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:** 100

   If the course is cross listed, please provide the cross-listing:

   **Course Title:** Survey of Mathematics

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.

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**Initiated by:** Michael Kaczmarski  
Initiator’s printed name  
Date 04-04-16

**Approved by:** Michael Ferguson  
Division Chair’s printed name  
Date 4/12/16

**Routed via:** Kara Kam-Kalani  
CPC Chair’s printed name  
Date 4/15/16

**Accepted by:** Steven T. Mandraccia  
Foundation Board Chair’s printed name  
Date 4/7/2016
Official Course Description

MATH 100 – Survey of Mathematics

Course Description

- Prerequisite: C or higher in Math 25 or placement in Math 100
- Recommended Prep: Placement in ENG 22/60

A general survey of mathematics with emphasis on its historical development and the role it plays in modern society.

Student Learning Outcomes

Upon successful completion of Math 100, students will be able to:

1. Perform inductive reasoning by searching for patterns among specific examples and forming general conjectures.
2. Find counter-examples to inductive reasoning general conjectures.
3. Perform deductive reasoning by using previously established general principles.
4. Perform set operations of union, intersection, and complements by roster or Venn diagrams.
5. Develop set laws by inductive or deductive reasoning.
6. Solve applied problems (e.g., survey analysis) using set operations.
7. Perform operations of conjunction, disjunction, and negation on logic statements that are either represented symbolically or by Euler diagrams.
8. Construct truth tables for compound logic statements.
9. Develop logic laws by inductive or deductive reasoning.
10. Determine the validity of logical arguments by truth tables, standard arguments (e.g., the Law of Contraposition, the Fallacy of the Inverse), or Euler circles.
11. Represent numbers using various numeration systems, both ancient and modern.
12. Perform arithmetic operations in various numeration systems.
13. Apply the binary, octal, and hexadecimal numeration systems to the modern digital world.
14. Count the elements of finite sets by systematic listings, trees, permutations, combinations, or the Fundamental Counting Principle.
15. Develop counting formulas by inductive or deductive reasoning.
17. Determine expected values of real-life events in games.
18. Summarize real-life data sets by bar graphs or histograms and interpret such summaries.
19. Determine means, medians, modes, ranges, and standard deviations of real-life data sets.
20. Solve applied problems (e.g., grade determination, stock volatility) by using descriptive statistics.

In general, the course will develop the student’s quantitative and analytical reasoning abilities and will familiarize the student with some of the different areas of mathematics so that the student might gain a better understanding of and appreciation for mathematics. Completion of
this course with a “C” grade or higher satisfies the three credits of quantitative reasoning requirement of many University of Hawaii Manoa Programs.

Assessment

Each hallmark is covered by student learning outcomes.

- **Hallmark 1**: SLOs 5, 6, 9, 10, 13, 15, 16, 17
- **Hallmark 2**: SLOs 1, 2, 3, 5, 9, 15
- **Hallmark 3**: SLOs 6, 10, 13, 14, 16, 17, 20
- **Hallmark 4**: SLOs All 1 through 20
- **Hallmark 5**: SLOs 1, 2, 3, 5, 9, 15
- **Hallmark 6**: SLOs 6, 10, 13, 16, 17, 20

Since the SLOs are covered, then the Hallmarks will also be covered.

The mathematics department will assign a liaison(s) for Math 100. The liaison(s) will discuss with all Math 100 instructors how the hallmarks relate to SLOs and the need to cover and assess SLOs. Each instructor will choose questions pertinent to each SLO, assign each question a point value, and embed them in homework, quizzes, tests, or the final exam. The liaison(s) will check to see that suitable questions have been embedded.

To assess student performance on an SLO, the point value of all the embedded questions pertinent to the SLO will be totaled. A student that has at least 70% of the total will be said to have achieved competence on the SLO. Each semester, for each Math 100 class, the instructor will tabulate how many students have achieved competence on each SLO, and the tabulations will be discussed with the liaison(s). The instructor and liaison(s) may agree to modify the way the instructor covers an SLO.

The liaison(s) will keep a copy of each Math 100 instructor’s SLO student performance tabulation. Every 3 to 5 years the liaison(s) will summarize all collected tabulations and discuss the summary at a meeting of the mathematics department. Strategies in the ways that SLOs can be covered, or whether or not an SLO should be modified, will be discussed.

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?*

The topics are discussed from two complementary viewpoints: theoretical and practical. The theoretical viewpoint infers general laws expressed in precise symbols via inductive or deductive reasoning. The practical viewpoint then applies the general laws to the solution of real-world problems, often resulting in a numerical result whose relevance is interpreted by the student. For example, in Set Theory, the Inclusion-Exclusion Principle for Finite Sets, \( n(A \cup B) = n(A) + n(B) - n(A \cap B) \), can be proved using a Venn diagram. The Principle can then be used to analyze a survey.
Part of the beauty and power of formal systems is that different systems often have remarkably similar general laws. Two examples follow: 1) In Probability Theory, the probability of two events, E and F, is calculated by \( P(E \text{ or } F) = P(E) + P(F) - P(E \text{ and } F) \), which can easily be deduced from the Set Theory Principle. The Probability Inclusion-Exclusion Principle can be used to calculate the expected value of a life insurance policy. 2) Using inductive reasoning, it can be deduced that \( 2^n \) can be used in Set Theory to calculate the number of subsets of a finite set and in Logic to calculate the number of lines required in a truth table. To help explain why this happens, students are asked to consider the common bi-polar nature of both sets and logical statements. An object is either inside a set or outside a set; a logical statement is either true or false.

Another part of the beauty and power of formal systems is that general laws can be proved many different ways. For example, in Logic, the Law of Disjunctive Syllogism can be proved deductively by using a truth table, a Venn diagram, or a chain of previously proved laws.

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 discussion of inductive and deductive reasoning. Inductive reasoning requires searching for a pattern among a finite number of several specific examples and then using the pattern to infer a general conclusion. Students will learn that while inductive reasoning often leads to correct conclusions, it may sometimes lead to an incorrect conclusion. They will search for counterexamples to show that a conclusion is incorrect, but they will also learn that finding counterexamples is not always easy.

Thus the need for deductive reasoning, where a general conclusion is inferred from general assumptions or general rules that have been previously been proved. Two examples follow:

1) In Logic, using either truth tables or Venn diagrams, it can be proved that \( \sim(\sim p) = p \), \( \sim(p \lor q) = p \land \sim q \), and \( p \rightarrow q = \sim p \lor q \). These rules can next be precisely chained together to deductively infer the Conjunctive Form of the Negation of a Conditional Statement, \( \sim(p \rightarrow q) = \sim(p \lor q) = \sim(p) \land q = p \land \sim q \).

2) In Probability Theory, it can first be proved that \( P(\text{impossible event}) = 0 \), \( P(\text{certain event}) = 1 \), and \( P(E \text{ or } F) = P(E) + P(F) - P(E \text{ and } F) \), the Inclusion-Exclusion Principle. These rules can next be precisely chained together to deductively infer the exact relationship between \( P(E) \) and \( P(\sim E) \). \( P(E) + P(\sim E) = P(E) + P(\sim E) - 0 = P(E) + P(\sim E) - P(\text{impossible event}) = P(E) + P(\sim E) - P(E \text{ and } \sim E) = P(E \text{ or } \sim E) = P(\text{certain event}) = 1 \). Students will also learn that deductive reasoning is not always easy.

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

The topics of Sets, Logic, Numeration Systems, Counting, Probability, and Descriptive Statistics each have their formal laws and principles. In each of these topics, students will have to learn, select, and correctly apply them, especially in the solution of real-world problems. For example, suppose a screening committee of 4 men and 3 women is to be formed from a pool of 10 men
and 8 women, and a student is asked how many different committees can be formed. The student must first realize that the multiplicative Counting Principle applies, since forming the committee is a two-stage process of first selecting the men and then selecting the women. Then the student must realize that order is not important, so the number of ways each stage can be accomplished can be calculated by the use of combinations. Then the student must correctly apply the combination formula and calculate the results. The student would need to show work as follows:

Number of different committees = \( C_{10,4} \times C_{8,3} = 21 \times 56 = 11,760 \).

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?**

The topics of Sets, Logic, Numeration Systems, Counting and Probability each have their own symbolism. In each topic, students will be required to express problems symbolically, manipulate the symbols using various laws or principles, arrive at a symbolic conclusion, and determine the meaning and reasonableness of the symbolic conclusion. Two examples follow:

1) In Logic, a student can be required to explain how the contract “If you score 85% on the final exam, then I will give you a C for the course” can be broken. With \( s \) representing “you score 85% on the final exam,” and \( g \) representing “I will give you a C for the course,” the student would represent breaking the contract as a negation of a conditional statement, apply a formal rule that allows the student to rewrite the contract in an equivalent conjunctive form, and then state its final meaning: 

\[ \neg(s \rightarrow g) = s \land \neg g, \]\n
which means “you score 85% on the final exam, but I don’t give you a C;”

2) In Numeration Systems, using only base sixteen numerals and base sixteen algorithms of subtraction with borrow, a student can calculate that \( 103_{sixteen} - D6_{sixteen} = 2D_{sixteen} \). The reasonableness of the answer can be ascertained by converting all base sixteen numerals to base ten numerals. Indeed \( 103_{sixteen} = 259_{ten} \), \( D6_{sixteen} = 214_{ten} \), and \( 2D_{sixteen} = 45_{ten} \), which checks.

5. **The course will include computational and/or quantitative skills. Students will be challenged to use symbolic trails of reasoning in efficient and elegant ways.**

The students will learn how to draw general conclusions using either inductive or deductive reasoning along with the advantages and disadvantages of each and the need for both. For example, in 1742, Christian Goldbach applied inductive reasoning to conjecture that “Every even number greater than 2 can be written as the sum of two prime numbers.” Many have tried to disprove the conjecture by finding a counterexample, even employing supercomputers to look at billions of specific examples, but no counterexample has yet been found. Many others have tried to prove the conjecture using deductive reasoning, but no one has yet found such a proof either.

When a basic principle is difficult to prove with deductive reasoning, students will understand its reasonableness via inductive reasoning. For example, an examination of three or four specific examples convinces most students that the general expression \( 2^n \) can be used to count the number of subsets of a finite set and determine the number of lines needed in a truth table. When a basic principle is easy to prove with deductive reasoning, a deductive proof will be given. For example, De Morgan’s Laws for statements can be proven using a general truth table.
Students will also learn how to chain previously proved laws to deduce new laws. For example, in Logic, once the Disjunctive Form of a Conditional Statement and the Law of Detachment have been proved, they can be chained to deduce the Law of Disjunctive Syllogism. [The Law of Disjunctive Syllogism can also be proved independently using either a truth table or a Venn diagram.]

Student will always be asked to think about the reasonableness of an answer, in the context of what they have learned. If the answer is expressed in words, does it sound about right? If the answer is numerical, is it in the ballpark? Is it possible to get a totally different answer if the problem is done by another method?

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 Sets, Logic, Numeration Systems, Counting, and Probability. In each of these topics, general principles are first discussed on an abstract level. Then they are discussed on a practical level in the solution of real-world problems. Some examples follow: 1) In Sets, many set laws are proved using general Venn diagrams, where the regions are given general names. But the Venn diagrams can be made more specific, with specific numbers placed in each region to indicate the number of elements in that region. Using Venn diagrams in this specific manner allows one to analyze real-world surveys. 2) In Logic, a student may use the contrapositive of a conditional statement to restate a contract in equivalent language. 3) In Numeration Systems, using the binary representation of numbers and the simple rules of binary arithmetic, one can understand how digital computers use low voltage, (symbolized by 0) and high voltage, (symbolized by 1) to perform arithmetic computations on numbers. 4) In Counting and Probability, general formulas can be applied to calculate the probability of a specific outcome in a game of chance (such as being dealt a hand of two aces and two kings in a game of 5-card poker) or the expectation of buying a single raffle ticket.

**Syllabus:**

See attachment.
MATH 100: SURVEY OF MATHEMATICS  FALL 2015  PROFESSOR: Michael Kaczmarski

e-MAIL: kaczmars@hawaii.edu  TEL: Cell 636-4309 (Use only if e-mail is down.)

OFFICE: 7-409  HOURS: MW(9:15am-9:30am), TR(09:15am-10:15am), and MTWR(2:15pm-2:45pm)

COURSE DESCRIPTION: The prerequisite for the course is a "C" or higher in Math 25 or placement in Math 100. Recommended preparation is placement in English 22/60. The course is a general survey of mathematics (arriving at mathematical principles by either inductive or deductive reasoning), with emphasis on its historical development and the role it plays in modern society.

REQUIRED EQUIPMENT: You will need a scientific calculator having a squaring key and a square root key. You may use it on homework and tests. Phone calculators not allowed.

TEXTBOOK: You may use either
- The hard-copy Mathematics All Around, by Thomas L. Pirnot.
  1. Rubik cubes are on the cover.
  2. Available at the HCC bookstore in bond version for $146.75 new.
  3. Comes with a Student Access Code which is needed to register for on-line MyMathLab.
- The e-textbook
  1. Accessible through MyMathLab.
  2. Student Access Code may be purchased for $95.70, either during registration for on-line MyMathLab, or within 14 days (by clicking on Temporary Access at the bottom of the screen).

TESTS AND ORDER OF COURSE TOPICS:
- TEST 1: Chapter 1, Problem Solving (1.2 only)
  Chapter 2, Set Theory (2.1 to 2.4)
- TEST 2: Chapter 3, Logic (3.1 to 3.5)
- TEST 3: Chapter 5, Numeration Systems (5.1 to 5.3)
- TEST 4: Chapter 12, Counting (12.1 to 12.4)
- TEST 5: Chapter 13, Probability (13.1 to 13.4)
- TEST 6: Chapter 14, Descriptive Statistics (14.1 to 14.3)

INTERNET HOMEWORK: Most (but not all) homework is done on-line using MyMathLab. MyMathLab is accessed through the site MyLab and Mastering. To register for the course, you will need to supply the Course ID, which is kaczmarski43012.

For student that have recently used MyMathLab with the above textbook:
- 1. Your old account is probably still active. If it is, sign in using your Pearson account name and password. You should not have to do anything else. No student access code is needed and no payment is required.

For students that already have a Pearson account and have not used MyMathLab with the above textbook:
- 1. Go to http://pearsonmylabandmastering.com/
- 2. Under Register, click Student.
- 3. Enter the above Course ID.
- 4. Sign in using your current Pearson account name and password.
- 5. Choose either Use an Access Code at the upper left (if you already have an access code, which comes with the hard-copy if purchased new), or Use a Credit Card/PayPal at the upper right or Temporary Access at the bottom (if you don’t have an access code yet, and you are going to use only the e-textbook).

For students that do not have a Pearson account:
- 1. Go to http://pearsonmylabandmastering.com/
- 2. Under Register, click Student.
- 3. Enter the above Course ID.
- 4. Create a Pearson account. You will need to give an e-mail address, user name, password, first name, last name, security question, and security answer. Read and accept the license agreement, and click on Create Account. Then choose either Use an Access Code at the upper left (if you already have an access code, which comes with the hard-copy if purchased new), or Use a Credit Card/PayPal at the upper right or Temporary Access at the bottom (if you don’t have an access code yet, and you are going to use only the e-textbook).
Internet homework is required and will be scaled down to 50 points of your entire grade. If you don’t have internet in your home, then use a computer in the HCC computer lab in Building 2, the Native Hawaiian Center, or a public library. If you have a laptop, you can use a hot-spot. Go to MyLab and Mastering and click the Sign In button (bookmark the sign in page) and log in. Click on the Math 100 course, and then on the Homework button on the left. You are allowed to do problems more than once until you get them right, and you can request extra tutorial assistance or extra similar problems.

- **STUDENTS DO VERY WELL ON THE INTERNET HOMEWORK, SINCE THEY CAN REPEAT THE PROBLEMS UNTIL THEY GET THEM RIGHT.** Once you get a problem right, the point you earned is never taken away, provided that you tell the program to save your best score.
- You must get at least 80% on a homework assignment before being allowed to start the next homework assignment. Remember to always save your homework before quitting. You may re-enter any homework assignment during the semester to raise the score.
- Prior to each test, a homework assignment named Review for Test will be assigned. You must get at least 80% on the Review for Test assignment before starting a test.
- Any internet homework assignment may be worked on until Thursday, 12-17-15, but you should try hard to complete homework at the 80% level soon after it is assigned. **THERE IS A FIRM DUE DATE ON INTERNET TESTS (SEE BELOW), SO IF YOU FALL TOO FAR BEHIND AND DO NOT COMPLETE THE REVIEW FOR TEST HOMEWORK ASSIGNMENT AT THE 80% LEVEL BEFORE THE DUE DATE FOR THE TEST, THEN YOU WILL MISS THE TEST AND GET A SCORE OF 0 ON THE TEST.**

**INTERNET TESTS:** These are closed book and closed notes (except that handouts will be provided on Test 2 and 3 to which you can refer). You may use a scientific calculator, but it must be your own (sharing is not allowed). Phone calculators are not allowed.
- On-line tests must be taken in the Testing Room on the 3rd floor of Building 7. They are open M TWR 09:00am-06:45pm and F 0:900am-01:00pm. You must bring a photo ID to sign up for a test. A password is required to take a test, which the test administrator will know.
- Each test will have a firm due date, which is posted on-line next to the test. The firm due date for a test will be about 1 - 1½ weeks after the Review for Test homework assignment has been posted. Click on the Quizzes and Tests button (under the Homework button) to see the tests that have been assigned, along with their due dates. Tests and their firm due dates will also be posted in Laulima, in your Math 100 course, under Announcements. I will also send you an e-mail about upcoming tests and their firm due dates, so check your UH e-mail on a regular basis.
- From the time the Review for Test homework assignment is posted, if you are behind, you only have about one week to catch up. Remember that you must get at least 80% on all internet homework assignments (including the Review for Test) before you can start a test. **IF YOU DO NOT TAKE A TEST BY ITS FIRM DUE DATE, THEN YOUR SCORE WILL BE 0, AND NO MAKEUP TEST WILL BE GIVEN.**
- You do not have to get 80% on a test to continue with the course. You can continue with the next internet homework assignment (covering new material), provided that you have 80% on all prior internet homework assignments (which can be worked on until Thursday 12-17-15, 11:59 pm).
- You will have 2 hours to take each test, so plan to show up at the Testing Room 2 hours before it closes. Once you start a test, you must complete it in one session. You will not be allowed to leave the Testing Room for any reason. (Go to the restroom before starting a test.)
- While taking a test, you use the buttons at the top of the page to move back and forth between problems. You may go back to a problem and change its answer. You may skip problems, and come back to them later. When you are finished answering problems, go to the bottom of the screen and click on the Submit button. Your test will be immediately graded and you can see your percent score. **DO NOT CLICK ON THE SUBMIT BUTTON UNTIL COMPLETELY FINISHED WITH THE TEST. WHEN THE SUBMIT BUTTON IS CLICKED ON, THE TEST IS OVER, AND YOU WILL NOT BE ALLOWED TO REENTER AND WORK ON ANY UNFINISHED PROBLEMS OR CHANGE ANSWERS.**
- The internet program grades test problems on a right/wrong basis. Since no partial credit is given, I will increase every test score by 10%: 60 increases to 66, 70 increases to 77, 80 increases to 88, and so on. I will go into the MyMathLab Gradebook after each test firm due date to increase the test scores.
- Each test is similar to the Review for Test homework assignment that you must complete with at least 80%: About the same type and number of questions. Students that take a
test shortly after completing the Review for Test (while the material is still fresh in their minds) usually pass the test.

- Some students suffer from text anxiety. If you are such a student, try writing a letter to yourself before the test. In this letter, express your feelings as they truly are, even if they change as you are writing the letter, and note the change in the letter. Scientific studies have shown that this technique often works because it allows you to focus on your anxiety before taking a test, putting your mind at rest, and freeing up your mind to focus on solving test questions while taking a test.

**TURN-IN HOMEWORK:** Some important material is not covered adequately in the internet homework. For this material, turn-in homework will be assigned and will be due in one week (meaning, if a turn-in homework assignment is assigned on Monday, then it is due the following Monday, at the beginning of class). I will grade this homework and return it to you. Each problem is worth one point. These turn-in homework assignments are in the lecture notes, which are posted in Laulima, in your Math 100 course, in the Resources folder. So if you miss a lecture, check Laulima, review the notes, and complete any associated turn-in homework. Turn-in homework will be scaled down to 10 points of your entire grade. Since the turn-in homework problems are graded on a right/wrong basis, I will increase the overall turn-in homework score by 10% after their due date. Your turn-in homework scores will be recorded in MyMathLab under the category Turn-In Homework.

**LAULIMA:** Check your Math 100 course after on a regular basis. I will post announcements of upcoming tests and their firm due dates. In the Resources folder you will also find PDF files for this syllabus and all lecture notes. I strongly recommend that you print out the lecture notes before coming to class, so you don’t have to waste time taking notes during the lecture, and instead can use the time to think about what we are discussing.

**ATTENDANCE/HOLIDAYS:** Attendance will be taken each lecture. Attendance is important at the end of the semester for students that are not passing the course with at least a D (see below). There will be no classes on Monday 09-07-2015 (Labor Day) and on Wednesday 11-11-2015 (Veteran’s Day).

**GRADING:**

<table>
<thead>
<tr>
<th>Test</th>
<th>Points</th>
<th>MyMathLab Overall Score</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test 1</td>
<td>100</td>
<td>90-100 = A semester grade</td>
<td></td>
</tr>
<tr>
<td>Test 2</td>
<td>100</td>
<td>80-89 = B</td>
<td></td>
</tr>
<tr>
<td>Test 3</td>
<td>100</td>
<td>70-79 = C</td>
<td></td>
</tr>
<tr>
<td>Test 4</td>
<td>100</td>
<td>65-69 = D</td>
<td></td>
</tr>
<tr>
<td>Test 5</td>
<td>100</td>
<td>0-54 = F or N (To qualify for the N grade, you must attend at least 21 sessions)</td>
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</tr>
<tr>
<td>Test 6</td>
<td>100</td>
<td>(about 70% of the course). N grades will not be given to anyone with a D or better.</td>
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</tr>
<tr>
<td>Internet Hwk.</td>
<td>50</td>
<td></td>
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</tr>
<tr>
<td>Turn-in Hwk.</td>
<td>10</td>
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</table>

The I grade will not be assigned for any reason.

**OVERALL GRADE OF INTERNET TESTS AND HOMEWORK:** At any time during the semester, you can go to MyMathLab, click on Gradebook, and choose Entire Course to Date, then All Assignments. At the upper left of the screen, you will see a number that represents the average of all internet tests you have taken, all internet homework that you have started, and all turn-in problems that you have done. The last day to improve internet homework scores is 12-17-15, 11:59 pm. Any internet homework assignments not started by that day will receive a score of 0. On 12-18-15 in the morning, I will assign a score of 0 for any internet assignments that have not been started. If you check your overall MyMathLab score between 3pm on 12-18-15 and 12-30-15, then you can use the above grading chart to know your course letter grade.

**STUDENT LEARNING OUTCOMES:** Upon successful completion of the course, you will be able to:

- To find patterns and draw conclusions by inductive reasoning.
- Reason by deduction.
- Perform set operations of union, intersection, and complement on sets described either by roster or Venn diagram.
- Solve applied problems using set operations, such as survey analysis.
- Represent numbers using various numeration systems, both ancient and modern.
- Perform arithmetic operations in various numeration systems.
- Perform operations of conjunction, disjunction, and negation on logic statements that
are represented either symbolically or by Euler circles.

- Construct truth tables for compound logic statements.
- Determine the validity of an argument.
- Perform counting operations, including permutations and combinations.
- Calculate the probability of an event in a sample space and calculate the expected value of an event in a game.
- Represent a set of data visually.
- Calculate the mean, mode, median, range and standard deviation of a data set, and know how to use these numbers to answer real-world questions (for example, using the mean and standard deviation to determine grades).

Assessment of the Student Learning Outcomes is required for accreditation. This assessment will be done by analysis of your internet homework problems.

**STUDENTS WITH DISABILITIES:** If you have a disability, you may be entitled to either a special environment or extra time for test taking. You must bring documentation to the learning disabilities coordinator for review.

**STUDENT BEHAVIOR:** All students are expected to always behave in a respectful manner to the instructor and their fellow students at all times when on campus. (See the Student Conduct Code, in the College Catalog, and also on the internet at honolulu.hawaii.edu.) You are expected to be attentive during the lecture, focusing on Math 100 material. If you are not, you will have to leave the room and will be marked absent.

**COLLEGE STUDYING/HOMEWORK EXPECTATIONS:** College students are expected to spend at least two hours studying and doing homework outside of class for every hour spent in class. In this course you will be in class for two and a half hours every week, so you should expect to spend at least five hours a week studying and doing homework.

**ATTEND CLASS REGULARLY.**

**DO NOT PROCRASTINATE IN DOING HOMEWORK.**

**FALLING BEHIND IN YOUR HOMEWORK IS A MAJOR FIRST STEP IN FAILING THE COURSE.**
MATH 100 Survey of Mathematics  
Fall, 2009

Instructor: Carol Hiraoka  
Office: 7-418; Phone: 845-9405  
E-mail: carolh@hcc.hawaii.edu  
Office Hours: Mon through Thurs: 11:30 am – 1:00 pm  
Mon & Wed: 4:30 pm - 5:15 pm  
Other hours available by appointment

**COURSE DESCRIPTION:** A general survey of mathematics, with emphasis on its historical development and the role it plays in modern society. (3 credits)

**PREREQUISITES/COMMENTS:** An entering student must have received a “C” or higher in MATH 25 (Elementary Algebra II) or have placed in Math 100. Recommended preparation: Placement in ENG 22/60.

The student should have already acquired the skills of elementary algebra including such topics as polynomial fractions, linear functions and equations, quadratic functions and equations, irrational numbers, radical expressions, and number systems.

**Symbolic Reasoning Objectives:**

Students will

- Demonstrate an understanding of the beauty, power, clarity, and precision of formal systems through guided practice in problem solving via inductive or deductive reasoning, on the theoretical level, and applying general laws to real-world problems on the practical level.
- Demonstrate through performances on assessment exams, classwork, and homework exercises the concept of proof as a chain of inferences, using both inductive and deductive reasoning.
- Learn, select and correctly apply formal rules of algorithms in selected real-world applications in areas of Sets, Logic, Numeration Systems, Counting and Probability, and Descriptive Statistics.
- Demonstrate correct and effective use of the symbolic techniques of algebra on assessment exams, classwork, homework exercises or related projects, particularly in topics of Sets, Logic, Numeration Systems, Counting and Probability, and Descriptive Statistics.
- Analyze rules and theorems to find the most effective solutions to problems.
- Apply algebraic principles to solve real-world problems related to real-world problems.

**Student Learning Outcomes**

Upon successful completion of Math 100, the student will be able to:
- Perform inductive reasoning by searching for patterns among specific examples and forming general conjectures.
- Find counter-examples to inductive reasoning general conjectures.
Perform deductive reasoning by using previously established general principles.
Perform set operations of union, intersection, and complements by roster or Venn diagrams.
Develop set laws by inductive or deductive reasoning.
Solve applied problems (e.g., survey analysis) using set operations.
Perform operations of conjunction, disjunction, and negation on logic statements that are either represented symbolically or by Euler diagrams.
Construct truth tables for compound logic statements.
Develop logic laws by inductive or deductive reasoning.
Determine the validity logical arguments by truth tables, standard arguments (e.g., the Law of Contraposition, the Fallacy of the Inverse), or Euler circles.
Represent numbers using various numeration systems, both ancient and modern.
Perform arithmetic operations in various numeration systems.
Apply the binary, octal, and hexadecimal numeration systems to the modern digital world.
Count the elements of finite sets by systematic listings, trees, permutations, combinations, or the Fundamental Counting Principle.
Develop counting formulas by inductive or deductive reasoning.
Determine probabilities of real-life events in sample spaces.
Determine expected values of real-life events in games.
Summarize real-life data sets by bar graphs or histograms, and interpret such summaries.
Determine means, modes, medians, ranges, and standard deviations of real-life data sets.
Solve applied problems (e.g., grade determination, stock volatility) by using descriptive statistics.

In general, the course will develop the student’s quantitative and analytical reasoning abilities and will familiarize the student with some of the different areas of mathematics so that the student might gain a better understanding of and appreciation for mathematics. Completion of this course with a “C” grade or higher, satisfies the three credits of quantitative reasoning requirement of many University of Hawaii Manoa programs.

TEXT AND REFERENCES: “Mathematics All Around” by Thomas L. Pirnot, 4th Edition, with use of MyMathLab. (Homework will be posted and completed via MyMathLab access on the internet.)

EQUIPMENT AND MATERIALS: The student is required to purchase a scientific calculator.
EXAMS: There will be three exams, one project, and a final exam. The final exam will cover the last topics since the third exam. Each exam and the project will have equal weight (one fifth each).

Exam 1: Chapter 1: Problem Solving
          Chapter 2: Set Theory
Exam 2:   Chapter 3: Logic
          Chapter 4: Graphs
Exam 3:  Chapter 13: Counting
        Chapter 14: Probability
        Chapter 15: Descriptive Statistics

Final:  Chapter 5: Numerations Systems
        Chapter 9: Consumer Mathematics
        Chapter 11: Apportionment
        Chapter 12: Voting

**GRADING:**

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“N” **Grade Policy:** No “N” grade will be assigned for this class. Withdrawals without grade penalty must be done before the prescribed deadline (October 10, 2009).

**Test Makeup Policy:** Under special arrangements, missed exams can be made up. The make up exam must be taken before the corrected exam is returned to the class, so you should plan to take any make up the day following the original test. You must call the above telephone number during office hours on the day of the missed test to schedule a time and place for the make up.

**ATTENDANCE & HOMEWORK:**

*You are expected to attend each class and do the assigned homework.*

Attendance will be taken for administrative purposes. Homework is posted online on MyMathLab and must be completed online. Homework will not be collected, but completion will be verified by the instructor online.

**CELL PHONE POLICY:** All cell phones should be turned off or set in silent mode. Do not make or accept phone calls during class time.
Embedded Questions

1. **Perform inductive reasoning by searching for patterns among specific examples and forming general conjectures.**

   i) When using specific examples to form a conjecture, you are using:
   a) Deductive reasoning, b) Inductive reasoning, c) Educated guessing, d) none of the above.

   ii) List the next two numbers of the sequence; 1, 4, 9, 16, 25, 36,…

   iii) Determine the units digit of $3^{31}$.

   iv) Given $4 = 2 + 2, 6 = 3 + 3, 8 = 3 + 5, \text{ and } 10 = 3 + 7$. Therefore, any even natural number can be written as the sum of two primes. __________ reasoning?

2. **Find counter-examples to inductive reasoning general conjectures.**

   i) A math student reasons as follows: “Consider the value of the polynomial $n^2 - n + 41$ for different natural numbers, $n$. For $n = 1$, $1^2 - 1 + 41 = 41$, which is prime. For $n = 2$, $2^2 - 2 + 41 = 43$, which is prime. For $n = 3$, $3^2 - 3 + 41 = 47$, which is prime. For $n = 4$, $4^2 - 4 + 41 = 53$, which is prime. Therefore, if $n$ is any natural number, the value of $n^2 - n + 41$ will be prime.” Supply a counter-example which shows that this reasoning is incorrect. Be sure to show enough work to justify your counter-example. A list of the first 100 primes is provided.

3. **Perform deductive reasoning by using previously established general principles.**

   i) When reaching a conclusion by applying general principles, you are using:
   a) Deductive reasoning, b) Inductive reasoning, c) Educated guessing, d) none of the above.

   ii) $(x + y)^2 = (x + y)(x + y) = x^2 + xy + xy + y^2 = x^2 + 2xy + y^2$. Therefore, $(x + y)^2 = x^2 + 2xy + y^2$. This is an example of __________ reasoning.

   iii) Let A and B be any sets. When Venn diagrams for $(A \cup B)'$ and $A' \cap B'$ are correctly shaded in, the resulting diagrams are the same. Therefore, $(A \cup B)' = A' \cap B'$. This is an example of __________ reasoning.

   iv) Draw a Venn diagram for $A \cup (B \cap C)$.

   v) Use previously established set laws to simplify $(A' \cup A')'$. What type of reasoning was used?

4. **Perform set operations of union, intersection, and complements by roster or Venn diagrams.**

   i) List the elements of the following sets:
   $U = \{1, 2, 3, 4, 5, 6, 7\} \quad A = \{3, 4, 5, 6\} \quad B = \{1, 2, 3, 5\}$ find:
   a) $A'$, b) $A \cap B$, c) $A \cup B$, d) $A - B$

   ii) List the elements of the following sets:
   $U = \{15, 16, 17, 18, 19, 20, 21, 22, 23\} \quad D = \{16, 19, 21\}, E = \{16, 18, 19, 20\}$, and $F = \{15, 17, 18, 19, 21\}$ find:
   a) $(D \cap E) \cap F$ b) $(D \cap F)'$
5. Develop set laws by inductive or deductive reasoning.
   i) Use previously established set laws to simplify $A \cap (A' \cup B)$ What type of reasoning was used?
   ii) Prove the associative law of intersection by deductive reasoning using Venn diagrams.
   iii) If $A$ is a set that has $k$ elements, then $A$ has:
         a) $k^2$ subsets, b) $2^k$ subsets, c) $2^k - 1$ subsets, d) none of the above.
   iv) DeMorgan’s Law for sets states $(A \cup B)' =$
         a) $A' \cup B'$, b) $A' \cap B'$, c) $A \cap B$, d) none of the above.

6. Solve applied problems (e.g., survey analysis) using set operations.
   i) In a fraternity with 37 members, 18 take math, 5 take both math and chemistry, and 8 take neither math nor chemistry. How many take chemistry but not math?
   ii) Thirty people were surveyed on what flavors of ice cream they like. 16 like vanilla, 21 like chocolate, 17 like strawberry, 8 like only vanilla and chocolate, 7 like vanilla and strawberry, 11 like chocolate and strawberry, and 5 like all three flavors. Using V for like vanilla, C for like chocolate, and S for like strawberry, label all eight regions of the Venn diagram below with the number of people in each region.

7. Perform operations of conjunction, disjunction, and negation on logic statements that are either represented symbolically or by Euler diagrams.
   i) Use Euler circles to draw a diagram for each of the following statements. Correctly label each circle using $p$ for “people”, and $h$ for “honest.” Show solid dots that indicate the relevant regions.
      a) “All people are honest.”
      b) “No people are honest.”
      c) “Some people are honest.”
      d) “Some people are not honest.”
   ii) $p$ is T, $q$ is T, and $r$ is F. Determine whether the compound expressions is T or F:
       a) $\neg (p \land r) \rightarrow q$
       b) $(p \lor r) \leftrightarrow (p \land q)$
8. Construct truth tables for compound logic statements.
   i) Make a truth table for the compound statement \((\neg p \lor q) \rightarrow (p \land \neg r)\). Circle the final column.
   ii) Fill in each column with the correct truth values, using T or F.

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iii) Is \(p \rightarrow q\) logically equivalent to \(\neg p \lor q\)? Make a truth and circle the column you are comparing, then answer “yes” or “no”.

9. Develop logic laws by inductive or deductive reasoning.
   i) Prove the other DeMorgan’s Law for Logic: \(\neg (p \land q)\) \(L.E.\) \(\neg p \lor \neg q\)
   ii) Prove the other Associative Law for Logic: \((p \lor q) \lor r\) \(L.E.\) \(p \lor (q \lor r)\)
   iii) Prove the other Distributive Law for Logic: \(p \land (q \lor r)\) \(L.E.\) \((p \land q) \lor (p \land r)\)

10. Determine the validity of logical arguments by truth tables, standard arguments (e.g., the Law of Contraposition, the Fallacy of the Inverse), or Euler circles.
   i) Draw and label an Euler diagram which shows the argument is invalid. Use \(d\) for “dogs”, \(f\) for “friendly”, and \(c\) for “cats”. Show solid dots as appropriate:

   - All dogs are friendly.
   - Some cats are friendly.
   - No dogs are cats.

   ii) Fill in the blanks to complete each standard form, both valid and invalid. \(LD = \text{Law of Detachment},\) \(LC = \text{Law of Contraposition},\) \(LS = \text{Law of Syllogism},\) \(DS = \text{Disjunctive Syllogism},\) \(FC = \text{Fallacy of the Converse},\) and \(FI = \text{Fallacy of the Inverse}\). The first premise of each argument is given.

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iii) First write the argument symbolically. Choose the standard form that it matches (LD, LC, LS, DS, FC, or FI), then state if the argument is “valid” or “invalid”.
   a. “If you study, then you will pass. You did not study. Therefore you did not pass.”
      Standard form________ argument is __________
   b. “If the moon orbits the earth, then a cat is a dog. A cat is not a dog. Therefore the moon does not orbit the earth.”
      Standard form________ argument is __________
   c. “If it rains, then I will not go to the beach. If I do not go to the beach, then I will study. Therefore if it rains, then I will study.”
      Standard form________ argument is __________
11. Represent numbers using various numeration systems, both ancient and modern.

i) Find the value of \( CMXXVIDCCXLIX \).
\( M = 1000, D = 500, C = 100, L = 50, X = 10, V = 5, \) and \( I = 1. \)
Two vertical bars around a group = multiply the group by 100.
A horizontal bar above a group = multiply the group by 1000.

ii) Find the value of \( <<<|| < | <<<\).\( < = 100, | = 1, ^\) = subtract

iii) Convert \( 111010_2 \) to base ten.

iv) Convert \( 3214 \) to base ten.

v) Convert \( 3AD_{16} \) to base ten.

vi) Convert \( 20 \) to base three.

vii) Convert \( 192 \) to base five.

viii) Convert \( 928 \) to base sixteen.

12. Perform arithmetic operations in various numeration systems.

i) Use the Egyptian doubling procedure to multiply \( 19 \times 25 \). Use base ten numerals, not Egyptian numerals. Show all work.

ii) Perform each computation. Show all steps, including carries and borrows, using only base two numerals. Base two addition and multiplication tables are provided for reference.

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a) \( 111010 + 11102 \)  
b) \( 111012 - 11102 \)

c) \( 10112 \times 1012 \)  
d) \( 111012 \) divided by \( 112 \)

iii) Perform each computation. Show all steps, including carries and borrows, using only base five numerals. Base five addition and multiplication tables are provided for reference.

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a) \( 31200_5 - 23315 \)  
b) \( 23_5 \times 32_5 \)

13. Apply the binary, octal, and hexadecimal numeration systems to the modern digital world.

i) Convert \( 1101011_{12} \) to base eight.

ii) Convert \( 3E7_{16} \) to base two.

iii) Convert \( 327_8 \) to base sixteen.
14. Count the elements of finite sets by systematic listings, trees, permutations, combinations, or the Fundamental Counting Principle.

i) At a local restaurant, customers can order a complete meal consisting of three choices: main course, starch, and vegetables. The main course can be meat (m), chicken (c), or fish (f). If a customer chooses meat, then he can choose for his starch either potatoes (p), rice (r), or noodles (n). If a customer chooses chicken or fish, then he can choose for his starch either potatoes or rice. For vegetables, all complete meals come with a choice of string beans (s) or broccoli (b). Make a tree diagram, and then use it to count the total possible number of complete meals.

ii) A local bottled water company assigns each of its customers and identification code. Each code begins with a letter of the alphabet from A to Z, followed by four numerical digits, from 0 to 9, (for example: K5209). If repletion of numerical digits is allowed, then what is the total number of identification codes possible?

iii) In the following situations, the number of ways to perform each task can be counted by using either a Permutation P(n, r) or a Combination C(n, r). State which method applies and specify the values of n and r. Write answer in the form P(n, r) or C(n, r).
   a) From a group of 30 players, an all-star team of 12 players will be formed.
   b) A club of 25 members is going to elect a president, a vice president, and a treasurer.
   c) From a deck of 52 playing cards, a hand of 5 cards will be dealt.
   d) 9 people are to be arranged in a straight line.

iv) Solve by any appropriate method and show all work.
   a) On a geography test, 7 states must be matched with 7 state capitals. What is the total number of possible ways to match states with capitals, (either correctly or incorrectly)?
   b) Three coins are randomly tossed and the outcome is recorded, (for example, one possible outcome is HHT). What is the total number of possible outcomes?

15. Develop counting formulas by inductive or deductive reasoning.

i) Consider arranging people in a straight line: Allen, Bob, Carol, Dave, and Ellen. Repetitions are not allowed and order is important. But we will not arrange all 5 people in line; we will take only 3 of them. How many arrangements are possible?
   a) Show a 3-stage tree to determine the number of arrangements.
   b) Use the fundamental counting principle to determine the number of arrangements.
   c) Can you use factorials to get the same result? Show how.

   Congratulations, you have just derived the formula for permutations \( P(n, r) = \frac{n!}{(n-r)!} \)

ii) What if order was not important; ABC was the same as CBA.
   a) How many arrangements of 3 letters can be made from \{ A, B, C, D \}; use a 3-stage tree.
   b) Assume order is not important and remove the repetitions and state how many arrangements of 3 letters remain.

iii) Note that \( C(n, r) = \frac{P(n, r)}{r!} = \frac{n!}{r!(n-r)!} \)
   i) Express each probability as a fraction reduced to lowest terms.
      a. A single card will be randomly drawn from a standard deck of 52 playing cards. Find the probability of drawing a face card.
      b. Three fair coins are randomly tossed. (HTT is one possible outcome). Find the probability of obtaining exactly two heads.
      c. A pair of fair dice is rolled once. For example, (2, 6) is one possible outcome. What is the probability of obtaining a total of seven?
      d. Ten balls are placed in a jar: 5 red, 3 blue, and 2 green. A person randomly selects two balls from the jar, without replacement. What is the probability the neither ball is blue?

17. Determine expected values of real-life events in games.
   i) The probability that a 80-year old male in the United States will die within one year is 0.073. An insurance company will offer a one-year policy to such a person for $500, non-refundable. If the person dies within one year, the beneficiaries will receive $5,000. What is the person’s expected value on one policy?

   ii) A church has sold 500 raffle tickets for $5 each, non-refundable. One first prize of $500 will be awarded, along with two second prizes of $250 and two third place prizes of $100. If you purchase one ticket, what is your expected value? Round to the nearest penny.

18. Summarize real-life data sets by bar graphs or histograms and interpret such summaries.
   i) The bar graph summarizes a group of students who have taken a test.

   ![Bar Graph](image_url)

   a) How many students took the test?
   b) How many students achieved a score of at least 71?
   c) What range of scores occurred most frequently?
ii) The weights (in pounds) of students in a class were distributed as follows: 115, 61, 75, 85, 79, 101, 89, 81, 99, and 90. Make a histogram that begins at 60 pounds and uses a class width of 20 pounds. Be sure to label the class width boundaries on the Pounds axis.

19. Determine means, medians, modes, ranges, and standard deviations of real-life data sets.

i) For each data set given, calculate the three ways to measure central tendency.
   a) 1, 1, 1, 3, 5, 14
   b) 3, 3, 3, 6, 9, 9, 9
   c) \[
   \begin{array}{c|c}
   x & f \\
   2 & 3 \\
   3 & 1 \\
   5 & 2 \\
   6 & 5 \\
   8 & 3 \\
   11 & 1 \\
   \end{array}
   \]

ii) The students in a class received the following scores: 80, 76, 81, 84, 79, 80, 90, 75, 75, and 80.
   a) Calculate the mean and standard deviation of these scores; round to the nearest tenth. Show all steps in the calculation.

iii) The following scores were achieved by a group of golfers on the first day of a tournament. Calculate the standard deviation of the scores, rounded to the nearest tenth. Show all steps.

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20. Solve applied problems (e.g., grade determination, stock volatility) by using descriptive statistics.

i) The students in a class received the following scores: 80, 76, 81, 84, 79, 80, 90, 75, 75, and 80.
   a) Calculate the mean and standard deviation of these scores; round to the nearest tenth. Show all steps in the calculation.
   b) Calculate how many standard deviations from the mean, a score of 76 is and round to the nearest tenth.
   c) Determine what letter grade corresponds to a grade of 76.
ii) You are given information on the performance of two stocks over a one-month period. The stock with a greater coefficient of variation is considered more volatile. Calculate the coefficient of variation for both stocks, rounded to the nearest tenth, and state which is more volatile.

Safeway: mean daily closing price = $156.23 with standard deviation = $15.50
Foodland: mean daily closing price = $94.86 with standard deviation = $11.40