Honolulu Community College
University of Hawai'i
General Education
Foundations Course Designation Proposal Form
For Fall 2014 – Summer 2018

Global & Multicultural Perspectives  Symbolic Reasoning  Written Communication

The Honolulu Community College Foundations Board will review all proposals to ensure that approved courses meet Foundations Hallmarks. If clarification is needed, a Board member will contact you. If the Foundations Board and the General Education Committee approve the proposal, all sections of the course will be designated as satisfying the requirement. The course will be reviewed every five years.

1. Course information.
   Course Alpha MATH Course Number 115
   If the course is cross listed, please provide the cross-listing: Alpha Number
   Course Title: Statistics

2. Foundations area requested. Check one.
   Global & Multicultural Perspectives ☒ Symbolic Reasoning ☒ Written Communication ☐

3. How many instructors currently teach this course? It makes a difference if there are only one or two instructors teaching this course versus ten instructors teaching this course. This question is asked to get an idea of how many instructors the department needs to communicate with to discuss this foundation course.

4. Syllabus. Submit a master syllabus. If multiple instructors teach the course and use varying texts and/or assignments, please include multiple representative syllabi for comparison. (Three is recommended.)

5. Hallmark Requirements. Provide an explanation of how each of the hallmarks for this proposed Foundation course will be satisfied. Try to completely answer how the course intends to meet each particular hallmark. Referencing assignments, tasks, and evaluations used in the course (as stated on the syllabus/syllabi being submitted) as supporting evidence would be very helpful.

6. Assessment. Provide a brief explanation of how the department will periodically review that this course has been meeting the Foundations Hallmarks including a description of what kinds of evidence will be collected to demonstrate this (Knowledge Survey results, sample of exam responses, writing samples, etc.). Also include a detailed description of how the department plans to have all instructors of this course share information with each other regarding how the hallmarks have been met. Please include a brief explanation of the assessment tools you will use to make this determination (such as Knowledge Surveys, Exams, Projects, Portfolios, etc.) and how you will use the results to make course improvements.

7. Signatures. The signatures of the initiator and the initiator’s Division Chair are required. The completed proposal must be routed to the Chair of the CPC before being delivered to the chair of the Foundations Board. No action on the part of the CPC is required unless the proposal also includes a new course Curriculum Action or a course modification Curriculum Action. The “routing” is a courtesy to the CPC. Signatures indicate approval/acceptance.

Initiated by: Steven Mandraccia
Initiator’s printed name Date 4/7/2016

Approved by: Michael Ferguson
Division Chair’s printed name Date 4/12/2016

Routed via: Kara Kam-Kalani
CPC Chair’s printed name Date 4/15/2016

Accepted by: Steven Mandraccia
Foundation Board Chair’s printed name Date 4/11/2016
Official Course Description

MATH 115 – STATISTICS

Course Description

- Prerequisite: C or higher in Math 25 or placement in Math 115
- Recommended Prep: Placement in ENG 22/60

This course covers a basic introduction to topics in statistics, with a brief look at probability. There is an emphasis on applications to physical and social sciences. The main objective of this course is to provide its students with a basic working knowledge of the methods of statistical inference, and how to apply these methods to real life situations. In particular, the formation and testing of hypotheses is emphasized.

This course fulfills the Symbolic Reasoning requirement for the Foundations requirement for Honolulu Community College and the University of Hawaii at Manoa. See the Manoa General Education requirements.

Symbolic Reasoning Objectives:

Students will

- Demonstrate an understanding of the beauty, power, clarity, and precision of formal systems through guided practice in statistical operations and problem-solving.
- Demonstrate through performances on assessment exams, class work, and homework exercises the concept of proof as a chain of inferences.
- Apply formal rules of algorithms in probability and statistics.
- Demonstrate correct and effective use of the symbolic rules of probability and statistics on assessment exams, homework exercises, or related projects.
- Analyze rules and theorems to find the most effective solutions to problems.
- Apply statistical principles to solve real-world problems.

Course Specific Learning Objectives

Students will

- Define important statistical terms such as population, sample, parameter, and statistic.
- Describe and compare different types of sampling techniques such as systematic sampling, convenience sampling, stratified sampling, and random sampling.
- Recognize biased samples such as distorted graphs, loaded questions, and self-interest studies.
- Articulate and interpret various descriptive statistics such as the mean, median, mode, range, variance, and standard deviation.
- Organize, draw, and interpret various graphs such as a frequency histogram, pareto chart, and stem-and-leaf chart.
- Solve probability problems involving the concepts of independent events, mutually exclusive events, and conditional probability.
- Read and interpret statistical tables such as the binomial probability table, the standard normal probability distribution table, the student’s \( t \)-distribution probability table, and the chi-square distribution probability table.
- Solve application problems by calculating probabilities involving binomial and normal probabilities.
- Perform hypothesis testing and interpret the results.
- Calculate and interpret the correlation coefficient for a set of paired data; draw a scatter diagram; determine the equation of the regression line and sketch its graph.
- Develop critical thinking to correctly interpret the results of valid statistical methods.

**Foundations Hallmarks – Symbolic Reasoning**

1. *Students will be exposed to the beauty, power clarity, and precision of formal systems.*
   
   *How will the course meet this hallmark?*

   Math 115 is an applied statistics course with an emphasis on studying and solving problems arising in the physical and social sciences. Mathematical theory including the development and derivation of statistical theorems, formulas, rules and laws will be introduced carefully and deliberately. Topics are discussed using both inductive and deductive reasoning with an emphasis of developing statistical literacy and thinking using real data. For example, the normal distribution curve is discussed as a two-parameter function dependent on the mean and standard deviation to determine its location and shape. Properties of the theoretical normal distribution curve and the connection to probability are discussed. The use of the standard normal distribution curve is applied to problems where the results are interpreted by the student.

   The beauty of formal systems is illustrated by a discussion of the different measures of central tendency (mean, median, and mode), variation (range, variance, and standard deviation), and position (z score, percentile) and how these measures describe real-life data.

   The power of formal systems is shown by the discussion of general laws which can be proved a variety of ways. An example would be the probability formula \( P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B) \) which can be proved by use of a Venn diagram or a chain of previously proven laws. The principle can then be used to analyze a survey such as the following example.

<table>
<thead>
<tr>
<th>Should Car be Seized?</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td>391</td>
<td>425</td>
</tr>
<tr>
<td>Women</td>
<td>480</td>
<td>256</td>
</tr>
</tbody>
</table>

   Find the probability of getting a man or someone who answered yes.

2. *Instructors will help students understand the concept of proof as a chain of inferences.*
How will the instructors help students understand this concept?

The course begins with a comparison of inductive and deductive reasoning. Inferential statistics involves inductive reasoning in which we come to a general conclusion from a small group of particular cases.

Example: A school administrator wants to know if students whose first language is not English score differently on the math portion of the SAT exam than students whose first language is English. The mean SAT score of students whose first language is English is 516, based on data provided by the College Board. A simple random sample of 20 students whose first language is NOT English resulted in a mean SAT score of 523. Assume SAT math scores are normally distributed with a standard deviation of 114. Test the claim that the mean math SAT scores for student whose first language is English is the same as the mean math SAT score for students whose first language is not English. Use a 0.05 significance level. Hypothesis test of mean.

Student will learn that while inductive reasoning often leads to a correct conclusion, it may sometimes lead to an incorrect conclusion. Because there is always uncertainty in inferential statistics, students will learn the importance of the significance of $\alpha$, the probability of making an incorrect conclusion.

In deductive reasoning, a general conclusion is inferred from assumptions or rules that have already been proved.

Example: Students will be shown that in probability theory, it can be first proved the $P(\text{impossible event}) = 0$, $P(\text{certain event}) = 1$ and $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$. These rules can be chained together to deductively infer the exact relationship between $P(A)$ and $P(\sim A)$.

$$P(A) + P(\sim A) = P(A) + P(\sim A) - 0$$
$$= P(A) + P(\sim A) - P(\text{impossible event})$$
$$= P(A) + P(\sim A) - P(A \text{ and } \sim A)$$
$$= P(A \text{ or } \sim A)$$
$$= P(\text{certain event})$$
$$= 1$$

3. Instructors will teach students how to apply formal rules of algorithms. How will instructors meet this hallmark?

Statistics includes a number of rules and algorithms for solving a wide variety of problems. Consider the following examples:

a. Calculation of the mean, median, mode, midrange, variance, and standard deviation to describe data.

b. Use of the binomial probability formula to solve a binomial probability problem:

$$P(X = x) = \binom{n}{x}p^xq^{n-x}$$

c. Make comparisons and determine whether a value is unusual by computing standard $z$ scores.
d. Solve probability problems using basic rules such as the addition and multiplication rules of probability.

e. Perform correlation/regression analysis on data and determine the amount of variation in the response variable explained by the model using the appropriate formulas and procedures.

4. **Students will be required to use appropriate symbolic techniques in the context of problem solving, and in the presentation and critical evaluation of evidence. What symbolic technique will be required and in what context? How will presentations and evaluation of evidence be incorporated into the course?**

In the course of solving problems, students must select an appropriate model for the given situation, manipulate the model by applying the appropriate techniques, interpret the results of the manipulations, and check the correctness of their results.

**Example:** A researcher wants to determine if a person’s age is related to the number of hours he or she exercises per week. The sample data are as shown:

<table>
<thead>
<tr>
<th>Age, x</th>
<th>18</th>
<th>26</th>
<th>32</th>
<th>38</th>
<th>52</th>
<th>59</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours, y</td>
<td>10</td>
<td>5</td>
<td>2</td>
<td>3</td>
<td>1.5</td>
<td>1</td>
</tr>
</tbody>
</table>

A hypothesis test can be used to determine whether the two variables are correlated. The assumption is that the two variables are NOT correlated. Critical values are found using an appropriate table or an appropriate test is applied to determine whether the calculated correlation coefficient \( r = -0.832 \). A conclusion is made that there is significant correlation between a person’s age and the number of hours he or she exercises per week. The results can then be verified by observing a scatter plot of the ordered pairs of data.

\[
H_0: \rho = 0 \\
H_1: \rho \neq 0 \\
R = -0.832 > \text{critical value } |0.811| \text{ so reject } H_0, \text{ there is sufficient evidence to conclude a linear correlation exists.}
\]
5. The course will include computational and/or quantitative skills. What reasoning skills will be taught in the course? What computational and/or quantitative skills will be taught in the course? How will you assess this and provide evidence that students are meeting this hallmark?

As the students learn and apply various rules and algorithms, they must decide which of these should be used to solve a particular problem. Since Math 115 is an applied course, many of the problems will involve situations in which students must apply either inductive or deductive reasoning in more than one stage of a problem’s solution. For example, students must study the basics of hypothesis testing, be able to select and use the appropriate distribution, correctly determine the null and alternative hypotheses, compute the test statistic and $p$ value, analyze the information, make a decision, and explain the decision in the context of the problem.

Example: A researcher reports that the average salary of assistant professors is more than $42,000. A random sample of 30 assistant professors has a mean salary of $43,260. Assume the population has a standard deviation of $\sigma = 5230$. Using a significance of $\alpha = 0.05$, test the claim that assistant professors earn more than $42,000 per year.

**Traditional Method**

1. State the null and alternative hypotheses in symbolic form

   $H_0: \mu \leq 42,000$

   $H_1: \mu > 42,000$

2. Identify the statistic that is relevant to the problem and determine the sampling distribution

   Since $\sigma$ is known and $n = 30$, we use the $z$ statistic and the standard normal distribution.

   Test statistic is $z = \frac{\bar{x} - \mu}{\sigma / \sqrt{n}}$

3. Compute the test statistic and the critical value(s) and the rejection criteria.

   $z = \frac{\bar{x} - \mu}{\sigma / \sqrt{n}} = \frac{43260 - 42000}{5230 / \sqrt{30}} = 1.32$

4. Make a decision

   Since $z = 1.32 < 1.65$ we cannot reject $H_0$.

5. Interpret the decision in the context of the problem

   At the $\alpha = .05$ level of significance, there is not enough evidence to support the claim that assistant professors earn more than $42,000 per year.
Alternate methods to test hypotheses include the $p$-value method and using confidence intervals are discussed. In addition, the use of technology, statistical calculator and computer software is introduced.

6. **Instructors will build a bridge from theory to practice and show students how to transverse this bridge. How will instructors help students make connections between theory and practice?**

Some of the major topics of the course are the design of an experiment, probability, hypothesis testing, correlation, and regression. In each of these topics, general principles are first discussed on an abstract level. Then they are discussed on a practical level by the solution of real-world problems.

**Examples:**

1. In the design of an experiment, students must decide on the appropriate method of sampling; systematic, convenience, stratified, or random.

2. In probability, general formulas can be applied to calculate the expected value for a life insurance policy.

3. In hypothesis testing, students can perform analysis on real-life data.

In 1994, 52% of parents of children in high school felt it was a serious problem that high school students were not being taught enough math and science. In a 2006 survey, 256 of 800 parents of children in high school felt it was a serious problem that high school students were not being taught enough math and science. Do parents feel differently today than they felt in 1994? Use $\alpha = 0.05$ level of significance.

**Assessment**

Historically, only two sections of Math 115 are offered in the fall and spring semesters, thus the course is taught by one instructor. The policy has been that the same instructor teaches this course for two to three years before passing on to another instructor.

Any faculty member assigned to teach Math 115 must become familiar with both the course content and the FS hallmarks. The learning outcomes and FS hallmarks will be assessed by the use of embedded questions on exams; see list below. It is the responsibility of the math department liaison to meet with the instructor and ensure that the course learning outcomes and the FS hallmarks are being satisfied. Math 115 faculty will meet every year, for two years, beginning with the spring 2011 semester to evaluate the embedded questions and determine whether the FS hallmarks are being addressed via the specific questions chosen. After the initial two year period, the Math Faculty will meet every three years for a review of the process.
Embedded Questions for Hallmark assessment follow on the next page.

- Define important statistical terms such as population, sample, parameter, and statistic.  
  Hallmark 1, 3, 5

1) Briefly describe the difference between a parameter and a statistic and provide an example of each.
2) Briefly describe the difference between a population and a sample and provide an example of each.

- Describe and compare different types of sampling techniques such as systematic sampling, convenience sampling, stratified sampling, and random sampling.  
  Hallmark 5, 6

Identify the proper type of sampling needed to collect the following types of data; random, stratified, cluster, systematic, or convenience.

1) Every fifth person entering a concert is checked for possession of drugs. What sampling technique is used?
2) Thirty-five sophomores, 35 juniors and 49 seniors are randomly selected from 230 sophomores, 280 juniors and 577 seniors at a certain high school. What sampling technique is used?
3) A computer is used to generate 500 random phone numbers to be used for a survey.
4) Over a period of two days, measure the length of time every fifth person coming into a bank waits for teller service.
5) Take a sample of five zip codes from the Cleveland metropolitan region and use every elementary school from each of the zip code regions. Determine the number of students enrolled in first grade in each of the schools selected.
6) Split Internet users into different age groups and then select a random sample from each age group to determine the amount of time they are online each month.
7) Ask five friends for their opinions about the student cafeteria.
8) Pick a random sample of students enrolled at your college and determine the number of credit hours they have each accumulated toward their degree program.

- Recognize biased samples such as distorted graphs, loaded questions, and self-interest studies.  
  Hallmark 5

1) An anti gun advocate wants to estimate the percentage of people in favor of strict gun laws. He conducts a nationwide survey of 1,250 randomly selected adults, 18 and older. The interviewer asks the respondents: “Do you favor harsher penalties for individuals who sell guns illegally.”
• Articulate and interpret various descriptive statistics such as the mean, median, mode, range, variance, and standard deviation.  Hallmark 1, 3, 5, 6

1) The following table contains the miles per gallon obtained by a male and female driver, using the same type of vehicle over the same course over a five day period.

<table>
<thead>
<tr>
<th></th>
<th>22.3</th>
<th>21.2</th>
<th>20.8</th>
<th>19.8</th>
<th>23.8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male Driver</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female Driver</td>
<td>25.2</td>
<td>19.1</td>
<td>18.0</td>
<td>24.4</td>
<td>20.3</td>
</tr>
</tbody>
</table>

Find the mean, median, standard deviation, and the coefficient of variation of each distribution and compare the percentage of variation of each distribution.

2) Ninety-eight (98) men and women were asked "How many hours did you work last week?" A stem and leaf plot of their responses is presented. Each stem represents 10s of hours. For example, a stem of 2 with a leaf of 8 represents 28 hours of work. Summary statistics are also reported to the right of the stem-and-leaf plot.

```
<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>3</td>
<td>7</td>
<td>3</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>5</td>
<td>6</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>6</td>
<td>8</td>
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<tr>
<td>3</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```

\[ n = 98 \quad Q_1 = 25.0 \]
\[ \bar{x} = 35.51 \quad \text{Median} = 40.0 \]
\[ sd = 12.77 \quad Q_3 = 44.5 \]

a. Construct a boxplot of the data, showing outliers if any. You must show ALL calculations needed to determine if there are outliers.

Note: IQR = Q_3 - Q_1; potential outliers: \[ Q_1 - 1.5 \times \text{IQR} \] or \[ Q_3 + 1.5 \times \text{IQR} \]
b. What measure of CENTER would be the most appropriate statistic to report for this distribution?

c. What measure of VARIABILITY would be the most appropriate statistic to report for this distribution?

d. Describe the shape of the distribution and explain why you made your choices.

3) A test was given to 60 individuals. Half answered 80% of the questions correctly, the other half answered 90% correctly. Which of the following statements is correct: (a) mean > median; (b) standard deviation(SD) = 0; (c) mean = median; (d) mean < median. Explain.

- Organize, draw, and interpret various graphs such as a frequency histogram, pareto chart, and stem-and-leaf chart. **Hallmark 1, 3**

1) Do the bar widths used in making a histogram have an effect on the shape of the constructed histogram? Explain your answer and give an example to justify your answer.

2) The IQ (intelligence) scores of thirty-three students from the same third grade classroom are presented. One set is for boys and the other set is for girls. Summary statistics (mean, standard deviation, median, and quartiles) are provided for each set of children. Use the stems below to create a back-to-back stem-and-leaf plot so that you can visually compare the IQ scores of the boys with the IQ scores of the girls. Write a comparison of the distribution of IQ scores for the boys and girls that includes comparisons of shape, center, and variability.

<table>
<thead>
<tr>
<th>BOYS</th>
<th>GIRLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>115</td>
</tr>
<tr>
<td>10</td>
<td>102</td>
</tr>
<tr>
<td>11</td>
<td>119</td>
</tr>
<tr>
<td>11</td>
<td>114</td>
</tr>
<tr>
<td>12</td>
<td>108</td>
</tr>
<tr>
<td>13</td>
<td>108</td>
</tr>
<tr>
<td>13</td>
<td>111</td>
</tr>
<tr>
<td>13</td>
<td>113</td>
</tr>
<tr>
<td>14</td>
<td>125</td>
</tr>
<tr>
<td>14</td>
<td>118</td>
</tr>
<tr>
<td>14</td>
<td>96</td>
</tr>
</tbody>
</table>

**BOYS**

- Mean: $\bar{x} = 122.2$
- Standard Deviation: $s = 11.09$
- Median: $\text{Median} = 122$
- $Q_1 = 113$
- $Q_3 = 133$

**GIRLS**

- Mean: $\bar{x} = 114.4$
- Standard Deviation: $s = 8.05$
- Median: $\text{Median} = 115$
- $Q_1 = 111.5$
- $Q_3 = 120.5$
The following data are the magnitude in earthquakes of 57 earthquakes that occurred during one week in October 2007. NOTE the values are in order.

<table>
<thead>
<tr>
<th>Class Interval</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.95 – 4.45</td>
<td></td>
</tr>
<tr>
<td>4.45 – 4.95</td>
<td></td>
</tr>
<tr>
<td>4.95 – 5.45</td>
<td></td>
</tr>
<tr>
<td>5.45 – 5.95</td>
<td></td>
</tr>
<tr>
<td>5.95 – 6.45</td>
<td></td>
</tr>
<tr>
<td>6.45 – 6.95</td>
<td></td>
</tr>
</tbody>
</table>

**a)** Use a lower limit of 3.95 with class width = 0.5 to construct a frequency distribution in the following table.

<table>
<thead>
<tr>
<th>Class Interval</th>
<th>Frequency</th>
<th>Midpoint</th>
<th>Relative Frequency</th>
<th>Cumulative Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.95 – 4.45</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.45 – 4.95</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.95 – 5.45</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.45 – 5.95</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.95 – 6.45</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.45 – 6.95</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**b)** In the grids provided, sketch a histogram, left, and an ogive (cumulative frequency), right.

**c)** Comment on the distribution of the data. Does it appear to be skewed to the right, skewed to the left, bimodal, uniform, or symmetrical.
- Solve probability problems involving the concepts of independent events, mutually exclusive events, and conditional probability. Hallmark 1, 2, 3, 4, 5, 6

1) A hospital administration completed a survey of patients regarding satisfaction with care and type of surgery. The results follow:

<table>
<thead>
<tr>
<th></th>
<th>Heart</th>
<th>Hip</th>
<th>Knee</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not Satisfied</td>
<td>21</td>
<td>9</td>
<td>5</td>
<td>35</td>
</tr>
<tr>
<td>Neutral</td>
<td>18</td>
<td>25</td>
<td>37</td>
<td>80</td>
</tr>
<tr>
<td>Satisfied</td>
<td>36</td>
<td>43</td>
<td>59</td>
<td>138</td>
</tr>
<tr>
<td>Very Satisfied</td>
<td>28</td>
<td>31</td>
<td>48</td>
<td>107</td>
</tr>
<tr>
<td>Total</td>
<td>103</td>
<td>108</td>
<td>149</td>
<td>360</td>
</tr>
</tbody>
</table>

Assume the table represents the entire population of customers. Find the probability that a customer is

(a) Not satisfied
(b) Neutral and Heart surgery
(c) Not satisfied, given knee surgery
(d) Hip surgery
(e) Heart surgery, given very satisfied
(f) Very satisfied and heart surgery
(g) Are the events not satisfied and knee surgery independent? Prove your answer.

2) The Illinois Lottery has balls numbered from 1 to 52 in an urn. From this urn, six balls are randomly chosen. Without replacement. The order of the numbers of the selected balls does not matter.
   a) How many different arrangements of six numbers can be made from the 52 numbers?
   b) If you buy one ticket, what is the probability of winning?
   c) Do you feel lucky? Should you buy 1000 tickets? Why or why not.

3) In 2005, 1.71% of all deaths in the US were 25 to 34 years old. Of those 25 to 34 year old deaths, .15% was due to cancer. What is the probability that a randomly selected death is the result of cancer if the individual is known to be in the 25 to 34 year old age group?

- Read and interpret statistical tables such as the binomial probability table, the standard normal probability distribution table, the student’s t-distribution probability table, and the chi-square distribution probability table. Hallmark 3, 4
1) Of those mountain climbers who attempt Mt. McKinley, only 65% reach the summit. In a random sample of 11 mountain climbers who attempt to climb Mt. McKinley, what is the probability of each of the following?
   a. All 11 reach the summit. __________________________
   b. At least 9 reach the summit. __________________________
   c. No more than 3 reach the summit. __________________________
   d. Exactly 9, 10, or 11 reach the summit. __________________________

2) Quality control studies for Speedy Jet Computer Printers show the lifetime of the printer follows a normal distribution with mean $\mu = 4$ years and standard deviation $\sigma = 0.78$ years. The company will replace any printer that fails during the guarantee period. How long should Speedy Jet printers be guaranteed if the company wishes to replace no more than 10% of the printers?

- Solve application problems by calculating probabilities involving binomial and normal probability distributions.

1) An oil exploration firm plans to drill 6 holes. They believe that the probability that each hole will yield oil is 0.10. Since they will be drilling in different locations, the outcomes are statistically independent.
   a) If the firm needs two or more holes to produce oil to stay in business, what is the probability that they will stay in business?
   b) Give the expected value and standard deviation of the number of holes that will yield oil.

2) The length of time to complete a door assembly on an automobile factory assembly line is normally distributed with mean $\mu = 6.7$ minutes and standard deviation $\sigma = 2.2$ minutes. For a door selected at random, what is the probability the assembly line time will be (Normal Distribution)
   a) 5 minutes or less?
   b) 10 minutes or more?
   c) between 5 and 10 minutes?

3) Medical treatment will cure about 87% of all people who suffer from a certain eye disorder. Suppose a large medical clinic treats 57 people with this disorder. Let $r$ be a random variable that represents the number of people that will recover. The clinic wants a probability distribution for $r$. (Binomial approximation to normal)
   a) Write a brief but complete description in which you explain why the normal approximation to the binomial would apply. Are the assumptions satisfied? Explain.
   b) Estimate $P(x \leq 46)$ (b) __________________________
   c) Estimate $P(47 \leq r \leq 55)$.   (c) __________________________
• **Determine and interpret confidence interval estimates of population means and proportions**  
  **Hallmark 1, 2, 3, 4, 5, 6**

1) A researcher working for the National Highway Transportation Safety Administration, (NHTSA), needs to estimate the mean average blood alcohol concentration, (BAC), of drivers involved in fatal accidents. He randomly selects records of 1200 fatal accidents and finds the sample mean is 0.16 g/dL. Assume \( \sigma = 0.08 \) g/dL.

a) Find a 90% confidence interval for the mean.

b) All 50 states use a BAC of 0.08 g/dL as the legal limit for blood alcohol concentration. Would it possible for all drivers involved in fatal accidents who have positive BAC values to have a mean BAC below the legal limit? Would it be probable?

2) A sample of 10 Ipods showed the following length of time the battery lasted, in hours; 7.3, 10.2, 12.9, 10.8, 12.1, 6.6, 10.2, 9.0, 8.5, 7.1. Construct a 95% confidence interval for the mean battery life.

3) A random sample of 56 credit card holders showed that 41 regularly paid their credit card bills on time.

a) Let \( p \) represent the proportion of all people who regularly paid their credit card bills on time. Find a point estimate \( \hat{p} \) for \( p \). 

b) Find a 95% confidence interval for \( p \).

c) What assumptions are required for the calculations of part (b)? Do you think these assumptions are satisfied? Explain

d) How many more credit card holders should be included in the sample to be 95% confident that a point estimate \( \hat{p} \) will be within a distance of 0.05 from \( p \)?

• **Perform hypothesis testing and interpret the results.**  
  **Hallmark 1, 2, 3, 4, 5, 6**

**Note:** For all hypothesis tests, clearly state the following:

a) The null and alternate hypotheses and the level of significance, \( \alpha \).

b) The critical value and rejection regions, (it may be helpful to draw a sketch of the distribution)

d) Calculate the test statistic, and the \( p \)-value

e) State your decision, and interpret your decision in the context of the problem.

1) The trend of thinner Miss America winners has caused some to question whether beauty contests encourage unhealthy eating habits for young women. The following table lists the body mass index of 10 recent Miss America winners. Use a 0.01 level of significance to test the claim that the recent Miss America winners are from a population having a mean BMI less than 20.16.

| 19.5 | 20.3 | 19.6 | 20.2 | 17.8 | 17.9 | 19.1 | 18.8 | 17.6 | 16.8 |
2) A drug company guarantees that its new drug reduces systolic blood pressure. The table below shows the systolic blood pressures of eight patients before taking the drug and two hours after taking the drug. At a 0.05 level of significance, can you conclude that the new drug reduces systolic blood pressure?

<table>
<thead>
<tr>
<th>Patient</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before dosage</td>
<td>201</td>
<td>171</td>
<td>186</td>
<td>162</td>
<td>165</td>
<td>167</td>
<td>175</td>
<td>148</td>
</tr>
<tr>
<td>After dosage</td>
<td>192</td>
<td>165</td>
<td>167</td>
<td>155</td>
<td>148</td>
<td>144</td>
<td>152</td>
<td>134</td>
</tr>
<tr>
<td>Before-After</td>
<td>9</td>
<td>6</td>
<td>19</td>
<td>7</td>
<td>17</td>
<td>23</td>
<td>23</td>
<td>14</td>
</tr>
</tbody>
</table>

3) Five members of the college track team from Denver (elevation 5200 ft) went up to Leadville (elevation 10,152 ft) for a track meet. The times (minutes) for these team members to run two miles at each location are shown below.

<table>
<thead>
<tr>
<th>Team Member</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Denver</td>
<td>10.7</td>
<td>9.1</td>
<td>11.4</td>
<td>9.7</td>
<td>9.2</td>
</tr>
<tr>
<td>Leadville</td>
<td>11.5</td>
<td>10.6</td>
<td>11.0</td>
<td>11.2</td>
<td>10.3</td>
</tr>
</tbody>
</table>

Assume the team members constitute a random sample of track team members. Use a 5% level of significance to test the claim that the population mean time is longer at the higher elevation.
Calculate and interpret the correlation coefficient for a set of paired data; draw a scatter diagram; determine the equation of the regression line and sketch its graph.

Hallmark 1, 2, 3, 4, 5, 6

1) Do heavier cars use more gasoline? Let \( x \) be the weight of the vehicle and \( y \) the miles per gallon.

<table>
<thead>
<tr>
<th>( x )</th>
<th>27</th>
<th>44</th>
<th>32</th>
<th>47</th>
<th>23</th>
<th>40</th>
<th>34</th>
<th>52</th>
</tr>
</thead>
<tbody>
<tr>
<td>( y )</td>
<td>30</td>
<td>19</td>
<td>24</td>
<td>13</td>
<td>29</td>
<td>17</td>
<td>21</td>
<td>14</td>
</tr>
</tbody>
</table>

- **a.** Draw a scatter diagram. Does there appear to be a linear correlation? If so, is it positive or negative?
- **b.** Calculate \( r \). Does your value of \( r \) agree with your choice of linear correlation in step 1?
- **c.** Use Table 4-4 to test the significance of \( r \).
- **d.** If, in step 3, significant linear correlation was found, find the equation of the regression line. \( y = ax + b \)
- **e.** Use \( x = 3 \) and \( x = 4 \) to find the predicted \( y \) values and plot on the graph above. Use these two points to graph the regression line.
• **Develop critical thinking to correctly interpret the results of valid statistical methods.** Hallmark 2, 4, 5, 6

1) The number of people living on American farms has declined steadily during this century. Here are data on the farm population (millions of persons) from 1935 to 1980.

![Graph showing farm population from 1935 to 1980]

a. Based on the following regression output, provide an interpretation, in context, for the slope coefficient.

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Coef</th>
<th>StDev</th>
<th>T</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>1166.93</td>
<td>62.26</td>
<td>18.74</td>
<td>0.000</td>
</tr>
<tr>
<td>year</td>
<td>-0.58679</td>
<td>0.03180</td>
<td>-18.45</td>
<td>0.000</td>
</tr>
</tbody>
</table>

The regression equation is population = 1167 - .587 year

b. Use the regression equation to predict the number of people living on farms in 1990. Explain why this result makes no sense and why such a poor prediction results.

2) Currently, about 10% of marriages in the United States end in divorce during the first five years of marriage. A sociologist is studying the effects of having children within the first two years of marriage on the divorce rate. Using hospital birth records, she selected a random sample of 100 couples who had a child within the first two years. Following up on these couples, she finds that 21 of these couples had divorced within the first five years. Analyzing the data, she reported the following output:

H₀: p = .10; ̂p = .21, z = 3.67, p-value = .0001224.

f. Verify the researcher’s calculations and interpret the results.
Sample Syllabus:

Math 115 Statistics
Course Syllabus Spring 2010
Instructor Steve Mandraccia

Office: Building 7, Room 410; Phone: 847-9807
Email: stevenm@hcc.hawaii.edu

Office Hours: Tuesday/Thursday 10 AM - 12 PM – 2:30 PM – 4 PM; or by appointment, or if my office door is open, I am available.

Class Hours: Tuesday/Thursday 1 PM – 2:15 PM
Room 7/403
CRN: 23251

Prerequisite(s): A grade of “C” or higher in Math 25 or placement in Math 115.

Course Description: This course covers a basic introduction to topics in statistics, with a brief look at probability. Emphasis will be on applications to physical and social sciences.

Method of Instruction: Primary method of instruction will be lecture providing practical examples. Specific problems will be assigned for group discussion towards the end of each class session. Weekly quizzes will be given on Monday at the beginning of the class, except for the first class meeting and during a week when an exam will be given. Four exams and a comprehensive final exam will be given. The tentative dates are listed in the schedule at the end of this syllabus.

Course Objectives: To provide the student with a basic working knowledge of the methods of statistical inference, and how these methods can be applied to “real life” situations. In particular, the formation and testing hypotheses is emphasized.

Symbolic Reasoning Objectives:

Students will

- Demonstrate an understanding of the beauty, power, clarity, and precision of formal systems through guided practice in statistical operations and problem-solving.
- Demonstrate through performances on assessment exams, class work, and homework exercises the concept of proof as a chain of inferences.
- Apply formal rules of algorithms in probability and statistics.
- Demonstrate correct and effective use of the symbolic rules of probability and statistics on assessment exams, homework exercises, or related projects.
- Analyze rules and theorems to find the most effective solutions to problems.
- Apply statistical principles to solve real-world problems.

Course Specific Learning Objectives

Students will

- Define important statistical terms such as population, sample, parameter, and statistic.
- Describe and compare different types of sampling techniques such as systematic sampling, convenience sampling, stratified sampling, and random sampling.
- Recognize biased samples such as distorted graphs, loaded questions, and self-interest studies.
- Articulate and interpret various descriptive statistics such as the mean, median, mode, range, variance, and standard deviation.
- Organize, draw, and interpret various graphs such as a frequency histogram, pareto chart, and stem-and-leaf chart.
• Solve probability problems involving the concepts of independent events, mutually exclusive events, and conditional probability.
• Read and interpret statistical tables such as the binomial probability table, the standard normal probability distribution table, the student’s $t$-distribution probability table, and the chi-square distribution probability table.
• Solve application problems by calculating probabilities involving binomial and normal probabilities.
• Perform hypothesis testing and interpret the results.
• Calculate and interpret the correlation coefficient for a set of paired data; draw a scatter diagram; determine the equation of the regression line and sketch its graph.
• Develop critical thinking to correctly interpret the results of valid statistical methods.

Required Materials:


Calculator: A scientific calculator with Statistic functions will be needed regularly during the semester for use in class and for homework assignments. (TI30 is a good inexpensive choice)

Important Dates:

• March 15, 2010, Last day to apply for Spring Graduation.
• May 14, 2010, Graduation.

Drop Period:

• January 15, 2010; last day to drop/withdraw and receive 100% refund.
• February 01, 2010; last day to drop/withdraw and receive 50% refund and not appear on academic record.
• March 22, 2010; last day to officially drop/withdraw and receive a “W” grade; (CR to NC)

Holidays:

• January 18, 2010, Martin Luther King Day
• February 15, 2010, President’s Day
• March 22 – 26, 2010, Spring Recess.

Last day of Instruction: May 05, 2010.

Classroom Rules of Conduct: Students are expected to understand and follow the course requirements as presented by the instructor, to act with respect towards their instructors, fellow students, and others with whom they may interact in the course of their studies, and to complete all work required for their courses to the best of their ability. Student, in turn, may expect to be treated with respect and evaluated fairly based on their academic performance. No food or drinks are permitted in the classroom. Radios, cd/mp3 players, ipod, etc are not allowed. Cell phones should be set on vibrate or turned off.

Attendance: Students are expected to attend every class, arrive on time, and plan to stay for the entire class. Please discuss any anticipated or unexpected absences with me. If possible, please leave a message on my phone, or send me an email. It is the responsibility of the student to obtain lecture notes and to arrange any make-up work with me. Points are not awarded for attending class, however, nonattendance will be a consideration in the student’s final grade. If you do not attend class, do not expect to pass.
No Show: Students must attend the first two classes of the semester. It is the student’s responsibility to notify the instructor of anticipated or unavoidable absences. A student not attending the first two classes of the semester will be classified as a no-show and may be dropped from the class.

Disappearer Policy: Students who stop attending class or never attended class are considered “Disappearers.” A student classified as a disappearer by the official drop deadline may receive an “F” grade. If a student has a justifiable reason for temporarily missing class, it is his or her responsibility to contact the Instructor, Division Chair, or Program Dean to resolve the situation.

Students with Disabilities: In accordance with Section 84.4 of the Federal rules and regulations governing Section 504 of the Rehabilitation Act of 1973, no qualified individual with a disability shall, on the basis of their disability, be excluded from participation in, be denied benefits of, or otherwise be subjected to discrimination under any program or activity which receives benefits from Federal financial assistance.

Grade Policy:

Exams: Three exams and a comprehensive final exam will be given. Each exam will account for 20% and the final for 25% of the final grade. The tentative exam schedule is listed on the course schedule at the end of this syllabus. In addition, a reminder will be provided, announcing an exam, one week in advance. Students are expected to take exams at the announced time. It is understood that circumstances beyond a student’s control may arise that will prevent the student from taking an exam at the scheduled time. It is the student’s responsibility to inform the instructor prior to the exam, if possible. In these cases, a makeup exam will be given at a mutually acceptable time and place. For any unexcused absences, the makeup exam grade will be reduced by 10%.

Quizzes: Quizzes will be given both in-class and as take-home, except on days when an exam is given and during our first meeting. Take-home quizzes must be turned in by the next class; no late quizzes will be accepted and quizzes cannot be made up. Approximately fourteen quizzes will be given and the best twelve grades will account for 10% of the final grade.

Homework: Homework problems are essential in understanding the concepts of statistics. Homework assignments are listed on the last page of this syllabus, in the order in which we will cover the material. Homework will be collected at the beginning of each class. Homework assignments will account for 5% of the total grade. Late homework assignments will NOT be accepted.

Grading will be based on the following scale: A total of 500 points are possible. Each exam will account for 100 points and the final for 125 points. Quizzes will account for 50 points and homework 25 points.

A: 90% - 100%; 450-500 total points; B: 80% - 89%; 400-449 total points; C: 70% - 79%; 350-399 total points
D: 60% - 69%, 300-349 total points ; F: below 60%, less than 300 total points.

Incomplete grade: An incomplete grade will only be given to a student who is passing, but has not completed an examination or some other required work due to circumstances beyond the student’s control.

“N” Grade: An “N” grade will only be given to students who have made an effort or have extenuating circumstances beyond their control and will need to retake the class.
Emergency Procedures:

1. Evacuation procedures: see instructions posted in classroom.
2. First aid kit: located in room 612. All instructors have a key to the room.
3. Emergency ambulance: from any office phone, dial “9” for an outside number then “911.”
4. Call campus security.

Recommendations for Success:

Student initiative and determination are crucial elements for the success in mathematics courses. Mathematics courses require more than just reading the material and listening to lectures, working sample problems is of the utmost importance. It is highly recommended that you spend 1 1/2 to 2 hours of outside study time for each hour of class time. To gain a better understanding of the material, I recommend reading each section before it is presented in class and then reread it before working the homework problems. If help is needed, seek it immediately, do not allow yourself to fall behind, as it becomes increasingly difficult to “catch up”. Study groups with classmates are highly encouraged.

Note: This syllabus is intended as a guideline for this course. All information included in this syllabus is tentative and is subject to change at the discretion of the Instructor. The requirements and grading criteria may change during the course, if necessary. Note: Assignments are listed in the order in which the material will be presented.


1. Ex 1.1 #1 – 4, 6, 9, 10, 11, 12, 13 (What is Statistics)
2. Ex 1.2 #1 – 6, 9, 11, 13, 15, 16 (Random Samples)
3. Ex 1.3 #1 -3, 6, 7 (Intro to Experimental Design)
4. Ex 2.1 #1 - 6, 9, 10, 13, 15 (Frequency Distributions, Histograms)
5. Ex 2.2 #1 – 4, 7, 9, 10, 11 (Bar, Pie, time-Series Graphs)
6. Ex 2.3 #1 - 3, 6, 10 (Stem and Leaf Displays)
7. Ex 3.1 #1 – 6, 9, 11, 12, 14 (Measures of Center)
8. Ex 3.2 #1 - 8, 10, 14, 16 (Measures of Variation)
9. Ex 3.3 #1 - 5, 8, 9, 10 (Percentiles and Box and Whisker Plots)
10. Ex 4.1 #1 - 10, 12, 13, 17, 18, 19, 20 (Scatter Diagram and Linear Correlation)
11. Ex 4.2 #1 - 6, 8, 9, 11, 15, 16 (Linear Regression and Coefficient of Determination)

Exam 1 tentative date February 11, 2010

12. Ex 5.1 #1 – 6, 9, 10, 13, (What is Probability?)
13. Ex 5.2 #1 - 6, 7, 10, 12, 13, 17, 18, 20, 22 (Compound Events)
14. Ex 5.3 #1 - 4, 6, 9, 13 -20, 22, 25, 27 (Tree Diagrams and Counting Techniques)
15. Ex 6.1 #1 - 5, 8, 10, 14 (Random Variables and Probability Distribution)
16. Ex 6.2 #1 - 8, 10, 13, 17, 18 (Binomial Probabilities)
17. Ex 6.3 #1 4, 6, 8, 12, 14 (Additional Properties of Binomial Distribution)
18. Ex 7.1 #1 - 8, 10, 15 - 18, 23 - 26 (Graphs of Normal Probability Distributions)
19. Ex 7.2 #1 - 6, 8, 10, 15 - 18, 23 - 26 (Standard Normal Distribution)
20. Ex 7.3 #1 - 4, 7 - 10, 15 - 22, 28, 31, 34 (Areas under any Normal Curve)
21. Ex 7.4 #1 - 9 (Sampling Distribution)
22. Ex 7.5 #1 - 10, 13, 17 (Normal Curves and Sampling Distribution)
23. Ex 7.6 #1 - 4, 6, 9, 13 (Normal Approximation to Binomial)

Exam 2 tentative date March 17, 2010
<table>
<thead>
<tr>
<th>Ex</th>
<th>#</th>
<th>Exercises</th>
<th>Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>24. Ex 8.1</td>
<td>#1 - 10, 12, 13, 19</td>
<td>(Estimate (\mu) when (\sigma) is known)</td>
<td></td>
</tr>
<tr>
<td>26. Ex 8.2</td>
<td>#1 - 10, 15, 17, 18, 21</td>
<td>(Estimate (\mu) when (\sigma) is Unknown)</td>
<td></td>
</tr>
<tr>
<td>29. Ex 8.3</td>
<td>#1 - 4, 7, 9, 15, 17</td>
<td>(Estimate (p) in the Binomial Distribution)</td>
<td></td>
</tr>
<tr>
<td>30. Ex 9.1</td>
<td>#1 - 4, 5, 7, 10, 13, 14</td>
<td>(Introduction to Statistical Tests)</td>
<td></td>
</tr>
<tr>
<td>31. Ex 9.2</td>
<td>#1 - 6, 7, 10, 15, 18, 21, 23, 24</td>
<td>(Test Claim about Mean, (\mu))</td>
<td></td>
</tr>
<tr>
<td>32. Ex 9.3</td>
<td>#1 - 5, 7, 8, 12, 17, 20,</td>
<td>(Testing a Proportion, (p))</td>
<td></td>
</tr>
<tr>
<td>33. Ex 10.1</td>
<td>#1 - 6, 9, 12, 15, 16</td>
<td>(Inferences from Matched Pairs, Dependent Samples)</td>
<td></td>
</tr>
<tr>
<td>34. Ex 10.2</td>
<td>#1 - 6, 7, 8, 12, 14</td>
<td>(Inferences about the Difference of Two Means; (\mu_1, \mu_2))</td>
<td></td>
</tr>
<tr>
<td>35. Ex 10.3</td>
<td>#1 - 4, 5, 7, 11, 13, 18</td>
<td>(Inferences about the Difference of Two Proportions (p_1-p_2))</td>
<td></td>
</tr>
<tr>
<td>36. Ex 11.1</td>
<td>#1 - 5, 9, 10, 13</td>
<td>(Chi Square: Test of Independence)</td>
<td></td>
</tr>
<tr>
<td>37. Ex 11.2</td>
<td>#1 - 6, 9, 13, 14</td>
<td>(Chi Square: Goodness of Fit)</td>
<td></td>
</tr>
<tr>
<td>38. Ex 11.3</td>
<td>#1 - 2, 5, 7, 8, 10, 11</td>
<td>(Testing a Variance or Standard Deviation)</td>
<td></td>
</tr>
<tr>
<td>39. Ex 11.4</td>
<td>#1 - 6, 9, 10, 13</td>
<td>(Inferences for Correlation and Regression)</td>
<td></td>
</tr>
</tbody>
</table>

Exam 3 tentative date April 29, 2010

Comprehensive Final Exam Thursday May 13, 2010 at 1 PM