INSTRUCTIONAL GUIDE FOR FINITE MATHEMATICS

The purpose of this document is to provide suggestions on instructional techniques and philosophies. It is **not** meant to dictate policy and would likely be more useful to instructors who are relatively new to teaching the course (or ones similar to it) than those with more experience with such courses.

LOGIC

SECTION 8.1

Do not do example six (or problems like it) because quantifiers are not part of the course. Therefore, leave out the Sets of Real Numbers presentation on page 456. However, it would be nice to introduce it immediately before section 1.6.

SECTION 8.3

Although circuits are not part of the course, some students many benefit from seeing the Equivalent Statements box on page 478. Going over them could aid the students with their general understanding of the statements. Comprehension should take precedence over memory.

SECTION 8.4

Knowledge should be required of the names of all four statements in the blue box on page 483. Stress the equivalence or non-equivalence of the converse, inverse, and contra-positive statements to the condition statement.

SECTION 8.6

Have students understand that a logical argument with *n* premises is valid if and only if the statement

"If [(premise 1) and (premise 2) and … (premise n)], then (conclusion)" is a tautology. There is a shortcut one can use to decide if an argument is valid given in the separate handout *Analyzing Logical Arguments-Alternate Method*

SETS

SECTION 9.1

1) Students sometimes confuse the symbols $\varnothing, 0, \text{ and } \{0\}$. Provide clarification.

2) Make connections between set intersection, set union, and set complement with the respective conjunction, disjunction, and negation statements from logic.

3) Other relationships of set theory to logic can be made. An example is the connection between the set statement $A \cup U = U$ and the logic statement $p \vee T = T$.

4) Students sometimes believe that $(A \cup B)' \text{ is } A' \cup B' \text{ and that } (A \cap B)' \text{ is } A' \cap B'$. Show that neither is true using counterexamples. It would help to again use logic to make connections. **True statements** are

$(A \cup B)' = A' \cap B' \text{ and } (A \cap B)' = A' \cup B'$. These are known as the **DeMorgan's Laws for Sets**.

SECTION 9.2

1) Be sure to place emphasis on the material of hw problems 19-39.

2) Stress **comprehension** of the Union Rule for Counting on page 528 rather than strict memory.

Make liberal use of Venn Diagram when teaching set theory. Venn Diagrams are very effective visual aids.

PROBABILITY

This section should be presented using a conceptual rather than a formulaic one. Yes, the formulas are important but it is necessary for them to be **understood** as well as memorized.

Section 9.3

1) Stress the terms **experiment, outcomes, event, sample space**, and **equally likely events**.

2) Show how an experiment can have more than one sample space and point out that sample spaces with equally likely events are the most useful. That will become more apparent once the Basic Probability Formula on page 537 is given. This can be called the Classical Definition of the Probability of an Event.

3) Explain how by definition, all possible probability values range from 0 to 1. Grading is up to the discretion of the instructor and I make it my discretion to award **no credit for negative probabilities or probabilities larger than one**.

SECTION 9.4

1) Make connections between the probability rules of this section and set theory.

2) Avoid using the notation of the blue box on page 547. It can be confusing to students.

3) Problems like example 10 on page 547 and hw problems #59-62 can be solved using Venn Diagrams. Students tend to like that method of solution.

4) A common mistake of students is the forgetting of subtracting the probability of A and B when using the Addition Rule (page 541). The error stems from not understanding the rule. Show how a probability larger than one could arise if that error is made. One can use the sample space $S=\{a,b,c,d,e,f\}$ with events $A=\{a,b,e,f\}$ and $B=\{b,d,e\}$ to demonstrate.

SECTION 9.5

1) Conditional Probability causes much difficulty for students. It would help to stress the sample space restriction concept.

2) Deriving $\dfrac{P(E\cap F)}{P(F)}$ from $\dfrac{\frac{n(E\cap F)}{n(S)}}{\frac{n(F)}{n(S)}}$ can be useful.

3) Trees are very helpful in this section. One can use trees without ever having to directly memorize the Multiplication Rule.

4) The concepts of **independent events** and **mutually exclusive events** can be confused by students.

5) Be sure to test on problems like #57-62 on page 565. On the test, do **not** state that the problem is on independent events.

Part of the testing process is determining if the students are able to figure out that independent events are involved.

6) The derivation of the multiplication rule for independent events $P(E \cap F) = P(E)P(F)$ if and only E and *F* are

independent from the definition $P(E \mid F) = P(E)$ aids in student understanding.

SECTION 9.6

The material of this section should be treated as a part of 9.5. **DO NOT** state the Bayes Theorem Formula! Rather, teach these problems using trees. An alternative to the tree diagram method is the use of charts. There is a handout posted on my website. about the chart method. It is called *Conditional Probability and Bayes Theorem-Alternate Method.*

Counting, Probability Distributions, and Further Topics in Probability

Section 10.1

Be sure that students are aware that the expected value of a random variable *X* represents an **average**. Therefore, expected cannot be less than the minimum *X* or larger than the maximum. Students have been known to give such responses on test questions. Doing so indicates a lack of diligence on the part of the student.

Section 10.2

1) It can be easier for students to use the Multiplication Principle to evaluate ${}_nP_r$ instead of the formula given on page 396.

Also, ${}_nC_r$ can be evaluated as $\frac{{}_nC_r}{r!}$, which students sometimes prefer over $\frac{n!}{r!(n-r)!}$.

2) It helps to make clear to students that $(n-r)!$ is **not** $n!-r!$. Use specific values of *n* and *r* to demonstrate that.

3) The ability to decide if permutations or combinations are to be used cannot be overstressed. Permutations take order into

consideration and combinations do not. Key words for permutations are **arrangement**, **rank**, and **sequence**. Key

combinations words are **selection**, **sample**, **group**, and **subset**. Have students look for forms of such words when

encountered with situations involving counting techniques.

Section 10.3

1) This material tends to be one of the more difficult ones for the students. Frequent practice and asking for help when

needed are the keys. Stress finding the size of the sample space first when forming the probability fraction. That will help

minimize the possibility of giving a probability of larger than one.

2) Be sure to ask an expected value problem or two when counting techniques are useful in finding the probabilities

Section 10.4.

1) Mention that fact that the prefix *bi* of the word *binomial* indicates the number two. That could help bring out the concept of

the two mutually exclusive outcomes *success* and *failure*.

2) Give the classic coin toss experiment example and use outcomes such as heads/tails, yes/no, blue/not blue, five/not five as illustrations of possible outcomes of binomial experiments.

3) Show several examples of problems using the phrases “at least”, “no more than”, “no less than”, “less than”, and “more than”.

4) The “plausibility argument” on page 617 of the expected value formula for a binomial distribution should be supported mathematically. To accomplish that, one can compute the expected value in example two on page 616 using the definition from section 10.1. A general proof requires the Binomial Theorem and is beyond the scope of the course. However, it is good for the students to at least see how the short formula $E(x) = np$ arises mathematically from the section 10.1 def.

Introduction to Statistics

Section 11.1

1) Ask finding the median of a data set with an **even** number of data points.

2) Discuss the advantages and disadvantages of the mean, median, and mode as data set representations. Place strong emphasis on the median being more characteristic of a data set with extreme values (outliers).

3) As stated in the departmental syllabus, you can leave out the mean and modal class of grouped data.

Section 11.2

1) It is highly discouraged to cover the variance and standard deviation of grouped data. That material is not worth all the tedious arithmetic that it involves.

2) There are advantages of the standard deviation over the variance that should be mentioned:

a) Unless the variance is less than or equal to one, the standard deviation is a smaller number than the variance . That is especially convenient when the variance is large.

b) The variance can contain unfeasible units such as “squared dollars” or “squared units”. Since the standard deviation is the square root of the variance, there will be no presence of unusual “squared units” in the standard deviation.

c) The standard deviation has a high level of importance in higher level statistics but the variance does not.

Section 11.3

1) Do a good variety of examples and be sure to include those of determining a data point from a given probability. The equation $z = \frac{x-\mu}{\sigma}$ allows for going from data points to probabilities and the other way around. If desired, one can present the equivalent formula $x = z\sigma + \mu$ as the conversion tool from a probability to the corresponding data point *x*. That would apply to hw problems 15-18 and 37-39.

2) Remind students that *negative numbers or numbers greater than one are* ***impossible*** results for hw problems like #9-14, and 22-36.

3) Talking about the five-number summary and boxplots is fine, but **do not** require the construction of boxplots.

Section 11.4

Do not overlook the $np \geq 5$ and $n(1-p) \geq 5$ requirement given before example two on page 685. This material is one of the tougher sections of the course but is an important application of the normal distribution and should not be glossed over.

First-Degree equations

1) hw problems like 15-26 and 39-48 need not be done.

2) Applications are important. Be sure to assign at least some problems on page 55 and do problems like example 11 in class.

3) Discourage "guessing and checking" for solving problems. The algebraic manipulations are necessary and all students who earn a college degree should have the ability to solve a basic linear equation using algebra. Require that your students show work for full credit.

Graphs, Lines and Inequalities

1) It could be true that many of your students have covered this material in high school, but have done so using graphing calculators and/or open-note, open book, formula sheet-type assessment. As a result, they may not have a genuine understanding of the material. Thus, this material should be taught from the point of view of the students **never having seen it before!**

2) Applications of linear equations cannot be overstressed. **However**, do not cover material from this section involving square roots, quadratic functions (parabolas), cubic functions, or ellipses.

3) As stated in the Departmental Syllabus, for section 2.5, only problems like exercises 2-26 and 57-62 are required.

Systems of Linear Equations and Linear Inequalities

1) In section 6.1, do the 2 x 2 linear systems using substitution and elimination. As in the chapter 2 material, teach section 6.1 **as if the students have not seen the material before**.

2) When covering systems of linear inequalities, be sure that students are clear on the usage of dashed lines and solid lines.

3) Linear Programming applications (section 7.3) should not be treated lightly. One of these problems should be on your final exam and the semester test on the material.

Optional Topics

The requirement is that **exactly one** of Matrix Operations, the Gauss-Jordan Method, and Markov Chains be covered. Which one of the three is your choice. Points to consider are:

1) Matrix Operations is the easiest of the three but the least useful in applications.

2) Gauss-Jordan is **very tedious**.

3) Markov Chains require some matrix multiplication.

NOTE: *The course coordinator of MGF 1106 reserves the right to disallow the assignment of 1106 sections to any adjunct who demonstrates deviation from the requirements of material coverage and/or calculator and assessment policies stated in the MGF 1106 Departmental Syllabus.*