Statistics Pathways coursework approved for CSU GE Area B4 until Fall 2019
as of May 2016

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Below is my exchange with Myra Snell about how the committee could see details of the CAP curriculum that participating CCCs use when creating local courses.

In a subsequent phone conversation I let Myra know I would share her response below, plus the UC and C-ID documents it refers to.

KOD

From: Snell, Myra [mailto:MSnell@losmedanos.edu]
Sent: Thursday, May 05, 2016 9:13 AM
To: O'Donnell, Ken <kodonnell@calstate.edu>
Subject: Re: CAP exemplar?

Hi Ken,

I will be back at my computer this evening and will send you some course outlines. As you know CAP does not have a standard curriculum for the preparatory pre-statistics or co-requisite course, but at all colleges the statistics pathway culminates in a CSU-UC articulated statistics course (C-ID Math 110). My advice to colleges now is to develop pre-statistics courses or co-requisite models based on the skills described in UC’s TCA guidelines, http://ucop.edu/transfer-articulation/transferable-course-agreements/tca-policy/regulations-by-subject-area.html#s.

I think this combination (UC TCA and C-ID Math 110) is a decent way to represent a cross section of statistics pathways at the community college.

Myra

From: O'Donnell, Ken <kodonnell@calstate.edu>
Sent: Thursday, May 5, 2016 7:28:22 AM
To: Snell, Myra
Subject: CAP exemplar?

Hi, Myra,

At its March meeting our GE Advisory Committee asked me to gather more details of the CAP and Statway curriculum.

This was motivated by a sense that they’d approved a pilot period for curriculum they didn’t fully see, on the understanding from you and Kate that the phrase “statistics pathways curriculum” would be enough to hold us for the temporary policy. I think they’re still fine with that, but would just like to know what that means.

Attached is what I’ll share from Statway, which came from Carnegie HQ. In your case it may be more meaningful to show an actual COR you like, from a college doing good acceleration.

Thoughts?

Ken
Statistics/Probability

Transferable courses:

- Contain conceptual and computational skills in descriptive and basic inferential statistical methods; probability as it is relevant to statistical inference; and concepts useful in building statistical literacy (such as correlation is not causation, the difference between statistical significance and practical importance, common sources of bias in surveys and experiments, and appropriate interpretation of statistical results).
- May be in a business, economics, mathematics, social science, or science department.
- A second course in statistics may be acceptable if content is sequential and not duplicative.
- Statway
  - This year-long course sequence for non-STEM majors combines introductory college-level statistics with pre-college mathematical content as the foundation to the statistical topics.
  - Students must complete both Statway courses.
  - Maximum credit limitation: 4 semester/6 quarter units.

Prerequisites/co-requisites:

- Prerequisites/co-requisite courses should be consistent with CCCSM math standards and teach the skills and knowledge without which the student is highly unlikely to succeed in college-level statistics. These skills and knowledge cut across the CCCSM math standards and include:
  - Working with numerical information: ordering decimals, order of operations, operations with fractions and percentages, converting fractions to decimals and percentages, representing numbers, intervals, and inequalities on the number line.
  - Algebra: evaluating expressions with the use of technology that involve arithmetic with signed numbers, square roots, squaring, exponents, factorials, and summation notation. Solving simple linear equations in one variable.
  - Modeling: for linear models, interpret slope and intercept, graph a line and points, make predictions, and calculate vertical deviation of a point from the line.
  - Geometry: given the area under a curve or histogram, approximate areas of specified regions; extract information from graphs and tables.
- UCOP checks for but does not evaluate the prerequisite in TCA submissions.

Not transferable:

- Courses lacking conceptual or computational skills in basic inferential statistical methods, probability as it relates to statistical inference, or attention to statistical literacy.
General Course Description:

The use of probability techniques, hypothesis testing, and predictive techniques to facilitate decision-making. Topics include descriptive statistics; probability and sampling distributions; statistical inference; correlation and linear regression; analysis of variance, chi-square and t-tests; and application of technology for statistical analysis including the interpretation of the relevance of the statistical findings. Applications using data from disciplines including business, social sciences, psychology, life science, health science, and education.

Minimum Units: 3.0

Any rationale or comment:

Typically satisfies general education quantitative reasoning requirement (CSU GE B4).

Prerequisite(s):

Intermediate Algebra

Corequisite(s):

(none)

Advisories/Recommendations:

(none)

Course Content:

1. Summarizing data graphically and numerically;
2. Descriptive statistics: measures of central tendency, variation, relative position, and levels/scales of measurement;
3. Sample spaces and probability;
4. Random variables and expected value;
5. Sampling and sampling distributions;
6. Discrete distributions – Binomial;
7. Continuous distributions – Normal;
8. The Central Limit Theorem;
9. Estimation and confidence intervals;
10. Hypothesis Testing and inference, including t-tests for one and two populations, and Chi-square test;
11. Correlation and linear regression and analysis of variance (ANOVA);
12. Applications using data from disciplines including business, social sciences, psychology, life science, health science, and education; and
13. Statistical analysis using technology such as SPSS, EXCEL, Minitab, or graphing calculators.

Laboratory Activities (if applicable):

Course Objectives:

Upon successful completion of the course, students will be able to:

1. Distinguish among different scales of measurement and their implications;
2. Interpret data displayed in tables and graphically;
3. Apply concepts of sample space and probability;
4. Calculate measures of central tendency and variation for a given data set;
5. Identify the standard methods of obtaining data and identify advantages and disadvantages of each;
6. Calculate the mean and variance of a discrete distribution;
7. Calculate probabilities using normal and t-distributions;
8. Distinguish the difference between sample and population distributions and analyze the role played by the Central Limit Theorem;
9. Construct and interpret confidence intervals;
10. Determine and interpret levels of statistical significance including p-values;
11. Interpret the output of a technology-based statistical analysis;
12. Identify the basic concept of hypothesis testing including Type I and II errors;
13. Formulate hypothesis tests involving samples from one and two populations;
14. Select the appropriate technique for testing a hypothesis and interpret the result;
15. Use linear regression and ANOVA analysis for estimation and inference, and interpret the associated statistics; and
16. Use appropriate statistical techniques to analyze and interpret applications based on data from disciplines including business, social sciences, psychology, life science, health science, and education.

Methods of Evaluation:

Tests, examinations, homework or projects where students demonstrate their mastery of the learning objectives and their ability to devise, organize and present complete solutions to problems.

Sample Textbooks or Other Support Materials:

A college level text supporting the learning objectives of this course.

Notes:

none
Students completing the Statway course will understand that data analysis is a process that begins with the formulation of a question that can be addressed with appropriate data, followed by the development of a thoughtful plan for identifying and collecting the necessary data. Students will know how data can be displayed and summarized in informative ways, and they will understand how the data can be used to draw conclusions in the presence of uncertainty.

The following learning outcomes have been chosen by a committee (listed below) to enable students to achieve this overarching vision of what it means to be statistically literate.

**Student Learning Outcomes**

**S.1: Students will understand the data analysis process and the characteristics of well-designed statistical studies.**

**Learning Outcomes for S.1**

**Students should be able to:**

- S.1.1 Develop a plan for a statistical study.
- S.1.2 Know the type and scope of conclusions that can be drawn from different types of statistical studies (e.g., surveys, other observational studies, experiments).
- S.1.3 Know the characteristics of good sampling plans (e.g., representative of the larger population, minimize sources of bias and variability), well-designed experiments (e.g., random assignment, replication, control, blocking), and well-designed observational studies (e.g., recognizing potential sources of bias).
- S.1.4 Critically evaluate all aspects of a study.

**S.2: Students will demonstrate the use of distributional thinking to reason about the data in order to describe and summarize distributions of data, identify trends and patterns, judge the fit of a model to a distribution, and describe similarities and differences in comparing distributions. Distributional thinking involves the ability to consider a collection of individual observations as an entity (instead of focusing on individual observations) and to consider characteristics of the distribution to reason about the data.**

**Learning Outcomes for S.2**

**Students should be able to:**

- S.2.1 Given a data set of a particular type (i.e., numerical, categorical, bivariate numerical, bivariate categorical, or time series).
  - a. Display the data using appropriate graphical displays.
  - b. Summarize the data using appropriate numerical summaries.
  - c. Describe the data distribution in context.
  - d. Viewing data as a model plus error, assess the appropriateness of potential models (e.g., normal distribution as a model for numerical data, the least squares regression line as a fit to bivariate numerical data, independence as a model for bivariate categorical data, linear or exponential growth as a model for time series data).
- S.2.2 Recognize different representations of the same data distribution (e.g., dotplot, boxplot, histogram) and understand how numerical summaries are related to characteristics of the data distribution (e.g., extreme left skew tends to have mean < median; the effect of outliers and influential observations).
- S.2.3 Make meaningful and appropriate comparisons of distributions of data collected from two or more different groups.
S.3: Students will demonstrate an ability to use appropriate statistical evidence to reason about population characteristics and about experimental treatment effects.

Learning Outcomes for S.3
Students should be able to:

- S.3.1 Demonstrate a basic understanding of probability.
  - a. Interpret a probability.
  - b. Estimate probabilities (including conditional probabilities) empirically and using simulation.
  - c. Understand how a probability distribution models the behavior of a variable.
  - d. Understand how sampling distributions model the behavior of a sample statistic (e.g., a sample mean or sample proportion).
- S.3.2 Understand how sampling distributions and probability support drawing conclusions based on data and assessing the associated risks.
- S.3.3 Understand the logic and reasoning used to interpret results from different types of statistical studies, including surveys, other observational studies, and experiments.
- S.3.4 Determine what statistical methods are appropriate in a given situation based on the goal of the analysis and the data available, and know and assess the conditions required for appropriate use of a given statistical method.
- S.3.5 Critically evaluate whether conclusions based on data are reasonable.
- S.3.6 Compute confidence interval estimates and interpret confidence intervals, confidence level, and margin of error in context.
- S.3.7 In a given context, determine appropriate null and alternative hypotheses and understand that conclusions reasonably follow from a decision to reject the null hypothesis and from a decision not to reject the null hypothesis.
- S.3.8 Understand the concept of statistical significance, including significance levels and P-values.
- S.3.9 Carry out hypothesis tests to reach a conclusion and communicate the conclusion in context.

Mathematics Student Learning Outcomes
To best serve the diverse audience, the mathematics component of Statway focuses instruction and assessment on key concepts that support statistical thinking and data analysis.

Broad Objectives
- Students will be able to effectively use the language of mathematics to communicate ideas.
- Students will be proficient in procedural fluency, conceptual understanding, strategic competence, adaptive reasoning, and productive disposition.
- Students will be engaged in quantitative problems and investigations where they discover ideas and gain insights that develop questioning and solution-building skills.
- Students will use mental strategies and technology accurately and appropriately.

M.1. Numeracy: Students will develop and apply the concepts of numeracy to investigate and describe quantitative relationships and solve problems in a variety of contexts.

Learning Outcomes for M.1
Students will deepen their ability to reason and use numbers and be able to:

- M.1.1 Demonstrate number sense.
- M.1.2 Display proficiency in making calculations with rational numbers; know how and when to estimate results and round results.
- M.1.3 Create multiple representations of rational numbers and be able to recognize which representation is most useful for addressing a problem or to convey quantitative information.
M.2. Proportional Reasoning: Students will represent proportional relationships and solve problems that require an understanding of ratios, rates, proportions, and scaling.

Learning Outcomes for M.2
Students will be able to:
- M.2.1 Compare proportional relationships that may be represented in different ways and understand the role and function of $k$ in the relationship $y = kx$.
- M.2.2 Distinguish between absolute difference and relative difference, and use percentages to describe changes in a quantity or the error of an estimate given the exact value of the quantity.
- M.2.3 Apply quantitative reasoning strategies to proportional relationships in real world problems using units effectively and precisely.

M.3. Algebraic Reasoning: Students will reason using the language and structure of algebra to investigate, represent, and solve problems.

Learning Outcomes for M.3
Students will be able to:
- M.3.1 Use variables, evaluate expressions, and solve for unknown quantities and for quantities that may vary.
- M.3.2 Represent real-world and quantitative relationships with equations, inequalities, expressions, tables, verbal descriptions, symbols, and graphs.
- M.3.3 Solve equations and inequalities and explain how results relate to the original context.

M.4. Functions and Modeling: Students will understand functions as a way of modeling a correspondence between two variables. Students will be able to represent functions in various ways: verbally, algebraically, and graphically.

Statway focuses on linear and exponential functions.

Learning Outcomes for M.4
Students will be able to:
- M.4.1 Represent a function algebraically and be able to compute values of a function.
- M.4.2 Describe a function verbally, algebraically, graphically, and in a table of values, and make connections among representations.
- M.4.3 Make conjectures about the behavior of a function given several values of the function and a given context.
- M.4.4 Model situations with linear, quadratic, and exponential functions, inequalities and equations.
- M.4.5 Be able to investigate graphically and numerically (with technology) the effect of changing a parameter within a model.

For linear functions
- M.4.6 Students will be able to:
  a. Use linear functions to model situations involving constant rates of change.
  b. Describe the constant of proportionality, \textit{slope}, as the rate of change of the function using appropriate units.
  c. Given the graph, an equation, or two or more points on a line, determine and interpret the intercept(s) and slope.
  d. Given a set of points that exhibit a linear trend, determine the line of best fit.
  e. Compute and interpret the errors or deviation from a line of best fit that is used to model a data set with a linear trend.
For exponential functions

- **M.4.7 Students will be able to:**
  a. Identify and quantify exponential growth or decay in formulas, graphs, tables, and applications.
  b. Characterize and describe exponential models and compare them to other models.
  c. Use exponential functions to represent relationships between variables involving exponential growth and decay.
  d. Describe transformations of the graphs of exponential functions.

**Carnegie Committee for Statistics Learning Outcomes**

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