Linear Systems and Statistics

Curriculum Framework

2012

Course Title: Linear Systems and Statistics
Course/Unit Credit: 1
Course Number: 439090
Teacher Licensure: Please refer to the Course Code Management System (https://adedata.arkansas.gov/ccms/) for the most current licensure codes.
Grades: 9-12
Prerequisite: Algebra I, Algebra II

Linear Systems and Statistics

Linear Systems and Statistics is a two-semester course designed for students who have successfully completed Algebra II and expect to further their studies in business, social sciences, or education. Linear Systems and Statistics builds on Common Core State Standards knowledge of probability, randomness, and variability to provide students with an understanding of experimental design, estimation, hypothesis testing, and effective communication of experimental results. Statistical information collected and analyzed by students is used to investigate ways of collecting, displaying, and analyzing data. Teachers are responsible for including the eight Standards for Mathematical Practice found in the Common Core State Standards for Mathematics (CCSS-M). Linear Systems and Statistics does not require Arkansas Department of Education approval.

Prerequisites: Algebra I, Algebra II

Strand	Content Standard
Linear Systems and Matrices	
	1. Students will perform operations on matrices and use them to solve systems of equations.
Finance and Counting Techniques	
	2. Students will use combinatorial reasoning to find numbers of outcomes and related probabilities to solve real-world problems involving financial decision-making.
Probability Distributions	
	3. Students will use and understand various probability distribution models and solve problems involving what the distribution of data should look like under a given model.
Probability Rules	
	4. Students will use the rules of probability to calculate compound events and expected values to solve problems.
Inference and Regression Analysis	
	5. Students will use probability and regressions to evaluate outcomes of decisions.

Strand: Linear Systems and Matrices

Content Standard 1: Students will perform operations on matrices and use them to solve systems of equations.

		Connections to CCSS-M
LSM.1.LSS.1	Use matrices to represent and manipulate data (e.g., to represent payoffs of incidence relationships in a network)	N.VM.6
LSM.1.LSS.2	Multiply matrices by scalars to produce new matrices (e.g., as when all the payoffs in a game are doubled)	N.VM.7
LSM.1.LSS.3	Find the inverse of a matrix if it exists and use it to solve systems of linear equations of dimension 3 x 3 or greater, with and without technology	A.REI.9
LSM.1.LSS.4	Understand that the zero and identity matrices play a role in matrix addition and multiplication similar to the role of 0 and 1 in the real numbers; the determinant of a square matrix is nonzero if and only if the matrix has a multiplicative inverse	N.VM.10
LSM.1.LSS.5	Add, subtract, and multiply matrices of appropriate dimensions	N.VM.8
LSM.1.LSS.6	Understand that, unlike multiplication of numbers, matrix multiplication for square matrices is not a commutative operation but still satisfies the associative and distributive properties	N.VM.9
LSM.1.LSS.7	Work with 2 x 2 matrices as transformations of the plane and interpret the absolute value of the determinant in terms of area	N.VM.12
LSM.1.LSS.8	Graph and solve systems of linear inequalities with multiple constraints	A.REI.12
LSM.1.LSS.9	Use linear programming to model and solve real-world problems (e.g., maximum profit/minimal cost, investments, agriculture, manufacturing, banking)	Not Applicable
LSM.1.LSS.10	Represent a system of linear equations as a single matrix equation in a vector variable (e.g., row echelon form, Gauss-Jordan method, inverses)	Not Applicable

Key: LSM.1.LSS.1 - Linear Systems and Matrices.Content Standard 1.Linear Systems and Statistics.1st Student Learning Expectation

Strand: Finance and Counting Techniques

Content Standard 2: Students will use combinatorial reasoning to find numbers of outcomes and related probabilities to solve real-world problems involving financial decision-making.

		Connections to CCSS-M
FCT.2.LSS.1	Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents	F.BF.5
FCT.2.LSS.2	Derive the formula for the sum of a finite geometric series when the common ratio is not 1, and use the formula to solve problems (e.g., compound interest, amortization, annuities, appreciation, depreciation, and investments)	A.SSE.4
FCT.2.LSS.3	Apply the rules of probability in a variety of examples, distinguishing between the use of permutations and *combinations*, when necessary, to solve problems involving probability and compound events to make fair decisions	S.CP.9
FCT.2.LSS.4	Construct and examine Pascal's Triangle; develop and apply the Binomial Theorem with the use of *combinations*	A.APR.5
FCT.2.LSS.5	Apply the general *Multiplication Rule* in a uniform probability model $P(A \text{ and } B) = P(A)P(B/A)$ and interpret the answer in terms of the model; develop and apply Bayes' Formula	S.CP.8

Key: FCT.2.LSS.1 – Finance and Counting Techniques.Content Standard 2.Linear Systems and Statistics.1st Student Learning Expectation

Strand: Probability Distributions

Content Standard 3: Students will use and understand various probability distribution models and solve problems involving what the distribution of data should look like under a given model.

		Connections to CCSS-M
PD.3.LSS.1	Define a random variable for a quantity of interest by assigning a numerical value to each event in a sample space; graph the corresponding probability *distribution* using the same graphical displays as for data *distributions*	S.MD.1
PD.3.LSS.2	Calculate the expected value of a random variable; interpret the value as the mean of the probability *distribution*	S.MD.2
PD.3.LSS.3	Develop a probability *distribution* for a random variable defined for a sample space in which theoretical probabilities can be calculated; find the expected value	S.MD.3
PD.3.LSS.4	Develop a probability *distribution* for a random variable defined for a sample space in which probabilities are assigned empirically; find the expected value	S.MD.4
PD.3.LSS.5	Translate z-scores to probabilities and vice-versa	Not Applicable

Key: PD.3.LSS.1 – Probability Distributions.Content Standard 3.Linear Systems and Statistics.1st Student Learning Expectation

Strand: Probability Rules

Content Standard 4: Students will use the rules of probability to calculate compound events and expected values to solve problems.

		Connections to CCSS-M
PR.4.LSS.1	Find the *conditional probability* of A given B as the fraction of B's outcomes that also belong to A and interpret the answer in terms of the model	S.CP.6
PR.4.LSS.2	Apply the *Addition Rule*, $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$, and interpret the answer in terms of the model	S.CP.7
PR.4.LSS.3	Apply the general *Multiplication Rule* in a uniform probability model, $P(A \text{ and } B) = P(A)P(B\|A) = P(B)P(A\|B)$, and interpret the answer in terms of the model	S.CP.8
PR.4.LSS.4	Use permutations and *combinations* to compute probabilities of compound events and solve problems	S.CP.9

Key: PR.4.LSS.1 – Probability Rules.Content Standard 4.Linear Systems and Statistics.1st Student Learning Expectation

Strand: Inference and Regression Analysis

Content Standard 5: Students will use probability and regressions to evaluate outcomes of decisions

		Connections to CCSS-M
IRA.5.LSS.1	Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values: • find the expected payoff for a game of chance (e.g., find the expected winnings from a state lottery ticket or a game at a fast-food restaurant) • evaluate and compare strategies on the basis of expected values (e.g., compare a high-deductible versus a low-deductible automobile insurance policy using various but reasonable chances of having a minor or a major accident)	S.MD.5a, S.MD.5b
IRA.5.LSS.2	Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator)	S.MD.6
IRA.5.LSS.3	Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game)	S.MD.7
IRA.5.LSS.4	Calculate the sum of the squared deviations for a given line modeling a set of data and interpret the regression line as the linear model that minimizes this sum	Not Applicable
IRA.5.LSS.5	Use the *principle of least squares* to find the curve of best fit for a set of data	Not Applicable
IRA.5.LSS.6	Analyze the *correlation* using residual plots, outliers, and influential points	Not Applicable

Key: IRA.5.LSS.1 – Inference and Regression Analysis.Content Standard 5.Linear Systems and Statistics.1st Student Learning Expectation

Glossary for Linear Systems and Statistics

Addition Rule	The sum of the probability of events A and B minus the probability of the intersection of events A and B
Combinations	The number of combinations of *n* things taken *k* at a time is the number of ways of picking a subset of *k* of the *n* things, without replacement and without regard to the order in which the elements of the subset are picked
Conditional probability	When event A is expected to occur but event B occurs, this knowledge should affect the probability that A occurred quantitatively
Correlation	A measure of linear association between two ordered lists where two variables can be strongly correlated without having any causal relationship and two variables can have a causal relationship and yet be uncorrelated
Distribution(s)	How the values of a set of numerical data are distributed over the real numbers
Multiplication Rule	The chance that events A and B both occur is the conditional probability that A occurs given that B occurs multiplied by the unconditional probability that B occurs
Principle of Least Squares	The least squares line is one with the properties of the sum of the errors equals 0 and the sum of squared errors is smaller than that for any other straight-line model