs	2546
Pilot 3	Spring 2022	72 items measuring 8 constructs (proper subset of Pilot 2)	*ongoing*

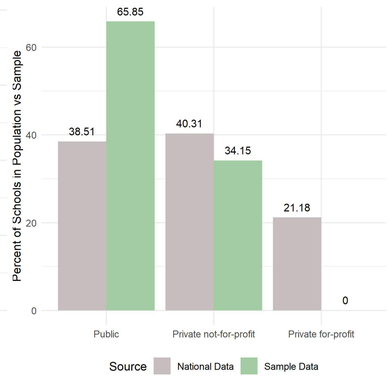
Validation: Sample Characteristics

- Carnegie Classification Database used to compare universities sampled in S-SOMASO Pilot 2 administration to the population all US Universities
- Informs which university types need to be better targeted in future data collection
- Analysis completed by undergraduate student research student

ACT Categorization



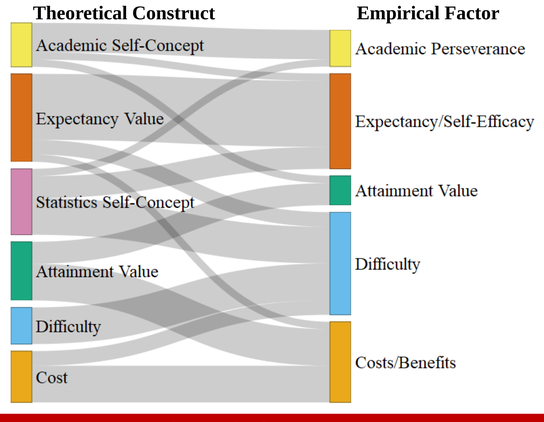
Control of Institution (IPEDS)



Validation: Psychometric Properties

- Triangulation of Exploratory Factor Analysis (EFA), Confirmatory Factor Analysis, and Item Response Theory
- All three analyses are explored to inform item cutting, revising, and new item writing
- Analysis completed by undergraduate student research student

Sankey Diagram Mapping Theoretical Constructs to Empirical Factors from EFA



Acknowledgements

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- To learn more about our work: www.SDSAttitudes.com

Survey Instrument Development Process

Survey Development Timeline

Survey	Spring 2021	Summer 2021	Fall 2021	Spring 2022	Summer 2022	Fall 2022	Spring 2023	Summer 2023	Fall 2023
S-SOMAS	Pilot 1	Analysis Development	Pilot 2	Pilot 3	Analysis Development	Pre/Post	Pre/Post	Data Analysis	
I-SOMAS		Initial Development Workshops	Develop	Pilot 1	Analysis Development	Pilot 2	Full Implementation	Data Analysis	
E-SOMAS		Initial Development Workshops			Initial Development Workshops	Pilot 1	Full Implementation	Data Analysis	
S-SOMADS		Initial Development Workshops	Develop	Pilot 1	Analysis Development	Pilot 2	Pre/Post	Analysis Development	Pre/Post
I-SOMADS					Initial Development Workshops	Pilot 1	Pilot 2	Analysis Development	Full Implementation
E-SOMADS					Initial Development Workshops	Develop	Pilot 1	Analysis Development	Full Implementation