Advanced Mathematical Decision Making

Advanced Mathematical Decision Making is proposed as a fourth-year course to follow Algebra II. Its primary purpose is to prepare students for college majors that are not math intensive, for technical training, or for a range of career options. This course may also be useful to other students as an elective. Basic course instructional materials and supporting professional development are being developed for piloting during 2009–2010, with full implementation in 2010–2011. For more information, go to www.utdanacenter.org/amdm.

(a) General requirements: This course is proposed as a one-credit course. Recommended prerequisite: Algebra II.

(b) Introduction:

(1) Students continue to build upon their K–8, algebra, and geometry foundations and expand their understanding through further mathematical experiences. The primary focal points of Advanced Mathematical Decision Making include the analysis of information using statistical methods and probability, modeling change and mathematical relationships, mathematical decision making in finance and society, and spatial and geometric modeling for decision making. In Advanced Mathematical Decision Making, students will learn to become critical consumers of the quantitative data that surround them every day, knowledgeable decision makers who use logical reasoning, and mathematical thinkers who can use their quantitative skills to solve problems related to a wide range of situations.

(2) As students do mathematics, they continually rely on mathematical processes, including problem-solving techniques, appropriate mathematical language and communication skills, connections within and outside mathematics, and reasoning. Students also use multiple representations, technology, applications and modeling, and numerical fluency in problem-solving contexts.

(c)

(DM.1) **Analyzing numerical data**. The student analyzes numerical data in everyday situations using a variety of quantitative measures.

The student is expected to:

(A) apply, compare, and contrast ratios, rates, and ratings (such as aspect ratios, growth rates, television program ratings, NFL quarterback ratings, and job ratings) to make informed decisions;

(B) apply, compare, and contrast averages, weighted averages, and indices (such as grade point average, body mass index, NFL quarterback ratings, and Consumer Price Index) to make informed decisions;

(C) solve problems involving large quantities (such as estimating crowd size, counting the number of available phone numbers, estimating animal populations, or managing natural resources); and

(D) apply algorithms to determine the check digit for identification numbers (such as universal product codes (UPCs), vehicle identification numbers (VINs), and credit card numbers) and identify errors in recording and transmitting these numbers.

(DM.2) **Analyzing information using probability.** The student analyzes and evaluates risk and return in the context of everyday situations.

The student is expected to:

(A) determine conditional probabilities and probabilities of compound events by constructing and analyzing representations (including tree diagrams, Venn diagrams, and area models) to make decisions in problem situations;

(B) use probabilities to make and justify decisions about risks in everyday life (such as investing in the stock market, taking medication, or selecting car insurance); and

(C) calculate expected value to analyze mathematical fairness, payoff, and risk.

(DM.3) **Critiquing applications of statistics.** The student makes decisions based on understanding, analysis, and critique of reported statistical information and statistical summaries.

The student is expected to:

(A) identify limitations or lack of information in studies reporting statistical information, especially when studies are reported in condensed form;

(B) interpret and compare the results of poll(s) given a margin of error;

(C) identify uses and misuses of statistical analyses in studies reporting statistics or using statistics to justify particular conclusions, including assertions of cause and effect rather than correlation; and

(D) describe strengths and weaknesses of sampling techniques, data and graphical displays, and interpretations of summary statistics and other results appearing in a study, including reports published in the media.

(DM.4) **Conducting statistical analyses.** The student applies statistical methods to design and conduct a study that addresses one or more particular questions.

The student is expected to:

(A) determine the need for and purpose of a statistical investigation and what type of statistical analysis can be used to answer a specific question or set of questions;

(B) identify the population of interest, select an appropriate sampling technique (such as simple random, stratified, or systematic sampling), and collect data;

(C) identify the variables to be used in a study;

(D) determine possible sources of statistical bias in a study and how such bias may affect the ability to generalize the results;

(E) create data displays for a given data set(s) to investigate, compare, and estimate center, shape, spread, and unusual features; and

(F) determine possible sources of variability of data, including sampling, measurement, and induced and natural variability.

(DM.5) **Communicating statistical information.** The student communicates the results of reported and student-generated statistical studies.

The student is expected to:

(A) report results of statistical studies to a particular audience, including selecting an appropriate presentation format, creating graphical data displays, and interpreting results in terms of the question studied;

(B) justify the design and the conclusion(s) of statistical studies, including the methods used for each; and

(C) communicate statistical results in both oral and written formats using appropriate statistical and nontechnical language.

(DM.6) **Modeling data.** The student models data, makes predictions, and judges the validity of a prediction.

The student is expected to:

(A) determine whether or not there is a linear relationship in a set of bivariate data by finding the correlation coefficient for the data, and interpret the coefficient as a measure of the strength and direction of the linear relationship; and

(B) collect or use numerical bivariate data to create a scatterplot; select a function (such as linear, exponential, logistic, or trigonometric) to construct a model using the data, justify the selection, and use the model to make predictions.

(DM.7) **Modeling change and relationships**. The student uses mathematical models to represent, analyze, and solve problems involving change.

The student is expected to:

(A) determine or analyze an appropriate growth or decay model (including linear, exponential, and logistic functions) to solve problems (such as those involving inflation, medication dosage, climate change, or bone decay);

(B) determine or analyze an appropriate cyclical model (including trigonometric and other periodic functions) to solve problems (such as those involving phases of the moon, ocean tides, musical tones, or sound);

		(C) determine or analyze an appropriate piecewise model to solve problems (such as those involving U.S. tax brackets, cab fare, and postal/shipping rates); and (D) solve problems (such as those involving pattern identification, population growth and decline, and compound interest) using recursion or iteration.
(DM.8)	**Modeling with geometric tools**. The student uses a variety of tools and methods to represent and solve problems involving static and dynamic situations.	The student is expected to: (A) create and use two- and three-dimensional representations of authentic situations using paper techniques or dynamic geometric environments for computer-aided design and other applications; (B) solve problems and represent situations using vectors in areas such as transportation, computer graphics, and the physics of forces and motion; (C) solve problems and represent geometric transformations using matrices in fields such as computer animations; and (D) solve geometric problems involving inaccessible distances (such as those encountered when building a bridge, constructing a skyscraper, or mapping planetary distances) using basic trigonometric principles.
(DM.9)	**Network modeling for decision making**. The student uses a variety of network models represented graphically to organize data in quantitative situations, make informed decisions, and solve problems.	The student is expected to: (A) solve problems involving situations (such as scheduling tasks, making deliveries, or finding shortest routes) that can be represented by a vertex-edge graph and find critical paths, Euler paths, or minimal spanning trees; and (B) construct, analyze, and interpret flow charts in order to develop an algorithm to describe a particular process (such as designing quality control procedures for a manufacturing facility).

(DM.10) **Mathematical decision making in finance**. The student creates and analyzes mathematical models to make decisions related to earning, investing, spending, and borrowing money.

The student is expected to:

(A) determine, represent, and analyze mathematical models for various types of income (such as commission, salary, and hourly wage) to determine the best option for a given situation;

(B) determine, represent, and analyze mathematical models for expenditures (such as credit cards, auto financing, cell phone plans, and financial aid) to determine the best option for a given situation; and

(C) determine, represent, and analyze mathematical models and appropriate representations (such as expected values or probability distributions) for various types of loans and investments (such as savings plans and real estate) to determine the best loan or investment plan for a given situation.

(DM.11) **Mathematical decision making in voting and selection**. The student analyzes and evaluates the mathematics behind various methods of voting and selection.

The student is expected to:

(A) evaluate various voting and selection processes to determine an appropriate method for a given situation; and [combines A and C from previous version]

(B) apply various ranking algorithms, (such as methods used to compute class rank or athletic team rankings) to determine an appropriate method for a given situation; and