Adding Courses to the New Mexico General Education Curriculum
Statistical Literacy (Draft)

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Is this course for the entire system (WNMU, NMSU & UNM)?
Answer: Yes

Institutional Course Information
Prefix: STAT
Number 134 (Suggested)
Title: Statistical Literacy
Credits 3 credits

Was this course previously part of the general education curriculum?
Answer: No

Will this course only count toward General Education for the AAS degree (at your institution)?
Answer: No

Co-requisite Course
Prefix: N/A
Number N/A
Title N/A

New Mexico Common Course Information
Prefix: MATH [Suggested]
Number 1340 [Suggested]
Title: Statistical Literacy

A. Content Area and Essential Skills

To which content area should this course be added?
Mathematics

B. Learning Outcomes

List all common course student learning outcomes for the course.
Quantitative Reasoning, Communication and Critical Thinking

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C. Learning Outcomes[1]

List all common course learning outcomes[2] for the course

1. Can use ordinary English to distinguish association from causation. Can use ordinary English to form arithmetic descriptions and comparisons of statistics.
2. Can identify and evaluate known influences (confounding, assembly, randomness and error) on a statistic. Can think hypothetically about influences that are unknown or unmeasured.
3. Can identify, evaluate and use various techniques to take control of – or control for – these influences. These techniques include the physical control of randomness to determine statistical significance and the mental control for the influence of measured confounders on a statistic, a statistical association and statistical significance.
4. Can use ordinary English to describe and compare ratios as presented in statements, tables and graphs using percent, percentage, rate and chance grammars.
5. Can evaluate the strength of evidence provided by statistics in the everyday media, in press releases and journal articles.

D. Narrative:

Explain what students are going to do to develop the critical skills (selected above) and how you will assess their learning?

[1] https://math.unm.edu/undergraduate/program-learning-goals-and-outcomes
[2] https://calbaptist.edu/programs/bachelor-of-arts-applied-statistics/outcomes

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#1: Communication. Genre and Medium Awareness, Application and Versatility; Strategies for Understanding and Evaluating Messages; and Evaluation and Production of Arguments. In this box, provide a narrative that explains how the proposed course addresses the outcomes of the first essential skill. 250 – 400 words. (399 words)

Students learn how to read, interpret and evaluate the statistics used as evidence in arguments in the everyday media. They will see how quantitative messages are encoded in various media: in text, tables and graphs.

Social statistics are typically used as evidence in arguments to support a non-statistical point or an action. Since social statistics are socially constructed, they are usually shaped or selected for a particular audience and purpose.

The key strategy for understanding and evaluating these messages involves the ability to read and interpret descriptions and comparisons of counts, measures and ratios using ordinary English.

This literacy courses studies the use of ordinary English to distinguish association from causation. They learn that most of these statements are ambiguous: they state an association but seem to imply causation.

Ordinary English is used to describe quantitative relationships qualitatively ("The more X, the more Y" or "As X increases, Y increases") or quantitatively ("As X increases by n1, Y increases by n2").

Ordinary English is used to make qualitative comparisons (X is more than Y) and quantitative comparisons: a difference (X is # more than Y), a ratio (X is # times [as much as] Y), and a relative difference ("X is #% more than Y" or "X is # times more than Y"). Students learn when "X is # times less than Y" is meaningful. They learn that a 6% interest rate is not 2% more than 4%. It is 2 percentage points more (or 50% more).

Ordinary English is used to describe ratios using ordinary prepositions (3 *out of* 4 pizza slices were sausage) and using "per" (In 2017, New Mexico's unintentional death rate was 70 *per* 100,000 population.) It shows how percent, percentage, rate and chance are used as named-ratio grammars each of which has its unique syntax. E.g., "The percentage of women who are runners" is different than "the percentage of women among runners."

Ordinary English is used to compare ratios using "likely". "Men are more likely to die accidentally than are women." Is the car stolen most often a Toyota Camry (most frequently) or a Cadillac Escalade (most likely to be stolen)?

ASSESSMENT: The literacy aspect of this course is assessed by multiple choice exercises, by writing one-line descriptions and comparisons of averages, rates and percentages, and by short essays analyzing and evaluating the statistics used in the everyday media, press releases, and journal articles.

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#2: Critical Thinking. *Problem Setting; Evidence Acquisition; Evidence Evaluation; and Reasoning/Conclusion*
In this box, provide a narrative that explains how the proposed course addresses the outcomes of the second essential skill. 250 – 400 words. (365 words)

Statistical literacy is critical thinking about statistics as evidence in arguments.

Typically these arguments involve inferences of an unobservable from observable. These include generalization (inferring population statistics from sample statistics), predictions (inferring future values from past or present data), specification (inferring relations between sub-groups based on relations between groups) and explanation (inferring causation from association). Statistical literacy studies the use of ordinary English to make these distinctions clearly or ambiguously.

Specifically, statistical literacy identifies and evaluates the sensitivity of statistics to various influences. These influences include 1) Confounding: the influence of related factors that were not analyzed, collected or known. 2) Assembly or Assumptions: how things are defined, counted, measured, collected, summarized and communicated in words, tables or graphs. 3) Randomness: how sample statistics are influenced randomly by sample size. How random assignment controls for all pre-existing confounders. 4) Error or bias: how sampled statistics can be influenced systematically by subject bias, researcher or measurement bias and sampling bias.

The greater the sensitivity of a statistic or a statistical association to any of these influences, the less support that statistic or statistical association provides to support the point of an argument.

Statistical literacy studies the Cornfield conditions: the necessary conditions for a related factor to nullify or reverse and observed association. This negates the claim that you can say anything you want with statistics.

Statistical literacy studies statistics as being socially constructed by people with motives and goals. In primary research, these motives and goals influence the questions being asked prior to collecting the data, the type of study involved, the choice of variables being counted or measured, the types of data in which the data is counted or measured, the ways in which count data is described and compared. See Communications skill.

In secondary research or arguments, these motives and goals influence the primary research that is selected and the ways in which this summary data can be combined, manipulated and presented to support a particular claim.

ASSESSMENT: The critical thinking aspect of this course is assessed in forums by student's writing short essays. In these essays they analyze and evaluate arguments that use statistics in the everyday media, press releases, and journal articles.

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#3: Quantitative Reasoning. *Communication/Representation of Quantitative Information; Analysis of Quantitative Arguments; and Application of Quantitative Models*
In this box, provide a narrative that explains how the proposed course addresses the outcomes of the third essential skill. 250 – 400 words. (321 words)

Statistical Literacy studies the quantitative aspects of comparisons and associations. Students learn how to calculate the arithmetic sensitivity of statistics to various influences. They learn how to calculate the uncertainty in generalizing from random sample to the associated population and from present to future.

Students learn how to describe and compare averages, rates and percentages as presented in text, tables and graphs. They learn how to calculate the number of deaths attributable to factors that are not observably related. E.g., the number of deaths attributable to obesity.

These influences are grouped into four categories: 1) Confounding: the influence of related factors that were not analyzed, collected or known. 2) Assembly: how things are defined, counted, measured, collected, summarized and communicated in words, tables or graphs. 3) Randomness: how sample statistics are influenced randomly by random selection or by random assignment. 4) Error or bias: how sampled statistics can be influenced systematically by subject bias, researcher or measurement bias and sampling bias.

The greater the sensitivity of a statistic or a statistical association to any of these influences, the less support that statistic or statistical association provides to support the point of an argument.

This courses introduces a graphical technique to show how a binary confounder can influence a statistical association involving a binary predictor. This allows students to work multiple-regression problems without needing a computer. It helps students understand Simpson's paradox: the reversal of an association after taking into account a related factor.

This course uses non-overlapping confidence intervals as a sufficient condition for statistical significance. This course uses a graphical technique to show how a statistically-significant relationship can become statistically insignificant – and vice versa – after taking into account a confounder. Showing how controlling for a confounder can reverse statistical significance remedies what is arguably the biggest weakness in the traditional research-based introductory statistics course.

ASSESSMENT: The Quantitative Reasoning aspect of this course is assessed in each exercise, quiz and test

E. Supporting Documents

☐ Sample Assessment Attached (required)

☐ Rubric Attached (Optional

F. Assessment (Must be on file with HED by August 1, 2019)

Link to Institution's General Education Assessment Plan Click here to enter text.

This course meets institutional standards for general education.

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Signature of Chief Academic Officer Date