

Preliminary Draft of Summary Data

Alyssa Hu

Last Updated: February 25, 2020

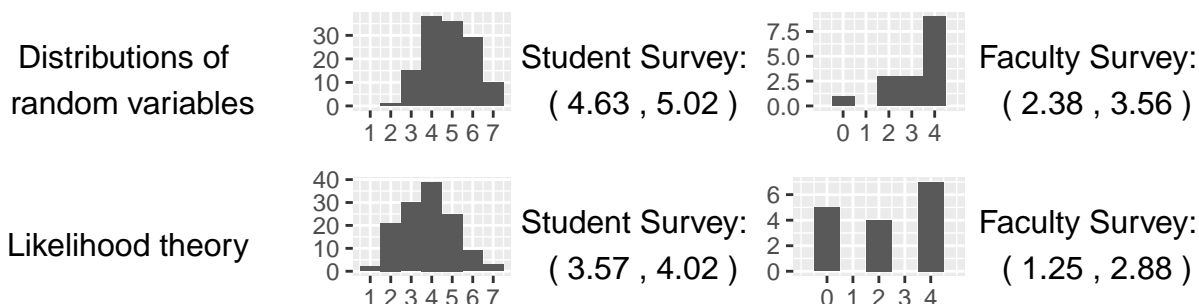
1 Introduction

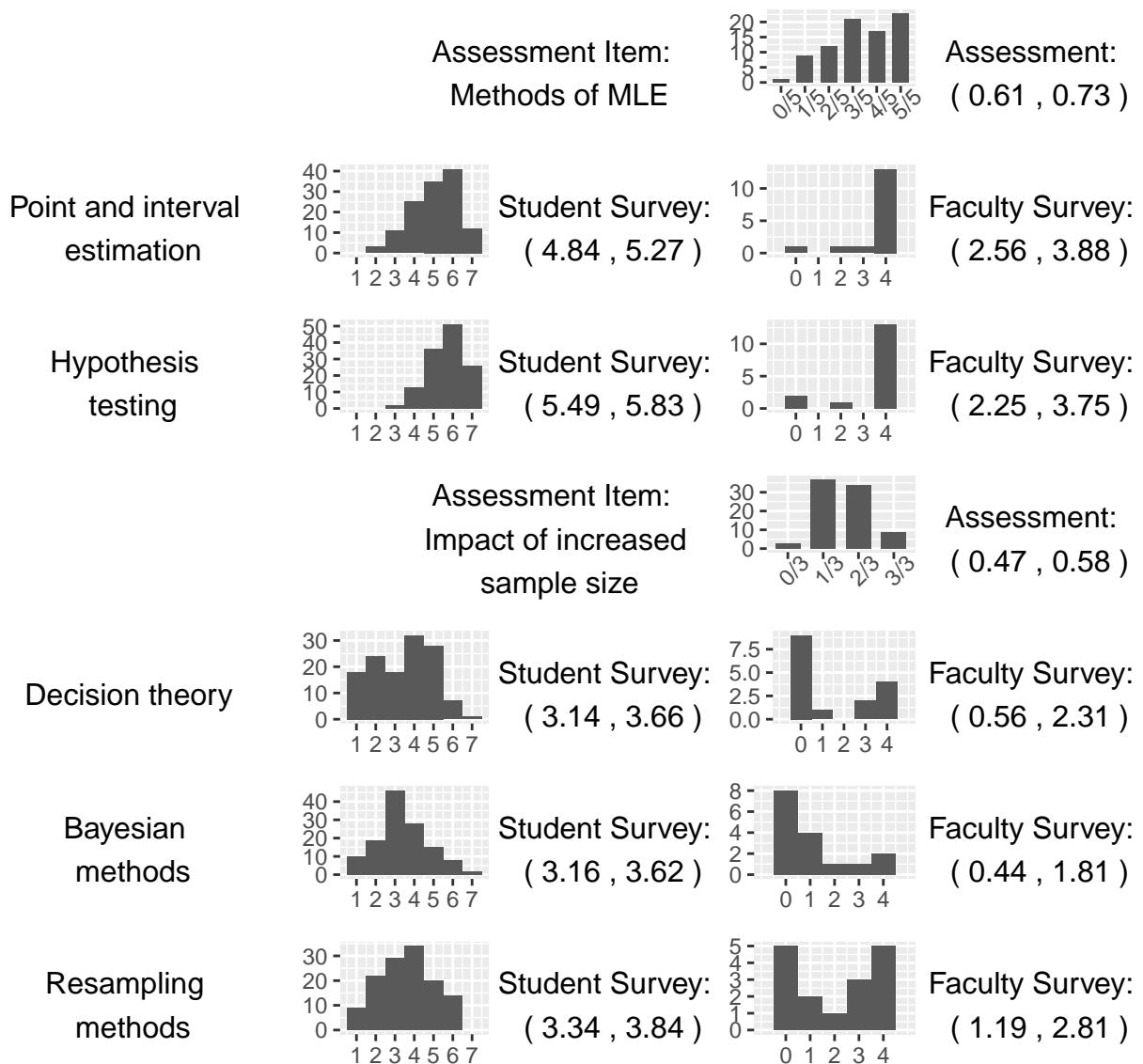
This document provides summaries of data collected at Penn State from the Comprehensive Undergraduate Statistics Program (CUSP) student survey and assessment and the Statistics Program Emphases & Contents (SPECs) faculty perception survey. Sections 2-7 provides item-level (topic) summaries. Section 8 provides subsection-level summaries. Section 9 provides 3 scatterplots: one for the CUSP and SPECs survey, one for the CUSP survey and assessment, and one for the CUSP assessment and SPECs survey. Section 10 provides other summaries for items that appear in only one of the three data sources.

2 Section: Statistical Methods & Theory

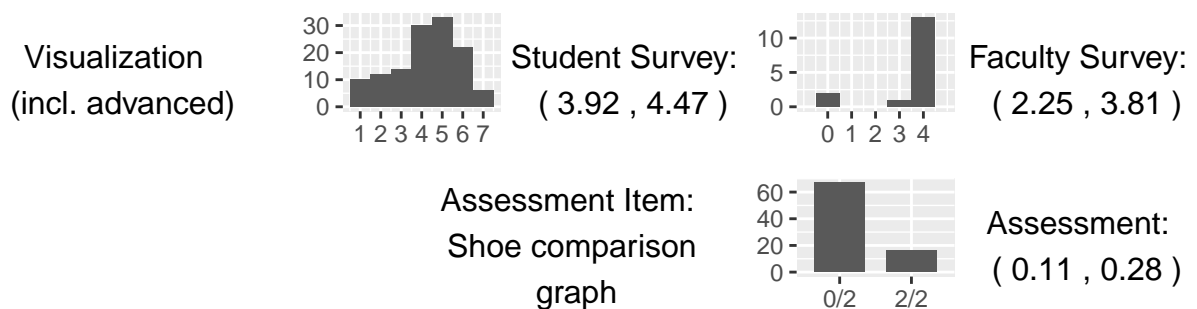
The results presented in Sections 2-7 and its subsections are organized as follows: Each row corresponds to a topic in the 2014 ASA Curriculum Guidelines and has at least 5 columns of information. The topic is specified in the first column. In the second column, the histogram displays self-reported CUSP survey responses from seniors in the statistics major. The x-axis is a Likert scale from 1 to 7 for a student's current level of knowledge/competency, where 1 is *very low/never learned* and 7 is *exceptional*. The histogram is accompanied by a 95% confidence interval for the mean student response, as shown in the third column. In the fourth column, the histogram displays SPECs survey responses from statistics faculty. The x-axis is a Likert scale from 0 to 4 for the amount of exposure that students have to that topic in the courses they teach, where 0 is *None: Not included in course* and 4 is *Assessed: Students are expected to do this for themselves AND will be assessed for proficiency*. The histogram is accompanied by a 95% confidence interval for the mean faculty response as shown in the last column. Note that only some of these topics have a related CUSP assessment item, which is displayed below that row (indented on the next line). The assessment item name is specified and followed by a histogram that displays CUSP assessment results for that topic from seniors in the statistics major. The x-axis indicates the proportion of questions answered correctly under that item. The histogram is accompanied by a 95% confidence interval for the mean assessment item score.

2.1 Subsection: Statistical Theory

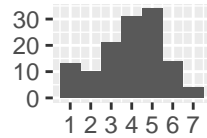




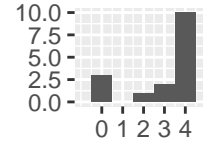
2.2 Subsection: Exploratory Data Analysis



Visualization
(errors,
anomalies)

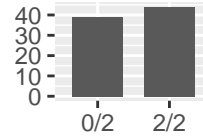


Student Survey:
(3.68 , 4.2)



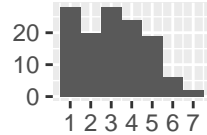
Faculty Survey:
(1.94 , 3.56)

Assessment Item:
Initial EDA

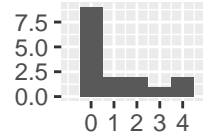


Assessment:
(0.41 , 0.63)

Smoothing/
kernel estimation

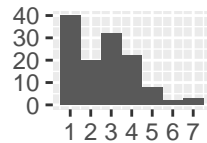


Student Survey:
(2.82 , 3.36)

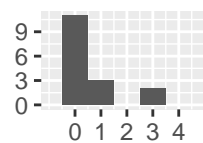


Faculty Survey:
(0.44 , 1.88)

Spatial methods

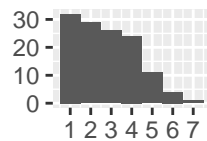


Student Survey:
(2.38 , 2.91)

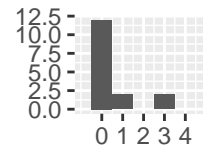


Faculty Survey:
(0.19 , 1.19)

Mapping



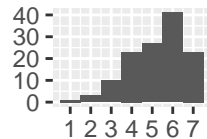
Student Survey:
(2.5 , 3)



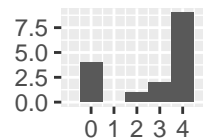
Faculty Survey:
(0.12 , 1.12)

2.3 Subsection: Design of Studies

Data collection

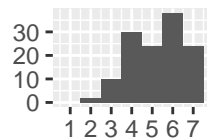


Student Survey:
(4.99 , 5.45)

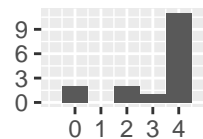


Faculty Survey:
(1.75 , 3.38)

Random
assignment

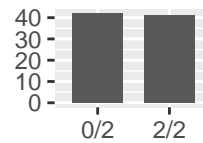


Student Survey:
(5 , 5.45)



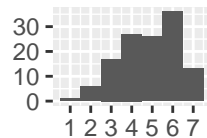
Faculty Survey:
(2.19 , 3.69)

Assessment Item:
Purpose of
random assignment

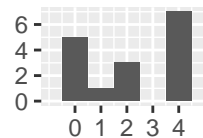


Assessment:
(0.37 , 0.59)

Blocking &
stratification

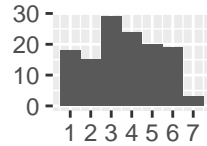


Student Survey:
(4.56 , 5.06)

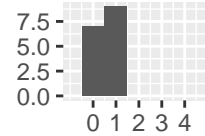


Faculty Survey:
(1.25 , 2.94)

Adaptive designs

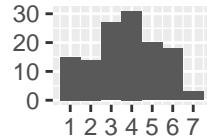


Student Survey:
(3.34 , 3.91)

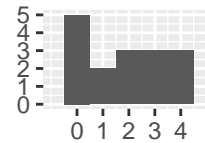


Faculty Survey:
(0.25 , 0.75)

Efficiency
(e.g. power)

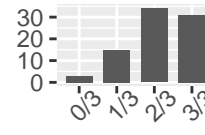


Student Survey:
(3.43 , 3.99)



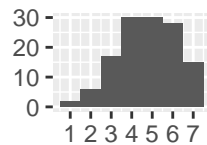
Faculty Survey:
(1.06 , 2.5)

Assessment Item:
Impact of decreased
sample size

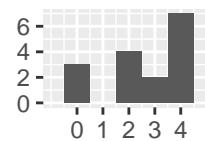


Assessment:
(0.64 , 0.76)

Issues of bias

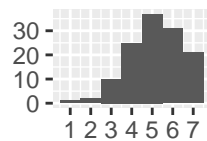


Student Survey:
(4.48 , 4.98)

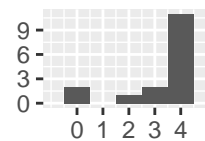


Faculty Survey:
(1.69 , 3.25)

Random
selection

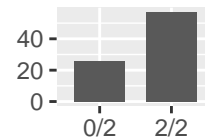


Student Survey:
(4.9 , 5.35)



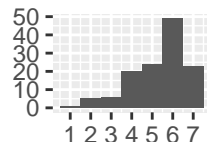
Faculty Survey:
(2.25 , 3.69)

Assessment Item:
Purpose of
random sampling

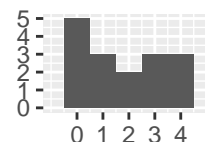


Assessment:
(0.57 , 0.77)

Survey sampling

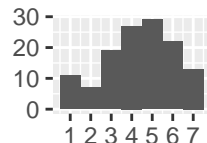


Student Survey:
(5.09 , 5.56)

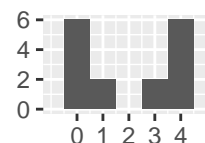


Faculty Survey:
(1 , 2.46)

Causality

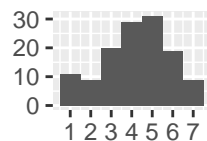


Student Survey:
(4.05 , 4.64)

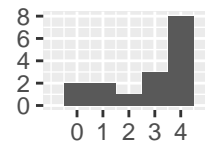


Faculty Survey:
(1.06 , 2.81)

Confounding &
coincidence



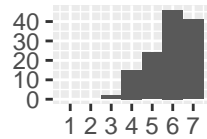
Student Survey:
(3.91 , 4.47)



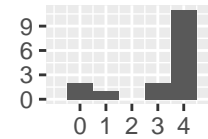
Faculty Survey:
(1.88 , 3.38)

2.4 Subsection: Statistical Models

Simple linear
regression

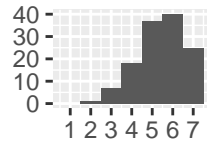


Student Survey:
(5.66 , 6.02)

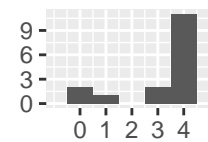


Faculty Survey:
(2.19 , 3.69)

Multiple
regression

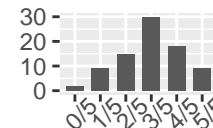


Student Survey:
(5.21 , 5.62)



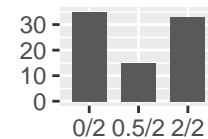
Faculty Survey:
(2.12 , 3.69)

Assessment Item:
Robust to
independence



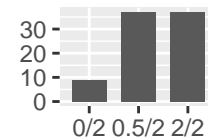
Assessment:
(0.53 , 0.64)

Assessment Item:
Regress crossed



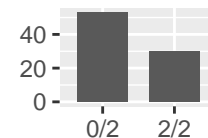
Assessment:
(0.34 , 0.54)

Assessment Item:
Regress parallel



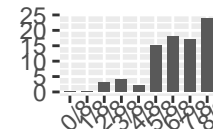
Assessment:
(0.47 , 0.64)

Assessment Item:
Interaction
model conclusion



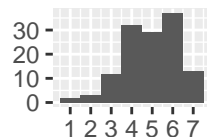
Assessment:
(0.25 , 0.46)

Assessment Item:
OLS assumptions

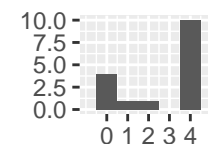


Assessment:
(0.74 , 0.82)

Generalized
linear models

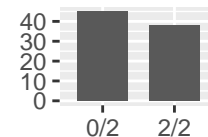


Student Survey:
(4.68 , 5.14)



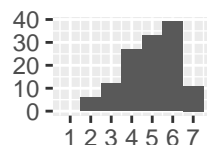
Faculty Survey:
(1.62 , 3.38)

Assessment Item:
Logistic regression
tool selection

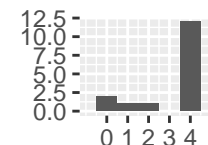


Assessment:
(0.34 , 0.55)

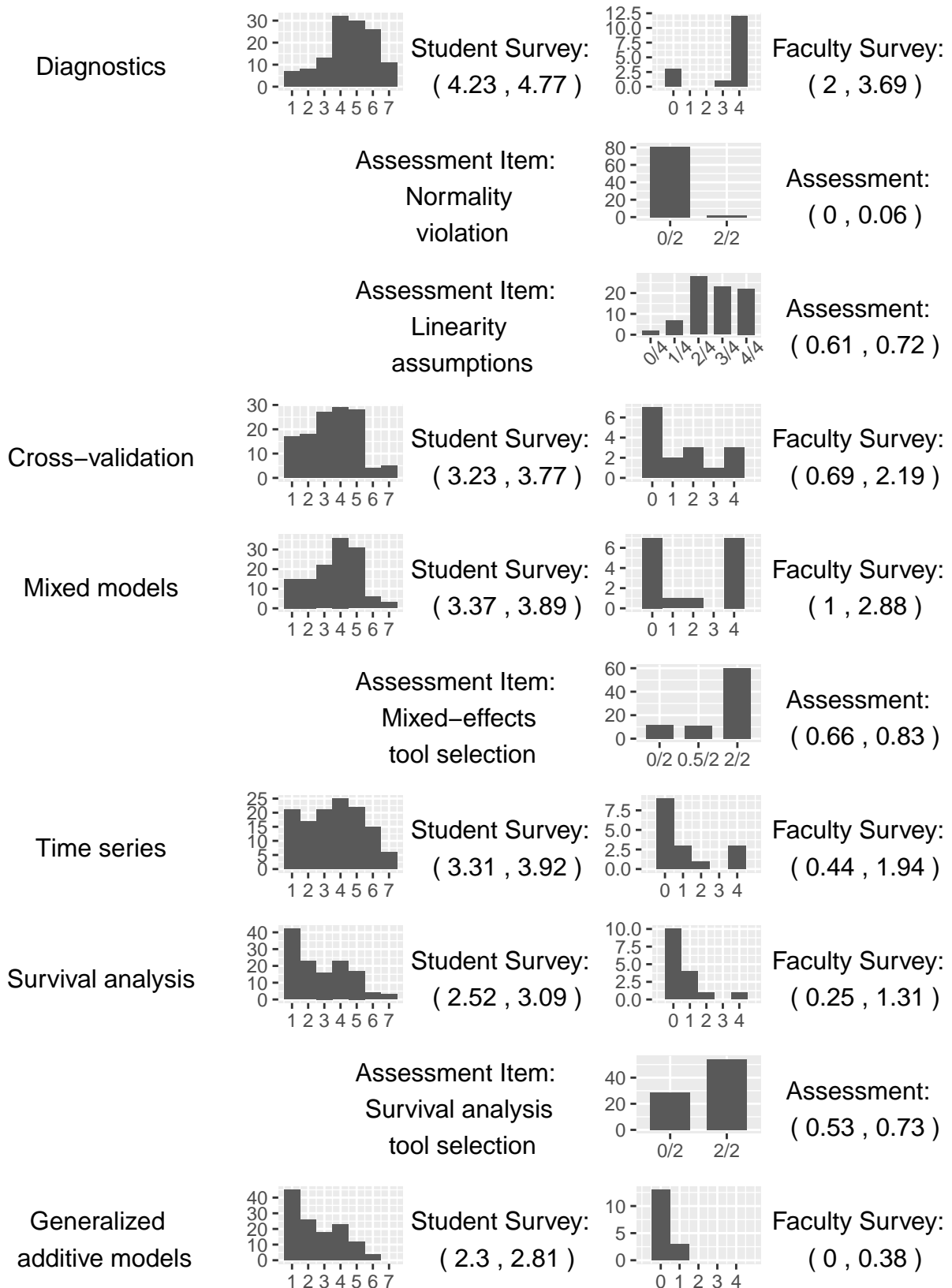
Model selection

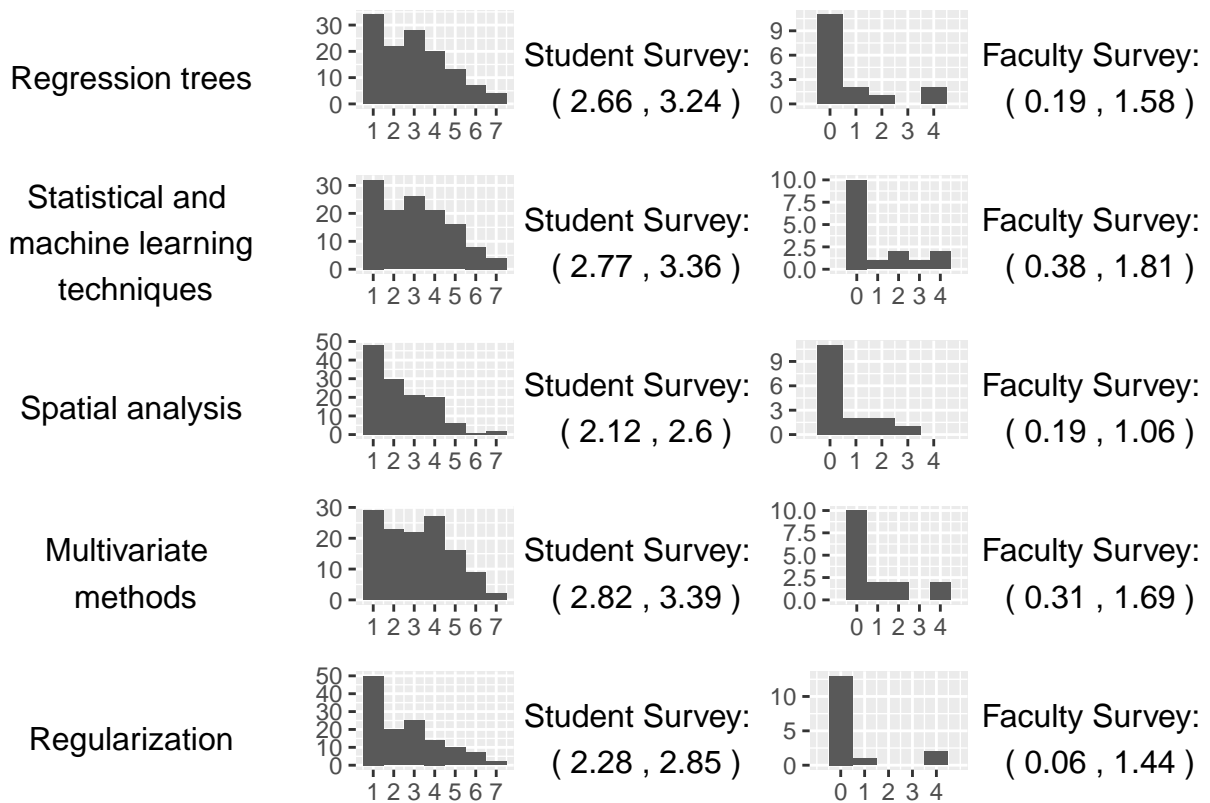


Student Survey:
(4.7 , 5.15)



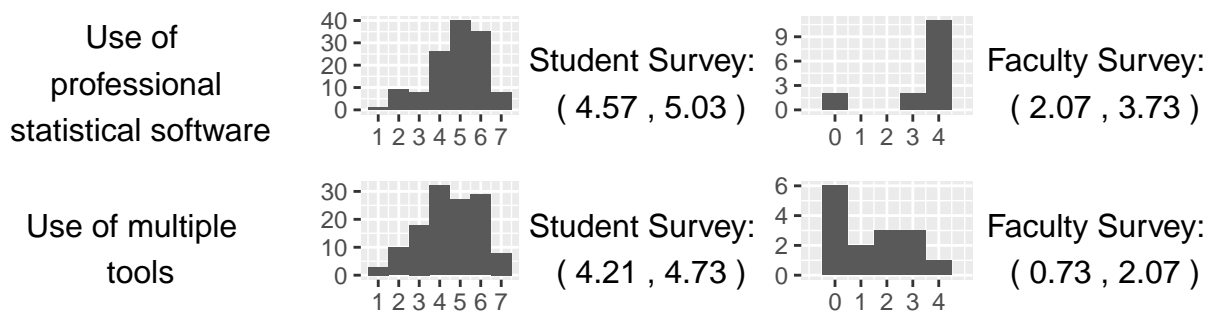
Faculty Survey:
(2.19 , 3.75)



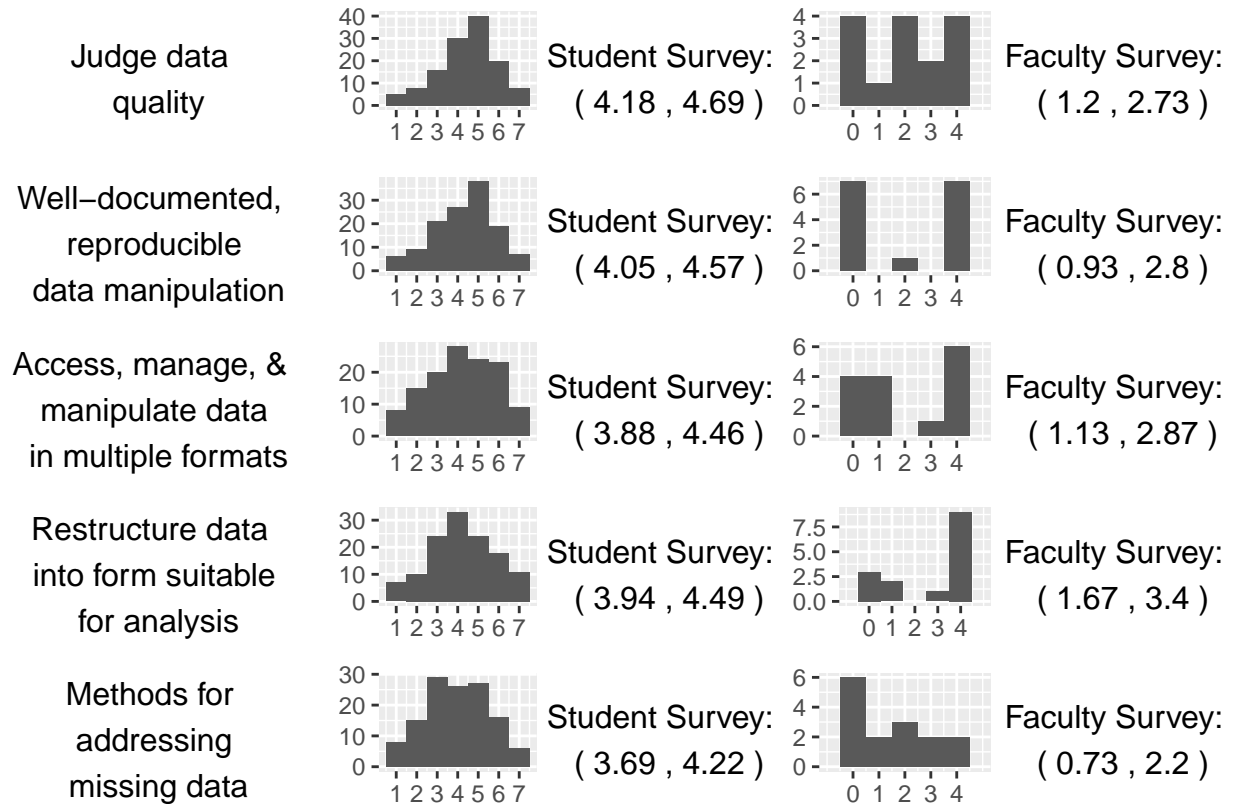


3 Section: Data Wrangling Computation and Data Science

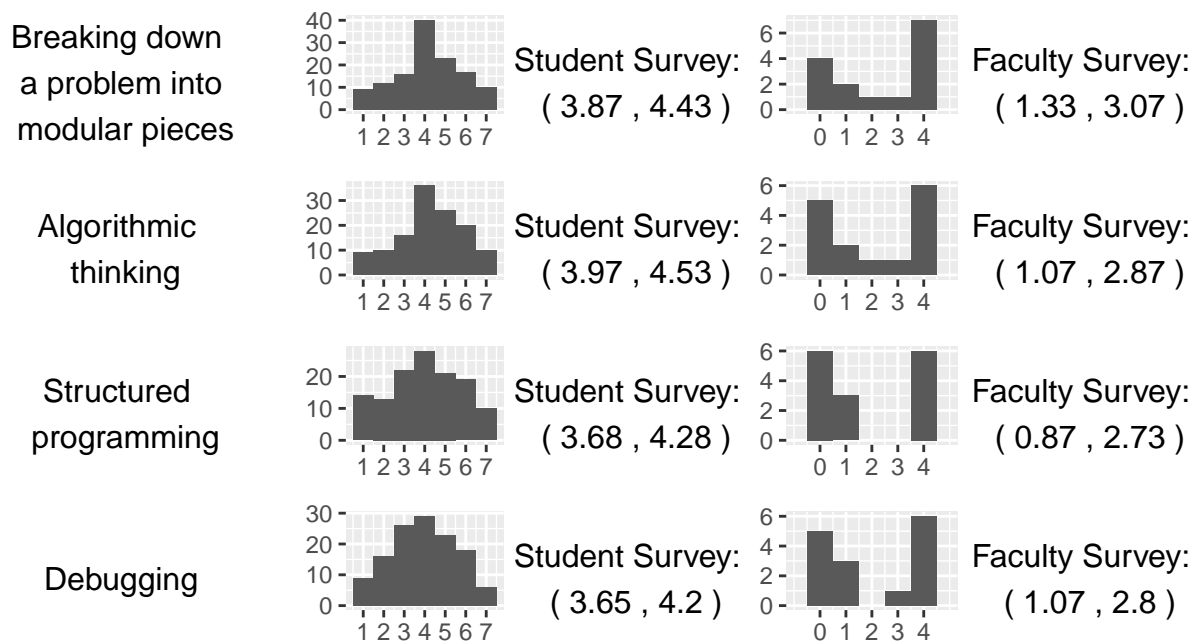
3.1 Subsection: Software and Tools

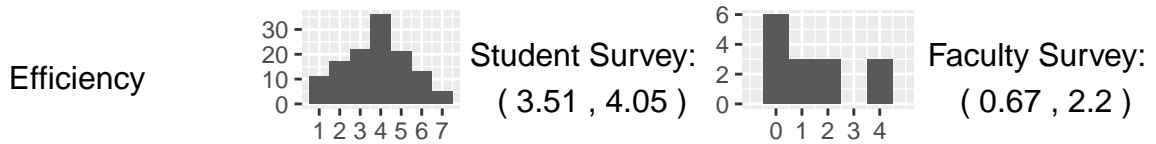


3.2 Subsection: Accessing and Wrangling Data

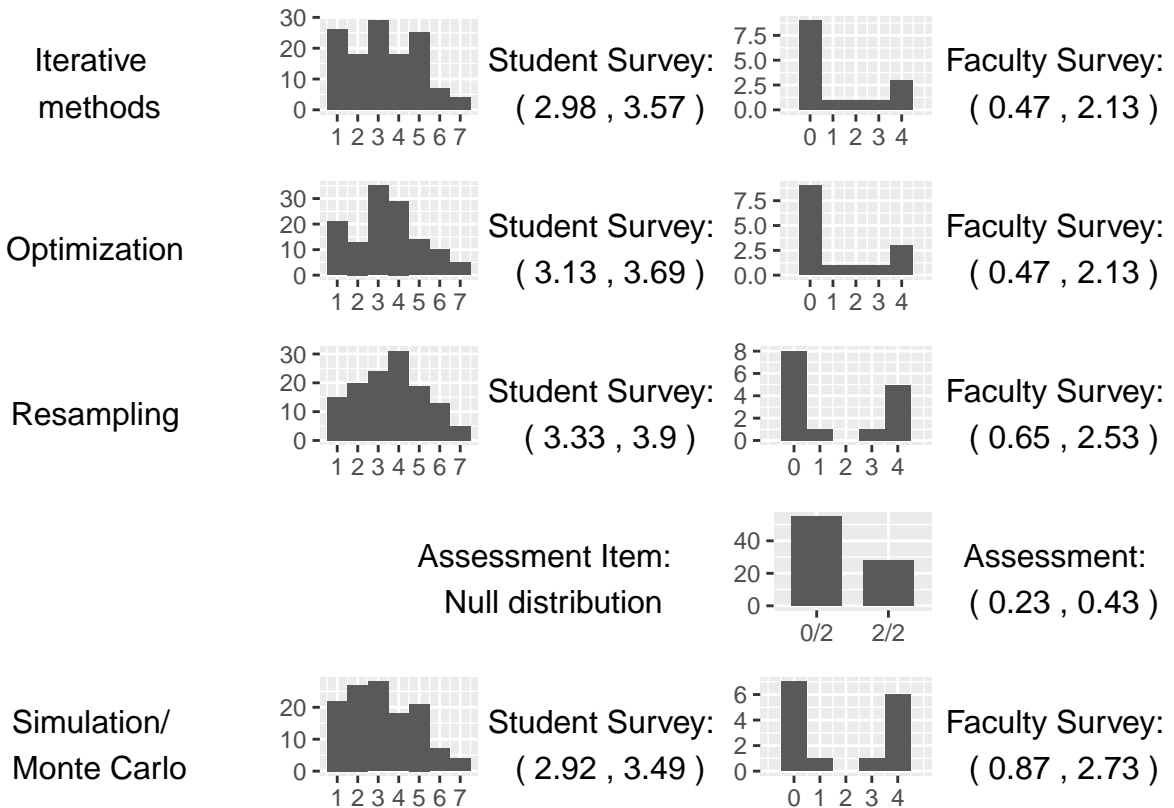


3.3 Subsection: Basic Programming Concepts



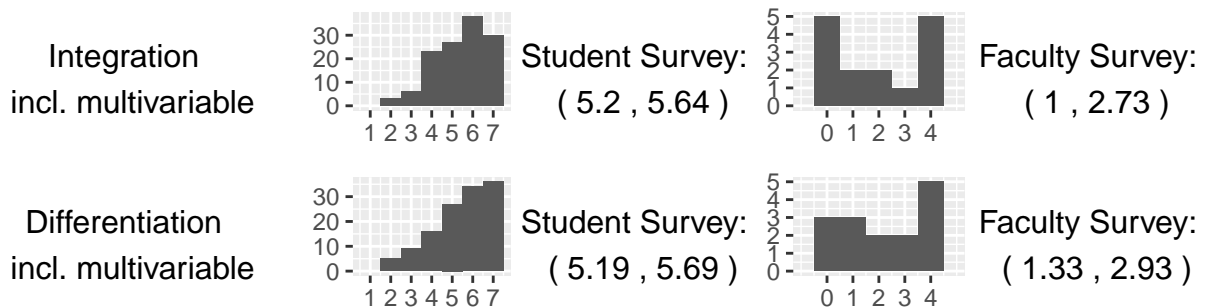


3.4 Subsection: Computationally Intensive Statistical Methods



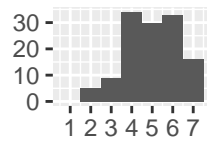
4 Section: Mathematical Foundations

4.1 Subsection: Calculus

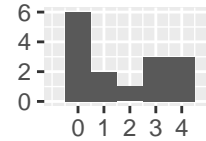


4.2 Subsection: Linear Algebra

Matrix
manipulation

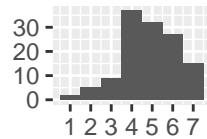


Student Survey:
(4.74 , 5.2)

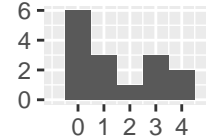


Faculty Survey:
(0.87 , 2.47)

Linear
transformations

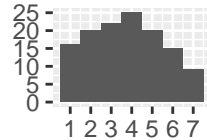


Student Survey:
(4.58 , 5.06)

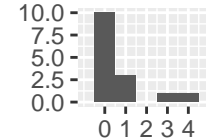


Faculty Survey:
(0.73 , 2.2)

Projections in
Euclidean space

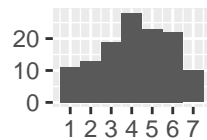


Student Survey:
(3.43 , 4.06)

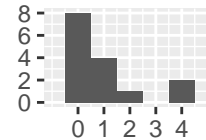


Faculty Survey:
(0.2 , 1.47)

Eigenvalues/
eigenvectors

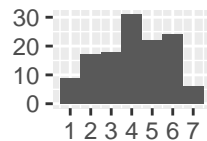


Student Survey:
(3.84 , 4.43)

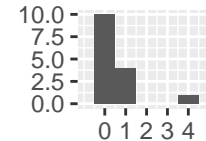


Faculty Survey:
(0.33 , 1.73)

Matrix
decomposition



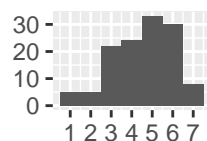
Student Survey:
(3.77 , 4.35)



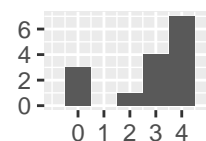
Faculty Survey:
(0.13 , 1.33)

4.3 Subsection: Probability

Properties of
univariate and
multivariate
random variables

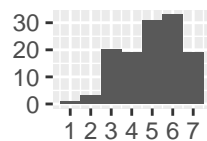


Student Survey:
(4.27 , 4.79)

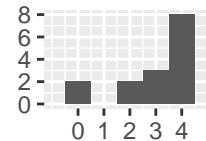


Faculty Survey:
(1.73 , 3.4)

Discrete & continuous
distributions

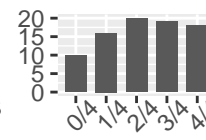


Student Survey:
(4.74 , 5.22)



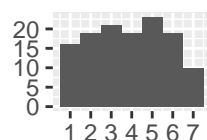
Faculty Survey:
(2 , 3.53)

Assessment Item:
Probability distributions

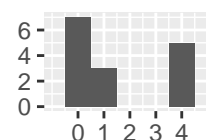


Assessment:
(0.48 , 0.62)

Markov chains



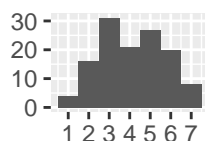
Student Survey:
(3.55 , 4.19)



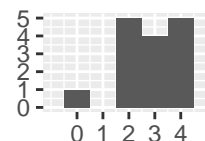
Faculty Survey:
(0.67 , 2.47)

4.4 Subsection: Connecting mathematical foundations & applications in statistics

Connections between the above mathematical foundations and their applications in statistics



Student Survey:
(3.84 , 4.39)

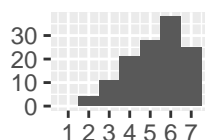


Faculty Survey:
(2.07 , 3.2)

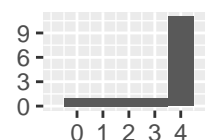
5 Section: Statistical Practice

5.1 Subsection: Communication

Write clearly

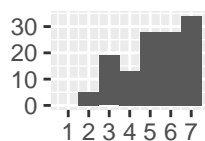


Student Survey:
(5.01 , 5.48)

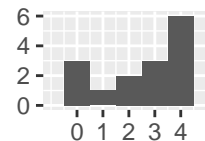


Faculty Survey:
(2.33 , 3.73)

Speak fluently

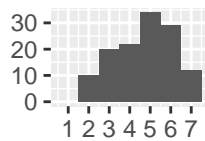


Student Survey:
(4.96 , 5.5)

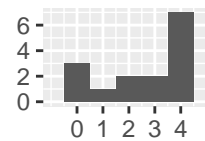


Faculty Survey:
(1.53 , 3.13)

Communicate complex statistical methods in basic terms

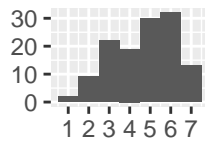


Student Survey:
(4.43 , 4.93)

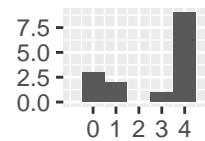


Faculty Survey:
(1.67 , 3.27)

Construct compelling written summaries / technical writing

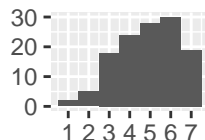


Student Survey:
(4.4 , 4.93)

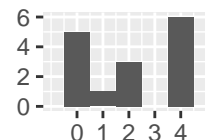


Faculty Survey:
(1.73 , 3.47)

Show results in an accesible manner/ presentation skills

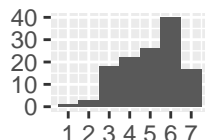


Student Survey:
(4.6 , 5.13)

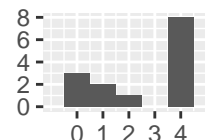


Faculty Survey:
(1.13 , 2.87)

Construct effective visual displays

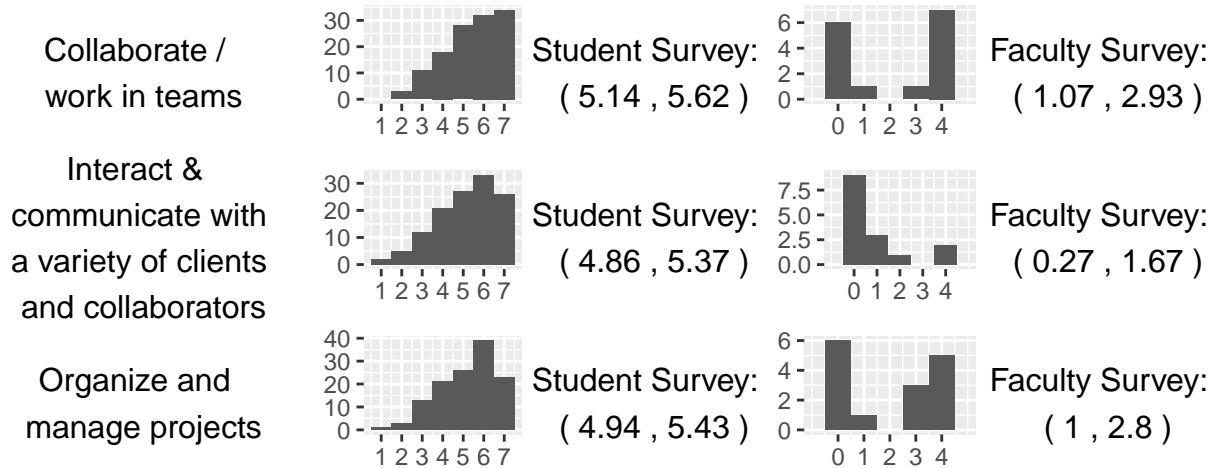


Student Survey:
(4.76 , 5.24)

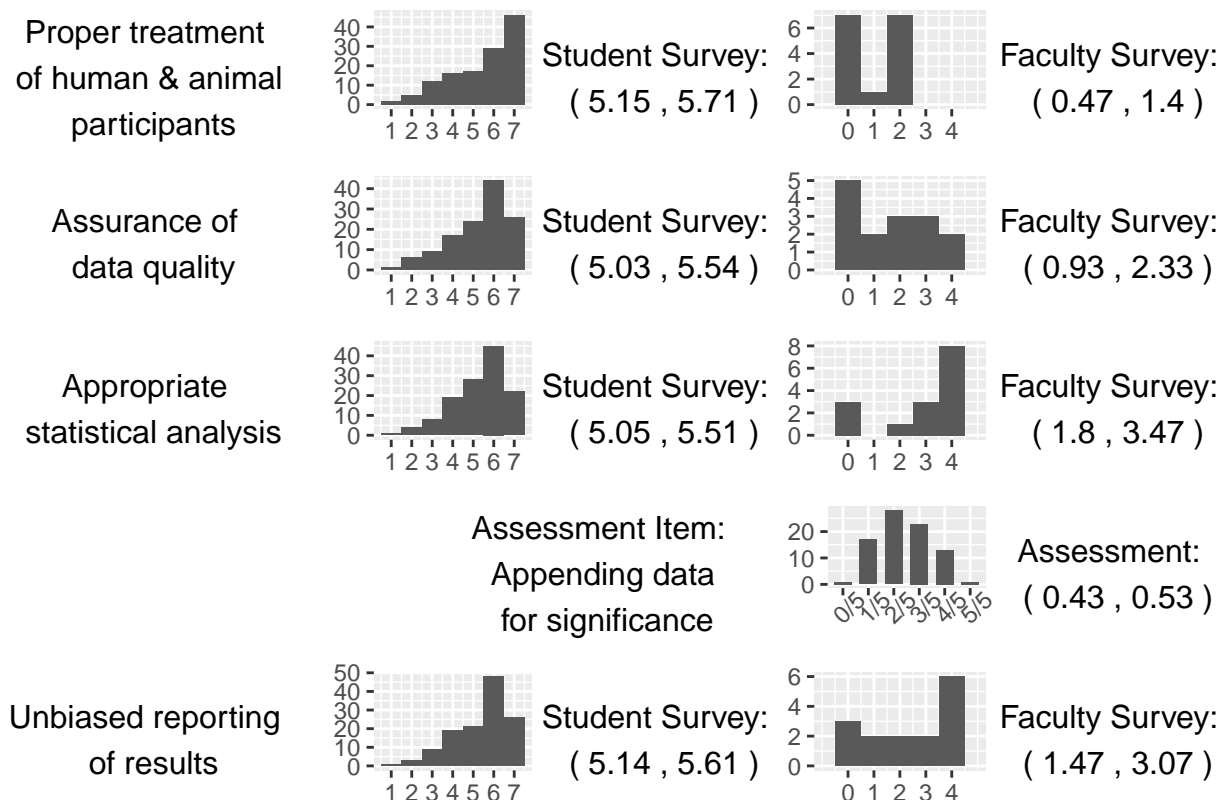


Faculty Survey:
(1.5 , 3.29)

5.2 Subsection: Collaboration



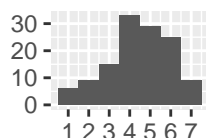
5.3 Subsection: Ethical Issues



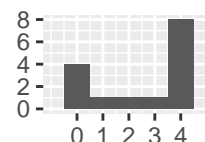
6 Section: Problem Solving

6.1 Subsection: Complex open-ended problems

Tackle real
research
questions

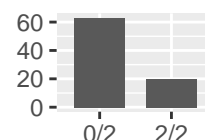


Student Survey:
(4.16 , 4.69)



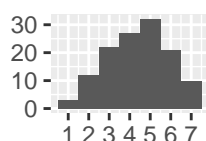
Faculty Survey:
(1.53 , 3.27)

Assessment Item:
Coral study

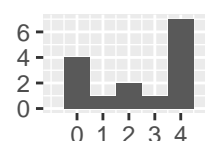


Assessment:
(0.14 , 0.33)

Ability to deal
with messy or
unstructured data



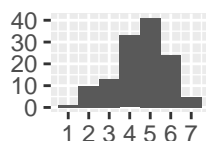
Student Survey:
(4.11 , 4.64)



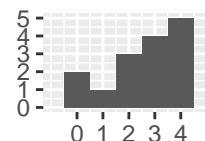
Faculty Survey:
(1.4 , 3.13)

6.2 Subsection: Scientific method and statistical problem-solving cycle

Formulating
good questions

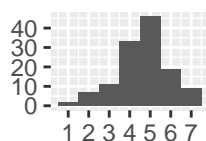


Student Survey:
(4.3 , 4.74)

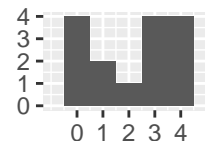


Faculty Survey:
(1.73 , 3.13)

Assessing
appropriateness
of data

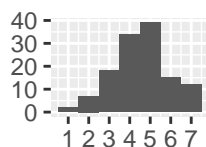


Student Survey:
(4.39 , 4.83)

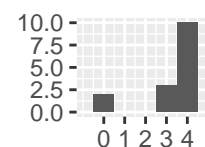


Faculty Survey:
(1.27 , 2.87)

Choosing
from a set of
different tools

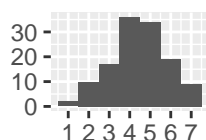


Student Survey:
(4.28 , 4.76)

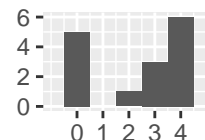


Faculty Survey:
(2.18 , 3.73)

Undertaking
analysis in a
reproducible
manner

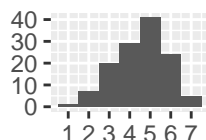


Student Survey:
(4.19 , 4.67)

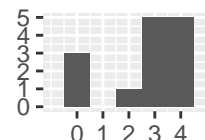


Faculty Survey:
(1.33 , 3.07)

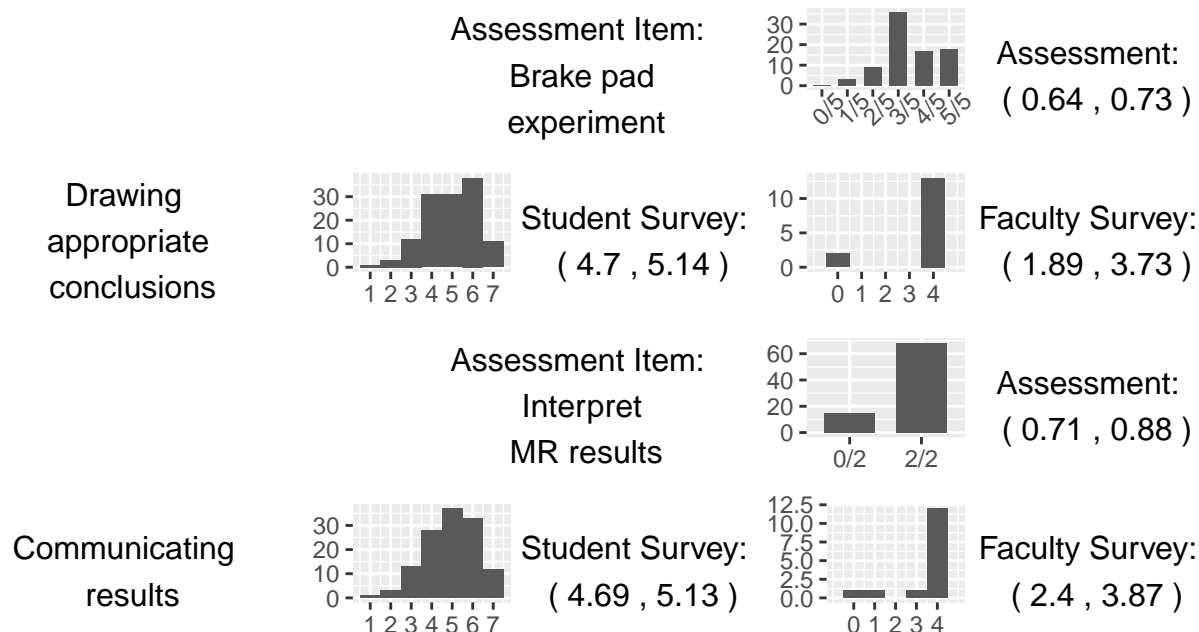
Assessing the
analytic methods



Student Survey:
(4.3 , 4.74)



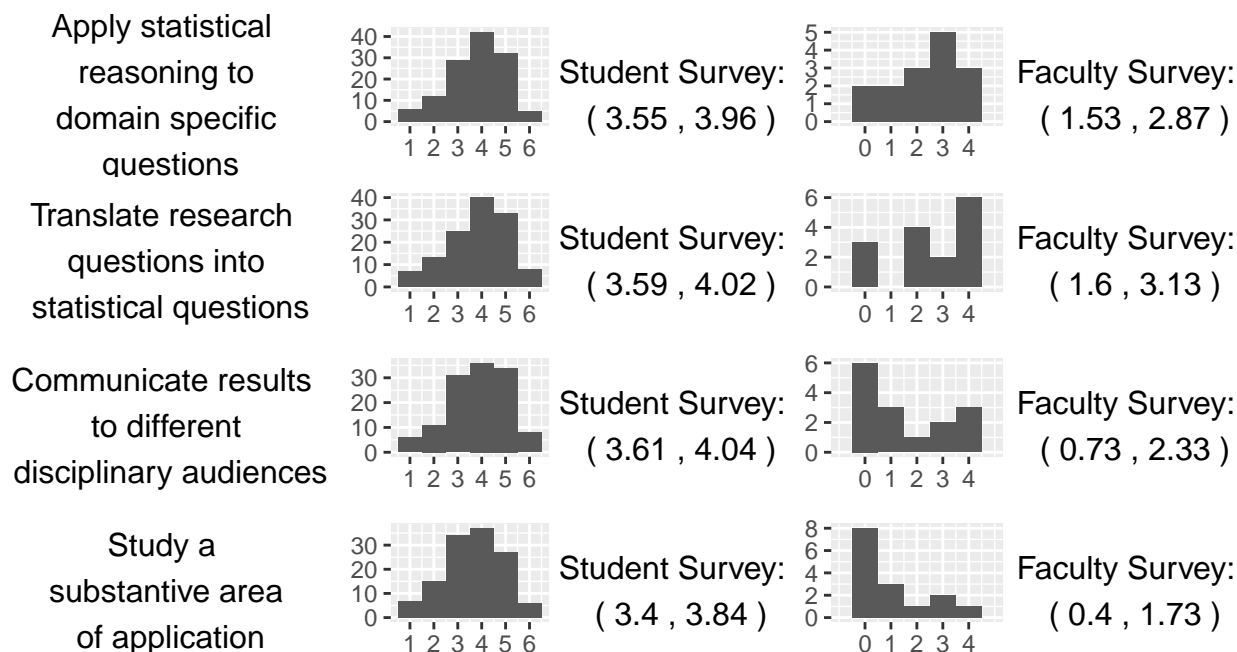
Faculty Survey:
(1.64 , 3.29)



7 Section: Discipline-Specific Knowledge

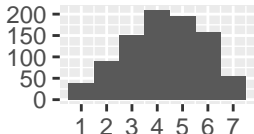
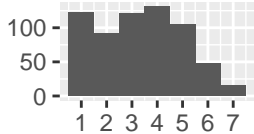
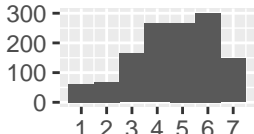
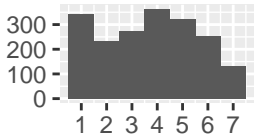
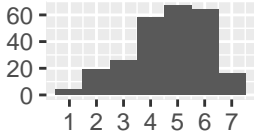
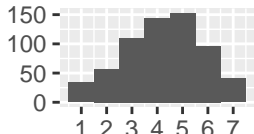
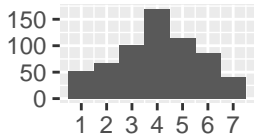
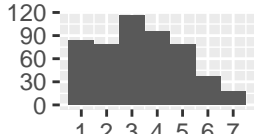
Note that the scale changes in this section for the CUSP student survey responses, as they are asked about the amount of opportunity/practice they have had in these areas, where 1 is *never* and 6 is *very frequently*).

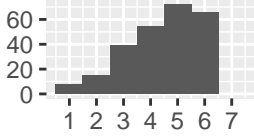
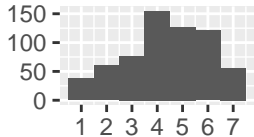
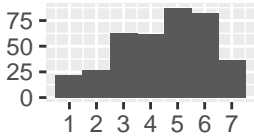
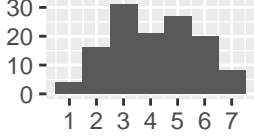
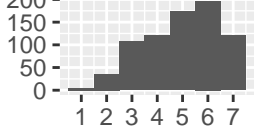
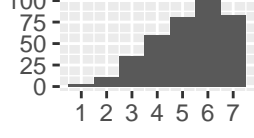
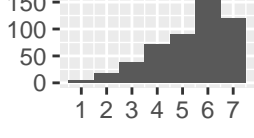
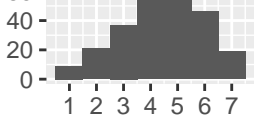
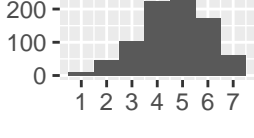
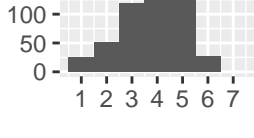
7.1 Subsection: Discipline-Specific Knowledge



8 Summarizing Subsections

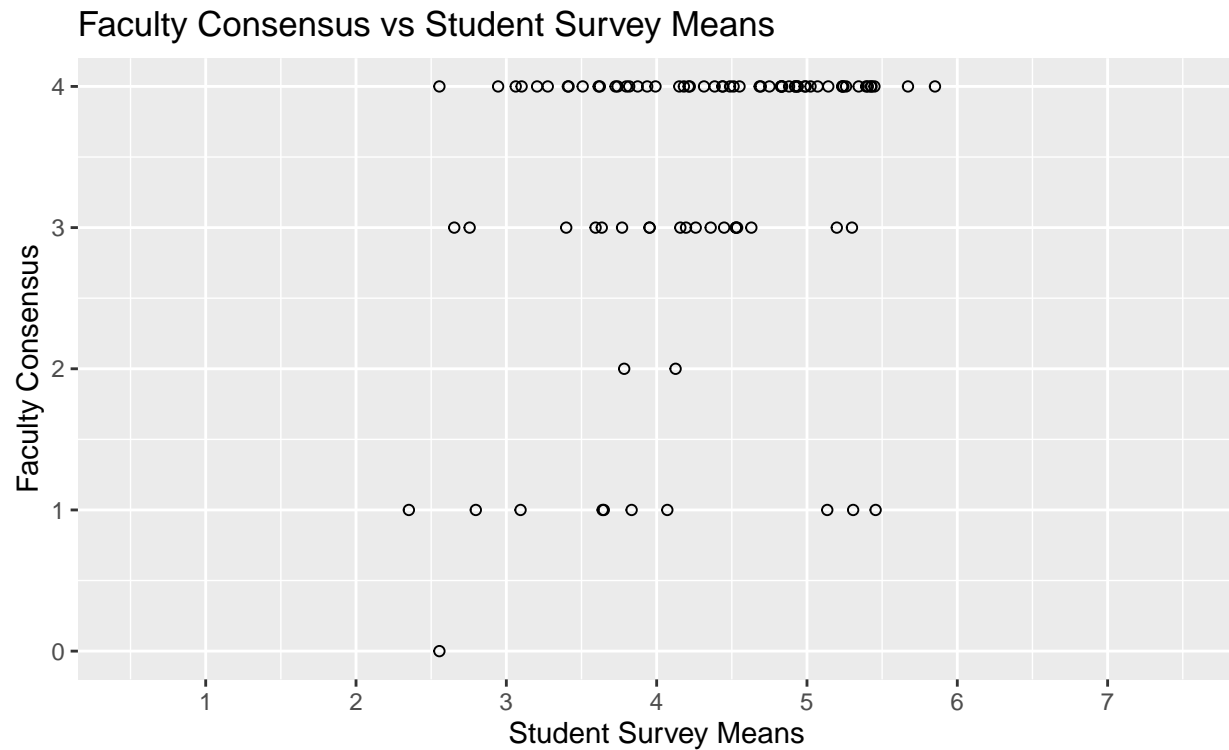
The results presented in this section are organized by skill/competency groups corresponding to the 2014 ASA Curriculum Guidelines. Histograms represent self-reported CUSP survey responses by seniors in the statistics major within that subsection, accompanied by a 95% confidence interval for mean response across that subsection. Under the “Faculty Assessed” column, the denominator corresponds to the number of specific skills & competencies cited in the ASA Guidelines for that subsection, and the numerator indicates how many of them are actively assessed in the undergraduate statistics major at Penn State as reported by faculty in the SPECs survey.

Statistical Theory		Student Survey: (4.15 , 4.35)	Faculty Assessed: 7/7
EDA		Student Survey: (3.2 , 3.46)	Faculty Assessed: 3/5
Design of Studies		Student Survey: (4.56 , 4.73)	Faculty Assessed: 9/10
Statistical Models		Student Survey: (3.64 , 3.8)	Faculty Assessed: 13/15
Software and Tools		Student Survey: (4.47 , 4.82)	Faculty Assessed: 2/2
Accessing and Wrangling Data		Student Survey: (4.1 , 4.34)	Faculty Assessed: 5/5
Basic Programming Concepts		Student Survey: (3.9 , 4.15)	Faculty Assessed: 5/5
Computationally Intensive Statistical Methods		Student Survey: (3.23 , 3.52)	Faculty Assessed: 4/4

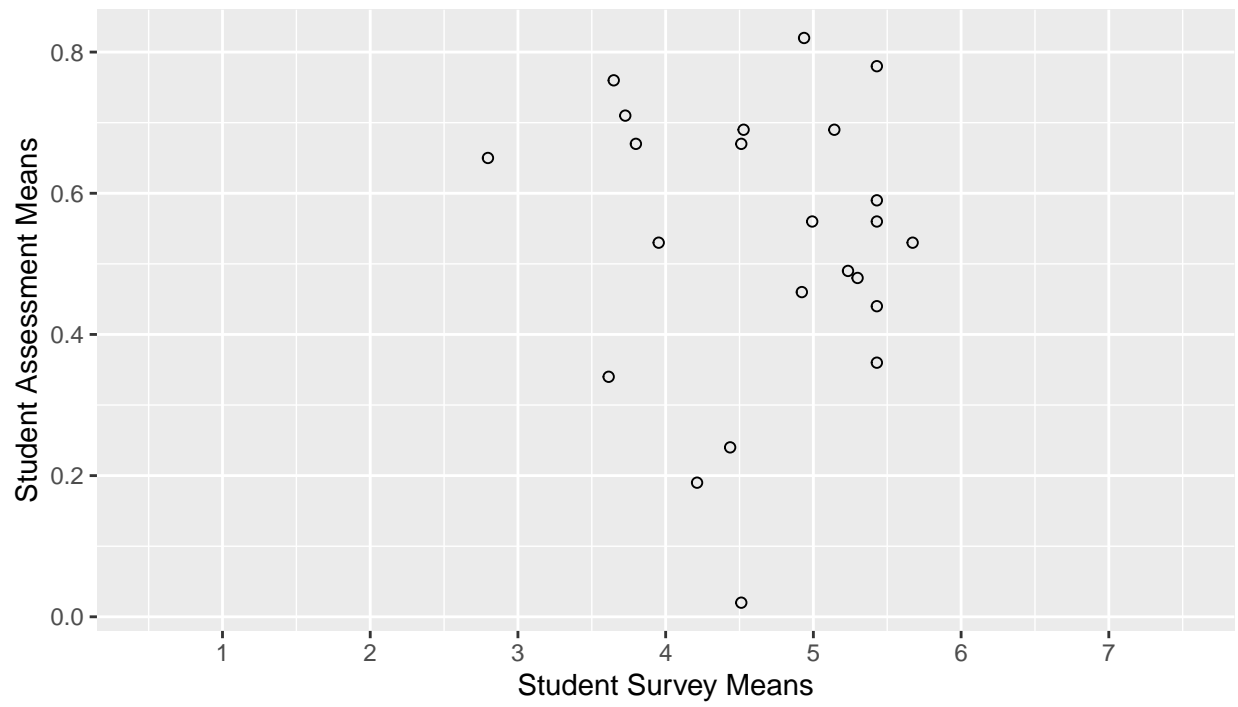
Calculus		Student Survey: (4.26 , 4.6)	Faculty Assessed: 2/2
Linear Algebra		Student Survey: (4.23 , 4.48)	Faculty Assessed: 5/5
Probability		Student Survey: (4.3 , 4.63)	Faculty Assessed: 3/3
Connecting Math and Statistics		Student Survey: (3.85 , 4.39)	Faculty Assessed: 1/1
Communication		Student Survey: (4.86 , 5.07)	Faculty Assessed: 6/6
Collaboration		Student Survey: (5.1 , 5.38)	Faculty Assessed: 3/3
Ethical Issues		Student Survey: (5.23 , 5.48)	Faculty Assessed: 3/4
Complex Open-ended Problems		Student Survey: (4.22 , 4.59)	Faculty Assessed: 2/2
Scientific Method		Student Survey: (4.56 , 4.73)	Faculty Assessed: 7/7
Discipline-Specific Knowledge		Student Survey: (3.65 , 3.87)	Faculty Assessed: 4/4

9 Scatterplots

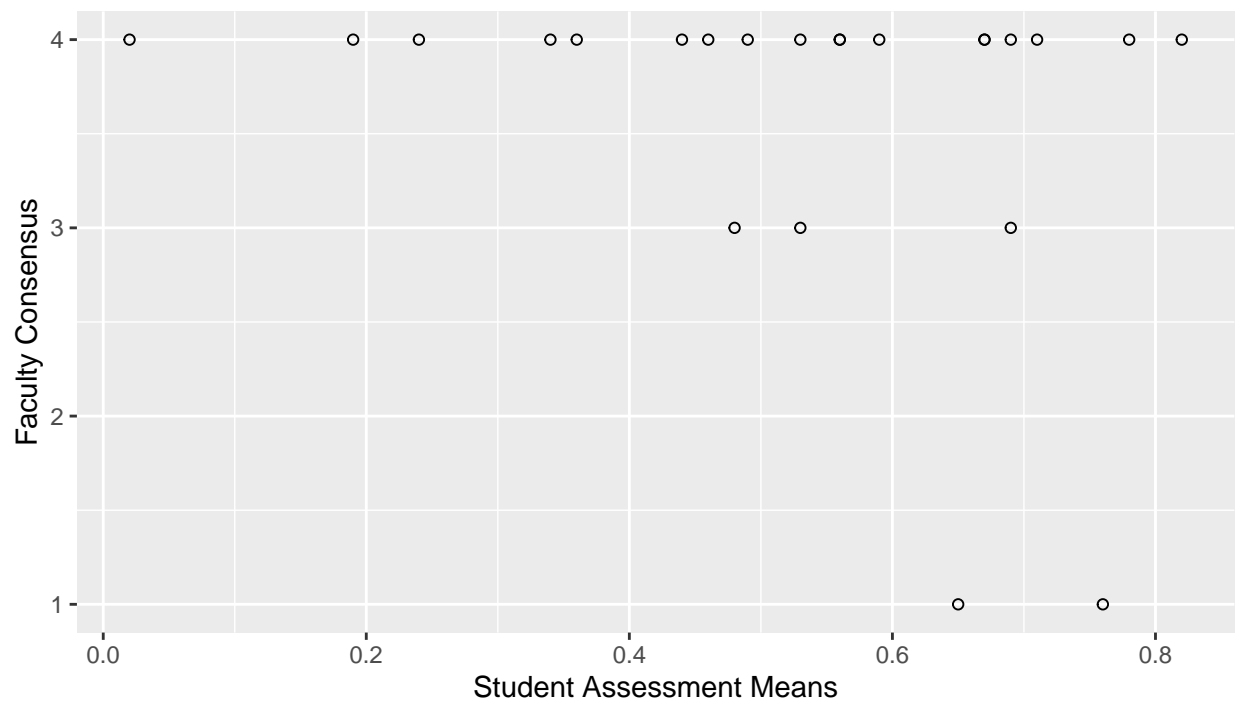
We are interested in seeing if there are any patterns between any pairs of the components: CUSP survey vs SPECs survey, CUSP survey vs CUSP assessment, and CUSP assessment vs SPECs survey. Each dot in the histogram represents a particular topic that both components share. Note that we are using 'Faculty Consensus' (more representative of the entire program) rather than the mean of faculty responses (where each faculty member's response would be affected by the specific course(s) that they teach).



Student Assessment Means vs Student Survey Means



Faculty Consensus vs Student Assessment Means

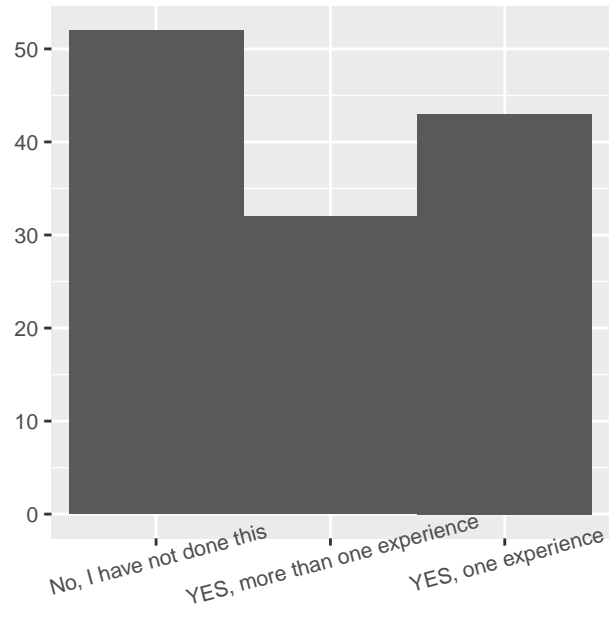


10 Section: Misc

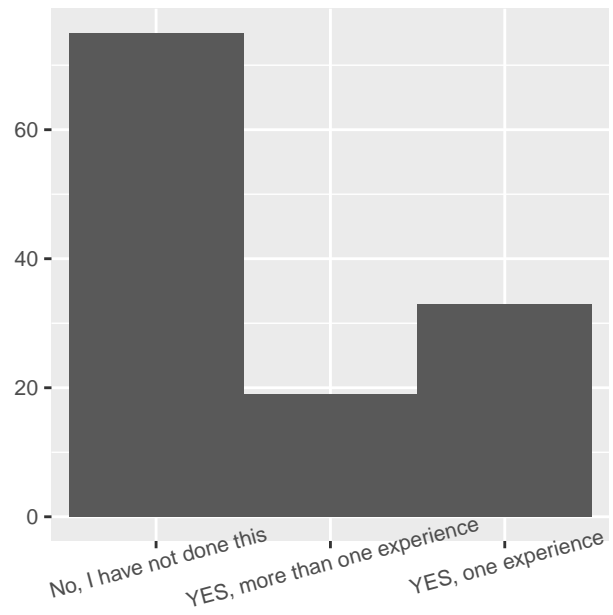
Recall that in Sections 2-7, each topic had a summary relating to the CUSP survey, SPECs survey, and sometimes the CUSP assessment. There are a couple of topics that appear in only one component of the data; Opportunities for Authentic Practice only appeared in the CUSP survey and questions from the Comprehensive Assessment of Outcomes in a First Statistics Course (CAOS) only appeared in the CUSP assessment.

10.1 Subsection: Opportunities for Authentic Practice

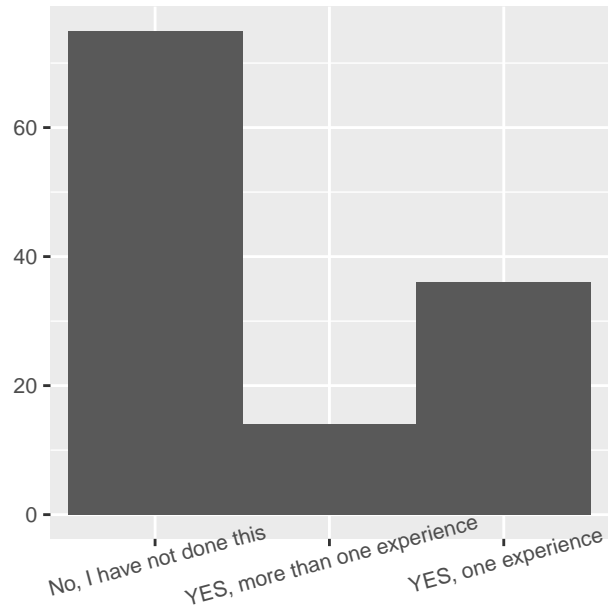
Internship(s)



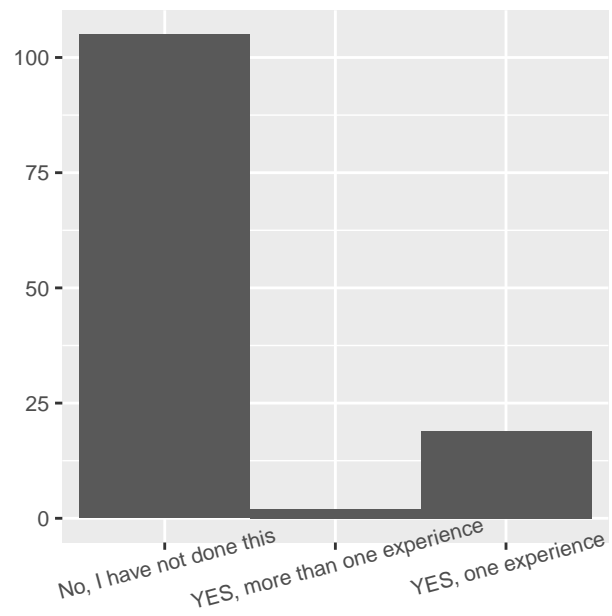
Research experience(s)



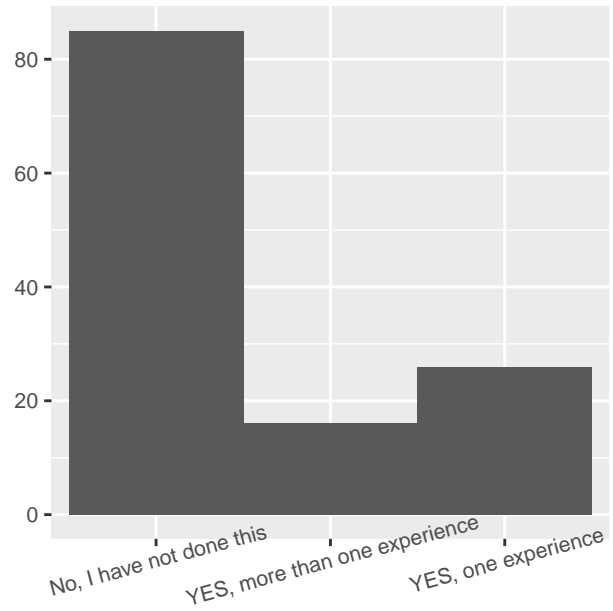
Senior-level
capstone course



Consulting
experience(s)

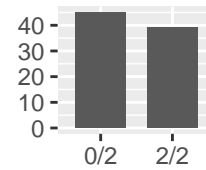


Other extracurricular
experiences posing
and answering
statistical questions



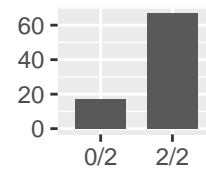
10.2 Subsection: CAOS

Assessment Item:
CAOS 9



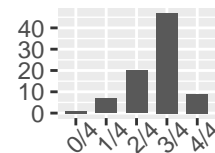
Assessment:
(0.35 , 0.56)

Assessment Item:
CAOS 15



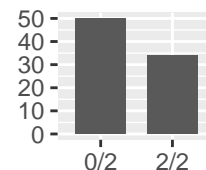
Assessment:
(0.69 , 0.86)

Assessment Item:
CAOS 28–31



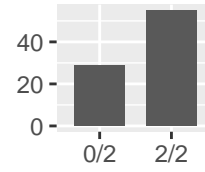
Assessment:
(0.62 , 0.71)

Assessment Item:
CAOS 37



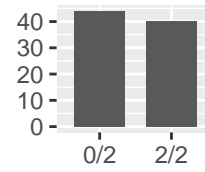
Assessment:
(0.3 , 0.5)

Assessment Item:
CAOS 38



Assessment:
(0.54 , 0.74)

Assessment Item:
CAOS 39



Assessment:
(0.36 , 0.57)