

Core Course Assessment Plan, 2019-20
Element 2: Mathematics

Please complete all sections; do not delete section information. Submit to Pilot when complete.

SECTION 1: GENERAL INFORMATION

Course Dept. Prefix: STT Course #: 2640

Semester when assessment will occur: Spring Summer Fall Year: **2019** or 2020

Course Title: Statistical Concepts

Section Types and number of sections offered in 2019-20. Complete all that apply.

 3 Dayton face-to-face 2 Lake face-to-face

 Dayton online Lake online

 Dayton Honors Lake Honors

Attributes: Integrative Writing in Core
 Multicultural Competency in Core
 Service Learning in Core

Dept. Core Assessment Lead: Shuxia Sun shuxia.sun@@wright.edu
Nate Tymes nate.tymes@wright.edu

List at least two assessors; this may include course instructor only if there are multiple sections and multiple instructors of the course. Note - The instructor may not assess his/her students' papers.

- Yang Liu
- Nate Tymes (Lake Campus)

SECTION 2: ASSESSMENT PLAN

It is preferable to have the assessment plan for all sections of a course. If not feasible, please complete an assessment plan for separate sections.

Course Outcomes. Check here if Outcomes have been modified.

The course must address all 5 outcomes but must assess a minimum of 1 outcome. Highlight in yellow the outcome(s) you will assess. If you have modified the outcomes, please insert here in place of standard outcomes.

1. Identify the elements of an inferential statistical model;
2. Determine the values of specific components of a mathematical/statistical model or relationships among various components;
3. Apply a mathematical/statistical model to a real-world problem;
4. Interpret and draw conclusions from graphical, tabular, and other numerical or statistical representations of data; and
5. Summarize and justify analyses of mathematical/statistical models for problems, expressing solutions using an appropriate combination of words, symbols, tables or graphs.

Assignments. Select **one** of the options below for assessment of one or more outcomes

Written assignment(s) that addresses/address outcome(s). Include outcome #, title and description for each assignment.

Outcome #: _____ Title:

Description of assignment:

X Lab question(s). Provide the question(s) and outcome(s) below.

1. Outcome #: 3
2. Outcome #: 4
3. Outcome #: 5

Outcomes 3, 4, and 5 will all be assessed using the question below.

Problem: Pipes used in a water distribution network are susceptible to breakage due to a variety of factors. When pipes break, engineers must decide whether to repair or replace the broked pipe. A team or civil engineers want to know the relationship between the ratio of repair to replacement cost (y) and pipe diameter (x). Data are given below:

x	80	100	125	150	200	250	300	350	400	450	500	600	700
y	6.58	6.97	7.39	7.61	7.78	7.92	8.20	8.42	8.60	8.97	9.31	9.47	9.72

- a) Make a scatter plot of the data set. Do you see any pattern?
- b) Find the least squares line relating ratio of repair to replacement cost (y) to pipe diameter (x) .
- c) Give the slope and intercept of the fitted lesast squares line. Interpret them in the context of the problem.
- d) Is there any significant linear relationship between the ratio of repair to replacement and the pipe diameter?
Explain.
- e) In one or two sentences, report your findings to the team of civil engineers.

Pilot asynchronous written discussion that addresses outcome(s). Provide the outcome # and question(s).

1. Outcome #: _____ Discussion Question: _____
2. Outcome #: _____ Discussion Question: _____
3. Outcome #: _____ Discussion Question: _____

Multiple Choice or T/F Marker questions – 3 to 4 questions per outcome. List the outcome and question numbers. A rubric is not used for Marker questions. “All the above” should not be used as the correct answer more than once. **Courses that are IW or SRV/SRVI must use written assignments for those attributes.** Complete the benchmark: We expect _____% of students to answer _____% of the question(s) correctly.

1. Outcome #: _____
 - a) Question: _____
 - b) Question: _____
 - c) Question: _____
 - d) Question: _____
2. Outcome #: _____

- a) Question: _____
 b) Question: _____
 c) Question: _____
 d) Question: _____

3. Outcome #: _____

- a) Question: _____
 b) Question: _____
 c) Question: _____
 d) Question: _____

Collecting and submitting the student assignment(s)

_____ Will upload assignment(s) to Pilot

_____ Will give access to assignment(s) on Pilot

Other: Will place question during the last lab session for each student in all sections of STT 2640.

Rubric Selection (A, B). Select the items you feel best match your assignment(s) in the rubric(s) on the next pages. Please highlight in yellow. **If this course has an IW attribute, please also see section B.**

A. Element 2 Rubric. Select the item(s) you will use in your rubric by highlighting in yellow the item(s). You may select one or more of them. As there is overlap, choose the items that best fit the assignment you select for assessment. The items below are taken from the Association of American Colleges and Universities (AACU) Value Rubrics for Math Literacy.

IF YOU ARE USING MARKER QUESTIONS FOR THE OUTCOME, DO NOT USE THIS RUBRIC.

	Capstone 4	3	Milestones 2	Benchmark 1
Interpretation <i>Ability to explain information presented in mathematical forms (e.g., equations, graphs, diagrams, tables, words)</i>	Provides accurate explanations of information presented in mathematical forms. Makes appropriate inferences based on that information. <i>For example, accurately explains the trend data shown in a graph and makes reasonable predictions regarding what the data suggest about future events.</i>	Provides accurate explanations of information presented in mathematical forms. <i>For instance, accurately explains the trend data shown in a graph.</i>	Provides somewhat accurate explanations of information presented in mathematical forms, but occasionally makes minor errors related to computations or units. <i>For instance, accurately explains trend data shown in a graph, but may miscalculate the slope of the trend line.</i>	Attempts to explain information presented in mathematical forms, but draws incorrect conclusions about what the information means. <i>For example, attempts to explain the trend data shown in a graph, but will frequently misinterpret the nature of that trend, perhaps by confusing positive and negative trends.</i>
Representation <i>Ability to convert relevant information into various mathematical forms (e.g., equations, graphs, diagrams, tables, words)</i>	Skillfully converts relevant information into an insightful mathematical portrayal in a way that contributes to a further or deeper understanding.	Competently converts relevant information into an appropriate and desired mathematical portrayal.	Completes conversion of information but resulting mathematical portrayal is only partially appropriate or accurate.	Completes conversion of information but resulting mathematical portrayal is inappropriate or inaccurate.

	Capstone 4	Milestones		Benchmark 1
		3	2	
Calculation	Calculations attempted are essentially all successful and sufficiently comprehensive to solve the problem. Calculations are also presented elegantly (clearly, concisely, etc.)	Calculations attempted are essentially all successful and sufficiently comprehensive to solve the problem.	Calculations attempted are either unsuccessful or represent only a portion of the calculations required to comprehensively solve the problem.	Calculations are attempted but are both unsuccessful and are not comprehensive.
Application / Analysis <i>Ability to make judgments and draw appropriate conclusions based on the quantitative analysis of data, while recognizing the limits of this analysis</i>	Uses the quantitative analysis of data as the basis for deep and thoughtful judgments, drawing insightful, carefully qualified conclusions from this work.	Uses the quantitative analysis of data as the basis for competent judgments, drawing reasonable and appropriately qualified conclusions from this work.	Uses the quantitative analysis of data as the basis for workmanlike (without inspiration or nuance, ordinary) judgments, drawing plausible conclusions from this work.	Uses the quantitative analysis of data as the basis for tentative, basic judgments, although is hesitant or uncertain about drawing conclusions from this work.
Assumptions <i>Ability to make and evaluate important assumptions in estimation, modeling, and data analysis</i>	Explicitly describes assumptions and provides compelling rationale for why each assumption is appropriate. Shows awareness that confidence in final conclusions is limited by the accuracy of the assumptions.	Explicitly describes assumptions and provides compelling rationale for why assumptions are appropriate.	Explicitly describes assumptions.	Attempts to describe assumptions.
Communication <i>Expressing quantitative evidence in support of the argument or purpose of the work (in terms of what evidence is used and how it is formatted, presented, and contextualized)</i>	Uses quantitative information in connection with the argument or purpose of the work, presents it in an effective format, and explicates it with consistently high quality.	Uses quantitative information in connection with the argument or purpose of the work, though data may be presented in a less than completely effective format or some parts of the explication may be uneven.	Uses quantitative information, but does not effectively connect it to the argument or purpose of the work.	Presents an argument for which quantitative evidence is pertinent, but does not provide adequate explicit numerical support. (May use quasi-quantitative words such as "many," "few," "increasing," "small," and the like in place of actual quantities.)

B. If this is an IW course, you will use the items on this page. You may select one or more of them. Please highlight in yellow.

Item	Mastery 4	Partial Mastery 3	Progressing 2	Emerging 1
Includes considerations of audience, purpose, and the circumstances surrounding the writing task(s).	Demonstrates a thorough understanding of context, audience, and purpose that is responsive to the assigned task(s) and focuses all elements of the work.	Demonstrates adequate consideration of context, audience, and purpose and a clear focus on the assigned task(s) (e.g., the task aligns with audience, purpose, and context).	Demonstrates awareness of context, audience, purpose, and to the assigned tasks(s) (e.g., begins to show awareness of audience's perceptions and assumptions).	Demonstrates minimal attention to context, audience, purpose, and to the assigned tasks(s) (e.g., expectation of instructor or self as audience).
Content Development	Uses appropriate, relevant, and compelling content to illustrate mastery of the subject, conveying the writer's understanding, and shaping the whole work.	Uses appropriate, relevant, and compelling content to explore ideas within the context of the discipline and shape the whole work.	Uses appropriate and relevant content to develop and explore ideas through most of the work.	Uses appropriate and relevant content to develop simple ideas in some parts of the work.
Formal and informal rules inherent in the expectations for writing in particular forms and/or academic fields (please see glossary).	Demonstrates detailed attention to and successful execution of a wide range of conventions particular to a specific discipline and/or writing task (s) including organization, content, presentation, formatting, and stylistic choices	Demonstrates consistent use of important conventions particular to a specific discipline and/or writing task(s), including organization, content, presentation, and stylistic choices	Follows expectations appropriate to a specific discipline and/or writing task(s) for basic organization, content, and presentation	Attempts to use a consistent system for basic organization and presentation.
Sources and Evidence	Demonstrates skillful use of high-quality, credible, relevant sources to develop ideas that are appropriate for the discipline and genre of the writing	Demonstrates consistent use of credible, relevant sources to support ideas that are situated within the discipline and genre of the writing.	Demonstrates an attempt to use credible and/or relevant sources to support ideas that are appropriate for the discipline and genre of the writing.	Demonstrates an attempt to use sources to support ideas in the writing.
Control of Syntax and Mechanics	Uses graceful language that skillfully communicates meaning to readers with clarity and fluency, and is virtually error-free.	Uses straightforward language that generally conveys meaning to readers. The language in the portfolio has few errors.	Uses language that generally conveys meaning to readers with clarity, although writing may include some errors.	Uses language that sometimes impedes meaning because of errors in usage.

Faculty Senate CORE Oversight Committee

Assessment Plan Review

Element: 2

Course: STT 2640

Review 1

Item	Complete / NA / Revision Requested	Comments
Learning Outcomes for Element 2 Mathematics	Complete	
Assignments matched to Element 2 LOs	Revision Requested	On p. 3, under "Collecting and Submitting the student assignment", Change "Other: Will place question during 'the last lab' to 'a lab'. Add, "Student workers will copy the assignment before any grading begins and scan a separate pdf of every students' assignment. The student worker will then create a zip file of the separate, ungraded exams to be sent to Carl Brun for entry into Aqua Watermark".
Rubric for LOs	Complete	
Rubric for IW Attribute	NA	
Assigned Approved Reviewers	Revision Requested	Coordinate with Lake Campus the assessment of this course, including the possibility of at least 1 assessor from Lake Campus. (Nate Tymes has agreed to serve as an assessor.)
Other	Revision Requested	On Page 1, Courses must be assessed in 2019-2020 academic year; Fall 2020 is not within that range.

Review Status: **Revision Requested**

Committee Chair Signature MH:bfm Date 5/1/2019

The next section is for the University Core Oversight Committee (UCOC) Review only.

UCOC Review

Item	Complete/NA	Revision Requested	Comments
Learning Outcomes for Global Traditions	XX		
Rubric for LOs	XX		
Rubric for MC Attribute	N/A		
Rubric for IW Attribute	XX		
Rubric for SRV/SRVI Attribute	N/A		
Assigned Departmental Reviewers	XX		

Committee Review Completed XX

Committee Chair Signature Ann M. Bowling Date 12/2019

Core Course Assessment Element 2 Report for STT 2640

Date Report Submitted: December 6, 2021 (submitted late due to Covid-19)

Element: Core Element 2 – Mathematics

Academic Year: 2019-2020

Course and Sections Assessed: STT 2640-01 (Dayton campus), W01 (Lake campus)

Assessment Plan:

We assessed the following course outcomes:

1. Apply a mathematical/statistical model to a real-world problem;
2. Interpret and draw conclusions from graphical, tabular, and other numerical or statistical representations of data; and
3. Summarize and justify analyses of mathematical/statistical models for problems, expressing solutions using an appropriate combination of words, symbols, tables or graphs.

Below is the problem we used for the course assessment:

Pipes used in a water distribution network are susceptible to breakage due to a variety of factors. When pipes break, engineers must decide whether to repair or replace the broked pipe. A team or civil engineers want to know the relationship between the ratio of repair to replacement cost (y) and pipe diameter (x). Data are given below:

x	80	100	125	150	200	250	300	350	400	450	500	600	700
y	6.58	6.97	7.39	7.61	7.78	7.92	8.20	8.42	8.60	8.97	9.31	9.47	9.72

Use R to accomplish the following:

- a. *Make a scatterplot of the data set. Do you see any patterns?*
- b. *Find the least squares line relating ratio of repair to replacement cost (y) to pipe diameter (x).*
- c. *Give the slope and intercept of the fitted least squares line. Interpret them in the context of the problem.*
- d. *Is there any significant linear relationship between the ratio of repair to replacement and the pipe diameter? Explain.*
- e. *In one or two sentences, report your findings to the team of civil engineers.*

Instructors gave students the above problem as part of Lab 13 and scanned students' solution pages without their names before they were graded. One of the statistics faculty members randomized all the solution files into two groups and gave the two lists to the secretary of the Department of Mathematics and Statistics, who rearranged the files into two sets of 21 solutions and assigned one set to each instructor. The two instructors/assessors graded solution pages using the highlighted items in the rubric below:

	Capstone 4	3	Milestones 2	Benchmark 1
Interpretation <i>Ability to explain information presented in mathematical forms (e.g., equations, graphs, diagrams, tables, words)</i>	Provides accurate explanations of information presented in mathematical forms. Makes appropriate inferences based on that information. <i>For example, accurately explains the trend data shown in a graph and makes reasonable predictions regarding what the data suggest about future events.</i>	Provides accurate explanations of information presented in mathematical forms. <i>For instance, accurately explains the trend data shown in a graph.</i>	Provides somewhat accurate explanations of information presented in mathematical forms, but occasionally makes minor errors related to computations or units. <i>For instance, accurately explains trend data shown in a graph, but may miscalculate the slope of the trend line.</i>	Attempts to explain information presented in mathematical forms, but draws incorrect conclusions about what the information means. <i>For example, attempts to explain the trend data shown in a graph, but will frequently misinterpret the nature of that trend, perhaps by confusing positive and negative trends.</i>
Representation <i>Ability to convert relevant information into various mathematical forms (e.g., equations, graphs, diagrams, tables, words)</i>	Skillfully converts relevant information into an insightful mathematical portrayal in a way that contributes to a further or deeper understanding. Student makes a scatter plot and explains that the scatter plot in Part (a) shows a linear pattern, implying that there exists a linear relationship between the replacement cost and the pipe diameter.	Competently converts relevant information into an appropriate and desired mathematical portrayal. Student makes a scatter plot and points out a linear pattern.	Completes conversion of information but resulting mathematical portrayal is only partially appropriate or accurate. Student only makes a scatter plot but does not give explanation.	Completes conversion of information but resulting mathematical portrayal is inappropriate or inaccurate. Student provides an incorrect plot.
Calculation	Calculations attempted are essentially all successful and sufficiently comprehensive to solve the problem. Calculations are also presented elegantly (clearly, concisely, etc.) Student calculates and presents the fitted regression line in Part (b) correctly.	Calculations attempted are essentially all successful and sufficiently comprehensive to solve the problem. Student calculates the regression line in Part (b) correctly but does not write a clear fitted line equation.	Calculations attempted are either unsuccessful or represent only a portion of the calculations required to comprehensively solve the problem. Student calculates the estimated slope or intercept in Part (b) incorrectly.	Calculations are attempted but are both unsuccessful and are not comprehensive. Student does not provide a correct line in Part (b), both regression coefficients are calculated incorrectly.
Application / Analysis <i>Ability to make judgments and draw appropriate conclusions based on the quantitative analysis of data, while recognizing the limits of this analysis</i>	Uses the quantitative analysis of data as the basis for deep and thoughtful judgments, drawing insightful, carefully qualified conclusions from this work. Student interprets the coefficients correctly in Part(c), states the regression model is significant in Part (d), and concludes in Part	Uses the quantitative analysis of data as the basis for competent judgments, drawing reasonable and appropriately qualified conclusions from this work. Student gets two parts of (c), (d), and (e) correctly.	Uses the quantitative analysis of data as the basis for workmanlike (without inspiration or nuance, ordinary) judgments, drawing plausible conclusions from this work. Student get one parts of (c), (d), and (e) correctly.	Uses the quantitative analysis of data as the basis for tentative, basic judgments, although is hesitant or uncertain about drawing conclusions from this work. Student does not get any of the parts of (c), (d), and (e) correctly.

	Capstone 4	Milestones		Benchmark 1
		3	2	
	(e) that there exists sufficient evidence that there is a linear relationship between the replacement cost and the pipe diameter.			
Assumptions <i>Ability to make and evaluate important assumptions in estimation, modeling, and data analysis</i>	Explicitly describes assumptions and provides compelling rationale for why each assumption is appropriate. Shows awareness that confidence in final conclusions is limited by the accuracy of the assumptions.	Explicitly describes assumptions and provides compelling rationale for why assumptions are appropriate.	Explicitly describes assumptions.	Attempts to describe assumptions.
Communication <i>Expressing quantitative evidence in support of the argument or purpose of the work (in terms of what evidence is used and how it is formatted, presented, and contextualized)</i>	Uses quantitative information in connection with the argument or purpose of the work, presents it in an effective format, and explicates it with consistently high quality.	Uses quantitative information in connection with the argument or purpose of the work, though data may be presented in a less than completely effective format or some parts of the explication may be uneven.	Uses quantitative information, but does not effectively connect it to the argument or purpose of the work.	Presents an argument for which quantitative evidence is pertinent, but does not provide adequate explicit numerical support. (May use quasi-quantitative words such as "many," "few," "increasing," "small," and the like in place of actual quantities.)

Assessment Data Collection:

We assessed responses from 48 students. The summary scores of the outcomes are listed in the table below.

Category	Representation	Calculation	Application/Analysis	Outcome Average
Average Score	3.595	3.643	3.214	3.484

Category 1: Representation		Category 2: Calculation		Category 3: Application/Analysis	
Representation	Frequency	Calculation	Frequency	Application	Frequency
1	0	1	2	1	1
2	6	2	0	2	5
3	5	3	9	3	20
4	31	4	31	4	16
Total	42	Total	42	Total	42
% at least 2	100.00%	% at least 2	95.24%	% at least 2	97.62%

Assessment Results:

This assessment used a real-world problem to allow students to apply their knowledge and understanding about the simple linear regression. They first used the statistical software R to make a scatter plot for the data set and described what they saw (for the assessment of “representation”), and then used the R output or hand calculation to identify the fitted model (for the assessment of “calculation”). They finally analyzed and interpreted the statistical results in the context of the problem as part of the assessment for “application”.

The 3.595 average score of “Representation” indicates that students knew how to successfully convert information or raw data into graphs and interpret them. The 3.643 average for “Calculation” indicates that students successfully used R or hand calculation to find the fitted linear regression model. And, the 3.214 average score of “Application” indicates that students generally knew how to conduct statistical analysis and interpret the results in the context of the real-world problem.

Plans to Share the Results:

We can share the results at the departmental meeting.

Plan for Improvement:

In the future, instructors should enforce individual work and emphasize interpretation and explanation of the statistical results.

UCOC Report Review

Item	Complete/NA	Revision Requested	Comments
Identified Outcome Assessed	XX		
Identified Procedure for Assessment	XX		
Summary of Results	XX		
Results Shared with Instructor, Dept Curriculum Committee, etc.	XX		
Plan for Improvements	XX		

Committee Review Completed XXX

Committee Chair Signature Ann M. Bowling Date 10/7/2022