

**The VMI Core Curriculum:
The Nucleus of Citizenship and Leadership**

MA 105-106 – Introduction to Probability and Statistics I and II

A. Course Information

1. Department: *Department of Mathematics and Computer Science*
2. Course Number: *MA 105/106* 3. Credit Hours: *6*
4. Full Course Title: *Introduction to Probability and Statistics I and II*
5. Course Description:

MA 105: Introduction to Probability and Statistics I
A study of problem solving skills, counting principles, finite probability theory, descriptive statistics and the binomial and normal distributions. Computer/calculator applications will be chosen to enhance understanding of the topics.

MA106: Introduction to Probability and Statistics II
A continuation of MA 105. Topics include random variables, correlation, regression, confidence intervals, and hypothesis testing. Computer/calculator applications will be chosen to enhance understanding of the topics. Prerequisite: MA 105.

6. Prerequisite(s): *No prerequisite for MA 105, but 105 is a prerequisite for 106.*
7. Indicate whether this is
 A new course
 An existing course with less than 75% content revision
 An existing course with greater than 75% content revision
8. When do you expect to offer these courses first? *Fall 2007*
And on what schedule thereafter? *Every semester, summer session, and Summer Transition Program*
9. Expected enrollment per section: *25 maximum*
10. Faculty who will teach these courses:

Instructor	Position
Dr. Robert Bennell	Full Time
COL Lee Dewald	Full Time
COL Myke Gluck	Full Time
COL Tom Lominac	Full Time
COL Soe Than	Full Time
COL Mike Tierney	Full Time
COL VK Walsh	Full Time
CDR Dan Joseph	Full Time
LTC Troy Siemers	Full Time
MAJ Greg Hartman	Full Time
MAJ Lea Lanz	Full Time
Mr. Richard Miller	Part Time
Mr. Bill Lowe	Part Time

11. Resources (existing or new) required offering the course for the Core Curriculum:

- A. In order to use technology efficiently, smart classrooms will be required for all sections of MA 105 and MA 106.*
- B. Financial support will be necessary in order to send members of the department to workshops on active learning and assessment at the Joint Statistical Meetings or other similar venues.*
- C. In order to facilitate the administration of the common portion of the final exam (and perhaps an entirely common final exam in the future) the department requests a common final exam block for MA 105 and MA 106 courses.*

B. Core Curriculum Contributions

1. Primary Core Curriculum Component for which the approval for the course is proposed: Mathematical Reasoning.

2. Indicate any meta-competencies that the proposed course will address. *NA*.

C. Syllabus

The attached syllabi will be used in each section of MA 105 and MA 106 taught during the regular school year and summer sessions. Each instructor may also attach any information he or she thinks necessary to facilitate a smooth running class. However, the basic contents of these syllabi—including weights for assignments, the technology statement, etc.—may not be changed without written consent of the Core Curriculum Oversight Committee. While, suggested problems may be changed to suit individual instructors' preferences, the daily schedule must be followed, in general, and tests must be given within a day or two of the given schedule.

See [here](#).

D. Discussion

1. Briefly describe how the department views the contribution of the course to the overall goal of the Core Curriculum.

The Core Sequence in MA 105-106 is based upon the belief that all graduates of VMI should be broadly educated, and that each graduate should be able to apply basic mathematical tools to the solution of real-world problems. The sequence MA 105-106 provides a comprehensive view of statistics, encourages critical thinking, and develops statistical intuition. Topics in MA 105-106 include design of experiments, descriptive statistics, correlation, regression, and tests of significance. Statistics is problem-solving, and we use statistics to make decisions and to understand the world around us. After completing MA 105-106, the student will be able to conceptualize and apply statistical logic to problem solving. Many of the major decisions affecting our lives have some statistical justification, and the methods that are taught in the MA 105-106 sequence are relevant to the understanding of these decisions.

Therefore, the Core Sequence in MA 105-106 will help students acquire the knowledge and develop the intellectual skills that encourage participatory citizenship, acknowledge the value of learning, and facilitate adaptation to change.

2. Briefly describe how the course will address each of the intended learning outcomes required by the core curriculum component for which approval is sought. (See Table 2)

The Department has mapped course objectives to the QEP MAI Learning Outcomes in Appendix F1 of VMI's Assessment Plan in the Institute's 2007 Response Report to SACS. In Appendix F2` of that same document the Department have indicated how and where each of the QEP MAIs Learning Outcomes are assessed.

3. Briefly describe how the course will address any of the meta-competencies identified in B.2.

Often in statistics service courses, the instructor is faced with negative attitudes towards statistics, low motivation, and statistical knowledge that is minimal and generally not transferable. So instead of teaching statistics as a tool for data analysis, the Department's approach is to place greater emphasis on data

collection, understanding and modeling variation, graphical display of data, design of experiments, and problem solving. It is this “collecting of data” that promotes learning by experience and connects the learning process to reality. It is this connection to reality that should trigger the students’ interest and their commitment to learning.

MA 105-106, with the assistance of technology (graphing calculator and spreadsheet software such as EXCEL), will develop the student’s ability to read and interpret data, enhance the students’ ability to think critically through the use of statistics, and bolster their capacity for lifelong learning.

Throughout MA 105-106, students will be given many opportunities to see examples of statistical communications, both orally and in written form. In order to help students develop oral and written skills, the student will also be expected to participate in

- *the formulation of problems,*
- *written and oral presentations of the proposed approaches,*
- *data collection and model building,*
- *written and oral presentation of results of analyses,*
- *critical and interactive discussion of all aspects of the study.*

4. Describe the plan for assessing the outcomes identified in D.2 and, when appropriate, D.3.

Summative Assessment:

The Department has developed a common portion of the MA 106 final exam that will be given each time MA 106 is taught. Each question on the common portion of the exam has been linked to a MAI Learning Outcome. This examination will contain substantial elements, at least 75%, that are common across all sections of the course. The common portion of the final exam will be graded by a committee according to a prescribed rubric.

Upon completion of the course and grading of the final exams, the Course Coordinator will solicit input from all of the instructors who taught the course and make a report to the Department Head with an emphasis placed on ways to improve the course. The results, along with required and suggested actions, will be shared with the department at a future departmental meeting and at the first meeting of the course instructors for the new term.

Formative Assessment:

Prior to each semester, the Course Coordinator will ensure that all instructors are on the approved instructor list. The Course Coordinator will also check with the

Department Head to ensure that SACCS qualifications are on file in the Dean's Office for all instructors.

The Course Coordinator will hold meetings with all instructors at least four times during the semester. The purpose of each meeting is outlined below.

Meeting 1: Pre-Semester Meeting

- A. The Course Coordinator will review all syllabi to ensure that they are satisfactory.*
- B. The Course Coordinator will preview the course and discuss any required or suggested actions resulting from previous summative assessments.*
- C. Strategies for the first portion of the semester will be discussed in some detail including discussion of the bank of application scenarios that must be covered. (See D.5)*
- D. Common questions for tests one and two will be disseminated (two to five common questions for each test). These questions will be linked to the MAI learning outcomes.*

Meeting 2: Mid-Semester Meeting

- A. Performance on tests (to include performance on the common questions) and performance of the class in general will be discussed. The group will qualitatively analyze the performance and make recommendations for improving learning in the next semester and in the second half of the current semester.*
- B. Success of the application scenarios will be discussed.*
- C. Strategies for the second half of the semester will be discussed in some detail, including discussion on the bank of application scenarios that must be covered.*
- D. Common questions for tests three and four will be disseminated (two to five common questions for each test). These questions will be linked to MAI learning outcomes.*

Meeting 3: Pre-Exam Meeting

- A. Performance on tests (to include performance on the common questions) and performance of the class in general will be discussed. The group will qualitatively analyze the performance and make recommendations for improving learning in the next semester and in the second half of the current semester.*

- B. Success of the application scenarios will be discussed.*
- C. The final exam will be discussed, in particular the administration and grading of the common portion.*
- D. Final comments and suggestions from the instructors will be solicited.*

Meeting 4: Post-Exam Meeting

- A. Overall performance in the course, including the exam, will be discussed and analyzed qualitatively. Recommendations will be made for improving the course in following semesters.*
- B. The Course Coordinator will solicit input for the end of the semester report to the Department Head.*

The focus of all of these activities will be the consistent improvement of the MA 105-106 Core Sequence.

A detailed assessment plan for these courses is available on the VMI webpage for Core Curriculum Assessment: <http://new.vmi.edu/show.asp?durki=8292>.

5. Core curriculum courses must be taught with an explicit effort to stimulate students' intellectual curiosity and awareness of why these requirements have been established as the core academic contribution to the Institute's mission to develop citizen-soldiers. The Core Curriculum Oversight Committee therefore encourages instruction that promotes active, engaged learning. Describe how the pedagogy for this course addresses the issue of relevance and routinely engages students as active learners.

In MA 105-106 students will collect and analyze data and make predictions based on the data they have collected and analyzed. The students usually enjoy making predictions more than they enjoy collecting and analyzing data. The ability to make accurate predictions will permit students to make critical and creative decisions. The student is motivated to collect and analyze data because doing these tasks correctly and well is essential to the sense of empowerment that comes with the ability to make accurate predictions.

Students learn best when material is interesting, relevant, presented in manageable sizes, repeated and reinforced, and builds on things that students already know. Students should have the capacity to perform the required analysis and calculations themselves and without technological assistance to ensure that they understand the processes and concepts; however, they can be overwhelmed by the volume and bored by the repetition; therefore, after requiring a reasonable amount

of appropriately scaled “pen and paper” problems, the students are encouraged and required to use appropriate technological aids (computer software/calculators) to work problems. This revives the students’ interest and allows them to work real world problems containing larger data sets.

Eventually we wish to develop a set of demonstrations, examples, and projects to inspire students to participate in class and work effectively in homework, exams, and group projects. The demonstrations involve student participation, while the examples are conducted by the instructor. With multiple scenarios to choose from in each testing period, each instructor has a greater chance of finding a scenario that that is exciting. The more enthusiastic an instructor is about the application scenario the more enthusiastic the students will be and the more successful the process will be.)

For illustration, here are two applications scenarios: one for MA 105, and one for MA 106:

Who Opposed the Vietnam War? – MA 105

To give students practice in working with discrete data, we hand out copies of the partially filled in table below, and ask them to guess the numbers to fill in the blanks. The table summarizes public opinion about the Vietnam War in 1971 among adults in the United States as classified by their educational level. We give the students two minutes to fill out the table (working in pairs) and then discuss the results. We ask one student to present his or her pair's guessed table on the blackboard, and we begin by checking it for arithmetic: the numbers in each column must add up to 100% and the numbers in the top and bottom row must average approximately 73% and 27% respectively.

We then ask the student at the blackboard to explain his or her numbers and ask other students in the class for comments. Finally, we present the true numbers which probably will differ dramatically from the students' guesses.

This is an interesting example because it connects the mathematics of tabular displays to an interesting historical and political question. The key link is that, if some group supports withdrawal by more than 73% (the national average), then some other group must support it by less than 73%. Thus the table of percentages (the conditional distribution of the survey response conditional on education) focuses on differences among the educational groups, which is of political interest.

In January 1971 the Gallup poll asked: "A proposal has been made in Congress to require the U.S. government to bring home all U.S. troops before the end of this year. Would you like to have your congressman vote for or against this proposal?"

Guess the results, for respondents in each educational category, and fill out this table (the two numbers in each column should add up to 100%):

Adults with:				
	Grade school education	High school education	College education	Total adults
% for withdrawal of U.S. troops (doves)				73%
% against withdrawal of U.S. troops (hawks)				27%
Total	100%	100%	100%	100%

The actual results from the 1971 Gallup Poll were,

Adults with:				
	Grade school education	High school education	College education	Total adults
% for withdrawal of U.S. troops (doves)	80%	75%	60%	73%
% against withdrawal of U.S. troops (hawks)	20%	25%	40%	27%
Total	100%	100%	100%	100%

Students are generally surprised that less-educated people were the ones most likely to be doves.

This example is from:
Loewen, J.W. (1995). *Lies My teacher told Me: Everything Your American History Textbook Got Wrong*. New York: Norton.

Sample Scenario for Math 106

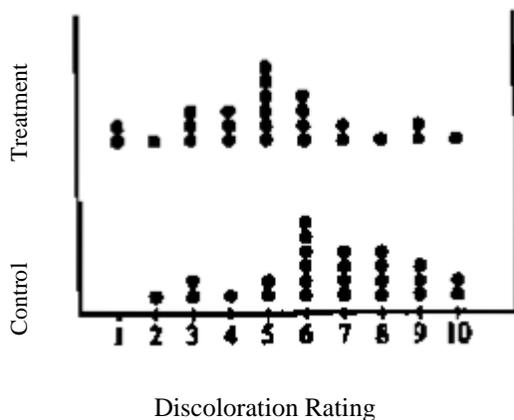
The Preservation Effect on the Discoloration of Strawberries

Directions: Show all your work. Indicate clearly the methods you use, because will be graded on the correctness of your methods as well as the accuracy and completeness of your results and explanations.

The department of agriculture at a university was interested in determining whether a preservative was effective in reducing discoloration in frozen strawberries. A sample of 50 ripe strawberries was prepared for freezing. Then the sample was randomly divided into two groups of 25 strawberries each. Each strawberry was place into a small plastic bag.

The 25 bags in the control group were sealed. The preservative was added to the 25 bags containing strawberries in the treatment group, and those bags were sealed. All bags were stored at 0°C for a period of 6 months. T the end of this time, after the strawberries were thawed, a technician rated each strawberry's discoloration from 1 to 10, with a low score indicating little discoloration.

The dotplots below show the distributions of discoloration rating for the control and treatment groups.



- The standard deviation of ratings for the control group is 2.141. Explain how this value summarizes variability in the control group.
- Based on the dotplots, comment on the effectiveness of preservative in lowering the amount of discoloration in strawberries. (No calculations are necessary.)
- Researchers at the university decided to calculate a 95 percent confident interval for the difference in mean discoloration rating between strawberries that were not treated with preservative and those that were treated with preservatives. The confidence interval they obtained was (0.16, 2.72). Assume that the conditions necessary for the t-confidence interval are met.

Bases on the confidence interval, comment on whether there would be a difference in the population mean discoloration ratings for the treated and untreated strawberries.

6. If this is a multi-section course, what faculty development plans does the department have for ensuring consistency and effectiveness across the various sections? Please note any resource requirements for faculty development in A.11.

Since consistency is critical in the teaching of mathematics, the objective of the Statistics Coordinator is to obtain consistency of instruction and focus throughout our multi-section courses in MA 105 and MA 106. In order to ensure consistency and effectiveness, the Department of Mathematics and Computer Science has developed a day-by-day syllabus for both MA105 and MA 106. The Department allows some flexibility within the syllabus, but all material on the syllabus must be covered. At least four in-class tests must be given. Additionally, the Department requires a common set of questions to be included on all tests. The Department analyzes the student performance on the common portion of the tests and provides feedback to the instructors regarding any identified deficits in instructional coverage and/or student understanding. The common portion of the final exam allows us to determine what material is being taught from the common syllabus and where more emphasize is needed. It also allows for corrections of misperceptions of instructional material.

Prior to each semester and periodically throughout the semester, the Course Coordinator will meet with those instructors assigned to teach in this core sequence and will discuss the goals of this core course sequence.

In addition, the Department Head will encourage faculty members to attend workshops at the Joint Statistical Meetings (or elsewhere) that will train instructors on methods of promoting active learning and assessment. The Department Head will also encourage increase faculty participation in the grading of the AP Statistics Exam.

Submitted by:

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