General Education Assessment Plan

5-Year Report

Items in section A should be addressed for every course the department offers in the objective under review; courses may be treated individually or combined into one report if appropriate. Items B and C need be addressed only once for the objective under review.

Objective: 3 – Mathematical Ways of Knowing
Department: Management & Marketing
Representative to Objective Review Committee: Teri Peterson
Course(s): MGT 2216 – Business Statistics

A. For each general education learning outcome that the course aims to achieve:

1. **Describe the specific assessment instrument(s) used to address the learning outcome.**
   Our assessment consists of a direct assessment and indirect assessment. The direct assessment is done on all students. Thisis a computer lab exam which occurs towards the end of the semester. Both the direct and indirect assessments are described below.

Direct assessment:

Objective 1. Read, interpret, and communicate mathematical concepts.

Students will interpret data based upon descriptive statistics and appropriate graphical display of continuous data and explain their choice of best measures of center and spread.

Objective 2. Represent and interpret information/data.

Student will produce JMP output of continuous data and interpret
Student will produce an Excel graph of categorical data
Students will produce appropriate output for relationships
Students will interpret output for relationships

Objective 3. Select, execute and explain appropriate strategies/procedures when solving mathematical problems

Students will be presented with a scenario and data and be expected to complete a hypothesis test. This requires that the student select the

appropriate test, write hypotheses appropriate for the test, and follow through with appropriate JMP output.

Objective 4. Apply quantitative reasoning to draw and support appropriate conclusions

To complete a hypothesis test, students must use appropriate logic and the p-value decision rule to draw an appropriate conclusion. For our exam, this will involve steps 6 and 7 of the hypothesis test.

Indirect Assessment:

All instructors of MGT 2216 will provide syllabi, example JMP/Excel deliverables, and example class activities that are used to scaffold student learning. These will be uploaded into a Moodle College of Business site for the undergraduate curriculum committee to review during the annual evaluation of student outcomes in the course. In addition, instructors will provide a brief discussion of changes implemented in the course and any benefit/detriment seen from these changes.

a. **Include full question text or assignment instructions, which may be included as an appendix.**

There are 14 versions of this exam. Two versions are attached as an appendix.

b**. Include a description of the timing of the assessment and the groups that were assessed.**

This exam is administered two weeks before the final exam. All students in all sections are required to take the exam.

c. **Describe the criteria used to evaluate each assessment instrument, and how this evaluation was performed.**

Find attached both the test choices, the grading rubric, and two actual example computer lab exams. Grading of statistical work applies best practices from the statistics education community. For example, in grading a hypothesis test…if a student incorrectly chooses the hypothesis test, only that portion of the hypothesis test is marked incorrect; the remainder of the hypothesis test is then judged on whether the student followed appropriate reasoning and supplied appropriate JMP output for that choice. Another example would be if a student incorrectly identified the response variable for a problem about relationships; if so, then only that point would be lost for the scatterplot and the remainder of the problem would be assessed on the basis of the student's choice. Source: the Advanced Placement Statistics readings where Dr. Sue Schou was a reader and leader. All instructors have met to discuss the rubric, and ensure that grading is consistent across all sections. Each instructor uses the rubric to assess the students in their own sections.

Specifics:

Hypothesis Testing
    Hypotheses: Student must have both the parameter and direction correct for hypothesis test choice.
    Choice of test: Student must choose the correct test.
    JMP output: Student must provide output that matches test choice
    Decision: the student must choose the correct p-value, apply the p-value decision rule correctly, and arrive at a conclusion that matches reject H_0 or do not reject H_0

Graph and reporting statistics – continuous data
    Graph: student must produce correct JMP output
    Interpret graph: student must correctly identify the data as skewed versus symmetric
    Descriptive statistics: student must produce summary statistics using JMP
    Report statistics: student must correctly report appropriate measures of center and spread
    Explain: student must explain choice of measures of center and spread by checking the interpretation of their graph

Graph – categorical data
    Graph: student can produce a graph using Excel
    Graded based upon correct type of graph, good title, labels, and source

Correlation and regression:
    Scatterplot: student must produce a scatterplot to show a relationship between two continuous variables. Correct if identified response versus predictor variables on correct axes and scatterplot of data
    Correlation: student must produce JMP correlation output
    Regression: student must produce JMP regression output
    Explain: student must explain the relationship with the following characteristics: strength, direction, whether the relationship is linear or not.

The following table presents the specific rubric used by all instructors for this class:

Grading Rubric with Specific Objectives for Goal 3							

	Hyp	*Test Choice*	*p-value*	*JMP output*	*correct p*	*good decision*	*logic ok*	*context*
	3	*3*	*2*	*3*	*1*	*1*	*1*	*1*
Objective	3	3	3	3	3	4	4	4

	graph	*stats*	*shape*	*discuss*	*bar/pie*	*title*	*labels*	*source*	*conf level*
	1	*1*	*1*	*2*	*1*	*1*	*1*	*1*	*1*
Objective	1	1	1	1	2	2	2	2	1

	output	*values ok*	*context*	*scatterplot*	*correlation*	*regression*	*direction*	*strength*	*form*
	1	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Objective	1	1	1	2	2	2	2	2	2

    d. **Describe the application of this or comparable assessment to any students earning credit for the class via early college program or test credit.**

Students who pass the Advanced Placement (AP) Exam for Statistics with a score of 4 or 5 are allowed to move directly into MGT 2217, the subsequent course in our statistics sequence.

2. **Describe the findings regarding the learning outcome, and overall conclusion as to the effectiveness of the class in achieving the learning outcome in question.**

The following graph represents the results for each objective across the 6 semesters since the approval of MGT 2216 as a Goal 3 course. For three of the four objectives the students have performed above the goal of 70%. For evaluation of each objective the rubric allows us to address individual aspects of each goal. Each instructor analyzes the results from their individual sections on all aspects for each goal. The instructors then meet together to discuss changes which they intend on making in their course to improve the outcome for each aspect. Frequently, if the change in the course has not improved the aspect the instructor addressed a different change is made the following semester or year. The instructors meet at least once a year to discuss the changes each one is making, and get feedback from the other instructor on the proposed change. This process happens every year. Each year a document is written that summarizes the results of our discussions and our intended changes. This is an ongoing process in which we engage to improve our course based on the results of the previous year's assessments. An example of the results of one annual evaluation is included in the appendix.

Goal 3 Objectives for MGT 2216
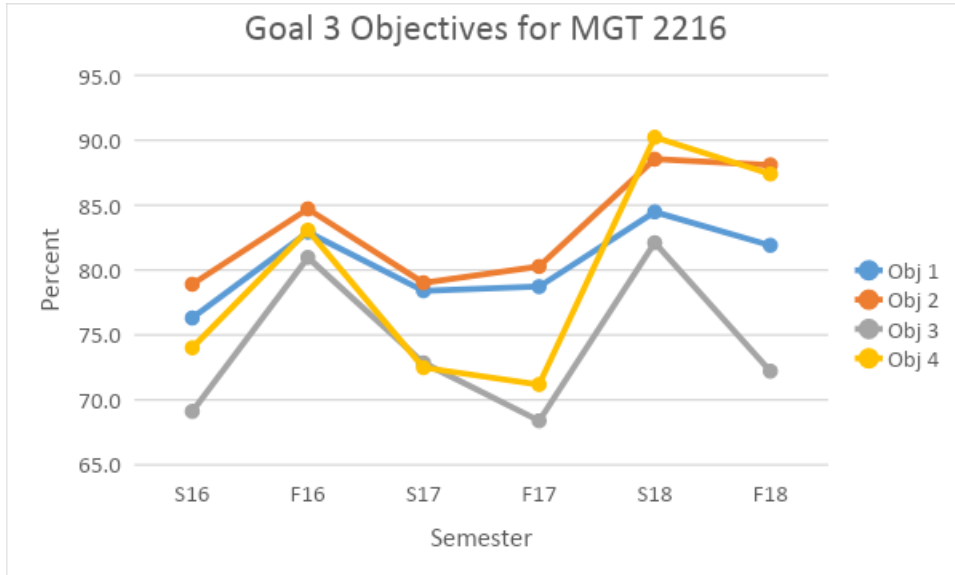
3. **Describe any changes made or proposed to better meet learning outcomes.**

In our best professional judgement, we do not see any changes necessary at this time.

1. **Describe any changes made or proposed to assessment procedures themselves.**

Only minor changes have been made to the assessment instrument. These changes were to clarify questions when wording could have led to misunderstanding of the questions themselves.

B. **Do you see any incongruities between the learning outcomes and the spirit of the objective? If so, how would you suggest the learning outcomes be modified?**

We do not see any incongruities, based on our course.

C. **Do you believe that the objective currently serves an optimal role in the broader general education program? If not, how could its contribution be improved?**

Yes, at the end of the course students should be able to demonstrate statistical literacy in consuming the broad presentation of statistics across many aspects of their daily lives.

JMP/Excel Statistics Competency Exam

1. Jobs in data science are becoming more common and desirable. However, as in many technology sector jobs, there is concern about salary equity between males and females. A random sample of 10 newly hired male data scientists and an independent random sample of 10 newly hired female data scientists were taken. The annual salary for each of the data scientists was recorded in thousands of dollars with the following results:

	Salary in $000									
Male	114	115	116	128	110	120	118	110	151	121
Female	95	123	100	86	108	95	104	102	108	85

Battery Life	Screen Size
3.6	15.6
3.4	17.3
3.2	14.5
4.0	12.1
3.5	14.0
4.1	13.3
4.5	11.6
3.9	13.1

At the .01 level of significance is there evidence that male data scientists have a higher salary on average than female data scientists? Assume the population variances are equal and the data come from a normally distributed population.

> • In order to explore the relationship between the battery life and screen size of laptop computers, data were collected on a random sample of 8 computers. The variables measured were battery life and screen size. Using screen size to predict battery life, construct a scatterplot, fit the regression line, and calculate the correlation coefficient. Based on the scatterplot and the correlation coefficient, interpret the relationship in terms of form, direction, and strength.

3. The following table shows the battery life in minutes on a single charge for a random sample of IPads. Create a histogram of the data and calculate descriptive statistics. Describe the shape of the distribution and report the most appropriate measure of center and spread.

215	249	229	230	236	239	240
244	247	255	262	264	271	259

4. Using the data from problem 3 (above) construct AND interpret a 90% confidence interval on the population mean battery life for IPads on a single charge.

5. A random sample of 1000 consumers were asked if they preferred powder detergent, liquid detergent, or detergent pods with the following results. Construct a pie chart in Excel to represent these data.

Detergent Type	Number of Consumers
Powder	357
Liquid	438
Pods	205

JMP/Excel Statistics Competency Exam

1. Since the financial scandals in the early 2000s, companies have been working to improve their internal audit procedures. A random sample of 180 American companies were surveyed and asked whether or not they plan on increasing the number of internal audit staff in the next year. Of the 180 companies 42 indicated they plan on doing this. At a 0.10 significance level, is there sufficient evidence to conclude the proportion of companies that plan on increasing the number of internal audit staff in the next year is less than 25%?

2. For the data described in problem #1, construct AND interpret a 90% confidence interval on the proportion of companies that plan on increasing the number of internal audit staff in the next year.

Weight Gain	Percent Daylight
9.9	72
9.2	41
5.0	31
9.6	61
7.3	47
11.2	86
7.6	56
6.7	41
9.1	65

3. An entrepreneur with a degree in dietetics owns a private weight loss clinic. In her clinic she provides diet consultations, exercise classes and personal training, and behavioral modification to facilitate weight loss. Recently she read a study relating the amount of daylight in a day to weight gain. She found the data performed in a lab, where mice were subjected to differing amounts of light as a percentage of the day, and their weight gain (as a percentage of body mass) was collected. Using percent daylight to predict weight gain, construct a scatterplot, fit the regression line, and calculate the correlation coefficient. Based on the scatterplot and the correlation coefficient, interpret the relationship in terms of form, direction, and strength.

4. A random sample of 511 business executives were asked to rate today's economy relative to one year ago with the following results. In Excel construct pie chart of these data.

Opinion of economy vs. 1 year ago	Counts
Better	359
Same	123
Worse	29

Total	511

5. The following data represent the number of times in the past month a randomly chosen student at ISU has eaten out for lunch or dinner. Create a boxplot of these data and calculate descriptive statistics. Describe the shape of the distribution and report the most appropriate measure of center and spread. Are there any outliers?

11	17	13	14	14	17	28	20	19	25	24

Annual Evaluation AY1718

Summarize key findings from review of direct and/or indirect assessment materials.

This year all 4 objectives exceeded the goal of 70%. However, there were individual items within each of the 4 objectives identified where improvement is needed. Although all sections exceeded the 70% goal on all 4 objectives both semesters, there were some notable differences between the semesters and between the online and in-person modes. This year the results of the assessment were better in the spring than in the fall. This could indicate an improvement associated with changes in the activities and assignments. One teacher noted that the areas of concern differed from fall to spring. The other teacher noted lower assessment scores in the online section than in the in-person section. Further evaluation indicated some of the online students were not access all the learning materials available. The other teacher noted improvement in the one learning outcome that had been substandard from the fall to the spring. Both teachers work to continually improve this course.

Summarize any steps taken or planned in response to assessment results.

One attempt to improve performance was the employment of a graduate student to offer tutoring office hours. Tutoring times were offered for face-to-face students in a room set aside in the BA building for tutoring, while online students were offered tutoring hours online. This offering was very under-utilized. One specific learning outcome item will be addressed through the clarification of the question used for

assessment, specifically a source will be listed for each graph problem. One instructor will modify computer deliverable assignments to incorporate a larger variety of hypothesis tests to assist the students in learning to choose correct hypothesis tests. Efforts to find qualified CAT tutors among successful students are continuing each semester.

Please indicate how these assessment results were used by and disseminated in your department.

Both instructors teaching this course discussed the results of this assessment. In addition, the instructors share activities and projects which address the learning outcomes. The results are disseminated by sending this report and supporting documentation to the department chair and the associate dean of the College of Business.