06 Probability

Content Area: **Math**
Course(s):
Time Period: **Full Year**
Length: **2 weeks**
Status: **Published**

General Overview, Course Description or Course Philosophy

This course combines the study of Statistics and Probability with Data Science. The goal is to have students think critically about data in today's data-driven world and understand its role in the 21st Century economy. Furthermore, students will become familiar with the concepts, topics, and techniques used by data scientists and statisticians in their day-to-day work.

Throughout this course, students will engage in project-based observational studies and experiments to develop their understanding of data analysis, sampling, correlation/causation, bias and uncertainty, probability, modeling with data, as well as making and evaluating data-based arguments. Students will also learn about the roles of data scientists, the power of data in society, machine learning, and how data scientists extract knowledge and insights from real-world data.

In this unit, students will gain an insight into using data from real-life situations to determine the probability of an event occurring. They will compare theoretical probabilities with experimental probabilities and explore the differences.

OBJECTIVES, ESSENTIAL QUESTIONS, ENDURING UNDERSTANDINGS

Essential Questions

- In an experiment, how can you determine the number of possible results?
- How can you describe the likelihood of an event?
- What is the difference between dependent and independent events?
- How can you determine whether a sample accurately represents a population?
- How can you compare data sets that represent two populations?

Enduring Understanding

- Theoretical probability can be described as what is expected to happen, whereas experimental probability is what actually happens when outcomes are tested.
- Conditional probability is a measure of the probability of an event occurring given that another event has occurred.

CONTENT AREA STANDARDS

S.ID

A. Summarize, represent, and interpret data on a single count or measurement variable

B. Summarize, represent, and interpret data on two categorical and quantitative variables

C. Interpret linear models

S.IC

A. Understand and evaluate random processes underlying statistical experiments

B. Make inferences and justify conclusions from sample surveys, experiments, and observational studies

S.CP

A. Understand independence and conditional probability and use them to interpret data

B. Use the rules of probability to compute probabilities of compound events in a uniform probability model

S.MD

A. Calculate expected values and use them to solve problems

B. Use probability to evaluate outcomes of decisions

MA.S-CP.A.1	Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events (“or,” “and,” “not”).
MA.S-CP.A.2	Understand that two events A and B are independent if the probability of A and B occurring together is the product of their probabilities, and use this characterization to determine if they are independent.
MA.S-CP.A.3	Understand the conditional probability of A given B as $P(A\ and\ B)/P(B)$, and interpret independence of A and B as saying that the conditional probability of A given B is the same as the probability of A, and the conditional probability of B given A is the same as the probability of B.
MA.S-CP.A.4	Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities.
MA.S-CP.A.5	Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations.

MA.S-CP.B.6	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.
MA.S-CP.B.7	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.
MA.S-CP.B.8	Apply the general Multiplication Rule in a uniform probability model, $P(A \text{ and } B) = [P(A)] \times [P(B \mid A)] = [P(B)] \times [P(A \mid B)]$, and interpret the answer in terms of the model.
MA.S-CP.B.9	Use permutations and combinations to compute probabilities of compound events and solve problems.
MA.S-MD.A.2	Calculate the expected value of a random variable; interpret it as the mean of the probability distribution.
MA.S-MD.A.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.
MA.S-MD.A.4	Develop a probability distribution for a random variable defined for a sample space in which probabilities are assigned empirically; find the expected value.
MA.S-MD.B.5	Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values.
MA.S-MD.B.6	Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).
MA.S-MD.B.7	Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).
MA.S-MD.B.5a	Find the expected payoff for a game of chance.
MA.S-MD.B.5b	Evaluate and compare strategies on the basis of expected values.

RELATED STANDARDS (Technology, 21st Century Life & Careers, ELA Companion Standards are Required)

9.1.12.RM.4: Determine when and why it may be appropriate for the government to provide insurance coverage rather than private industry. • 9.1.12.RM.5: Explain what self-insuring is and determine when it is appropriate. • 9.1.12.RM.6: Differentiate the costs benefits and features (e.g., riders, deductibles, umbrella policies) of renter's and homeowner's insurance.

LA.RI.11-12.7	Integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a question or solve a problem.
LA.11-12.SL.11-12.2	Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data.
CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
CRP.K-12.CRP7	Employ valid and reliable research strategies.
CRP.K-12.CRP8	Utilize critical thinking to make sense of problems and persevere in solving them.
CRP.K-12.CRP11	Use technology to enhance productivity.
TECH.8.1.12.A.4	Construct a spreadsheet workbook with multiple worksheets, rename tabs to reflect the data on the worksheet, and use mathematical or logical functions, charts and data from all worksheets to convey the results.

TECH.8.1.12.A.5	Create a report from a relational database consisting of at least two tables and describe the process, and explain the report results.
TECH.8.1.12.C.CS2	Communicate information and ideas to multiple audiences using a variety of media and formats.
TECH.8.1.12.C.CS4	Contribute to project teams to produce original works or solve problems.
TECH.8.1.12.E.CS2	Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media.
TECH.8.1.12.E.CS4	Process data and report results.
TECH.8.1.12.F.CS3	Collect and analyze data to identify solutions and/or make informed decisions.

STUDENT LEARNING TARGETS

Declarative Knowledge

Students will understand that:

- There are common myths about randomness.
- Simulation is used to model change behavior.
- Probability is the likelihood of an event occurring.
- A permutation is a way in which a set or number of things can be ordered or arranged.
- A combination is a selection of items from a collection, such that the order of selection does not matter.

Procedural Knowledge

Students will be able to:

- Interpret probability as a long-run relative frequency.
- Through experimentation, understand how probability events become more apparent when simulated over a long period of time or with a high frequency
- Use simulation to model change behavior.
- Use simulation to detect whether a probability event produces a worthwhile event for a game.
- Design an experiment that involves using a random number generated to support or deny a claim.
- Apply basic probability rules.
- Use the general multiplication rule to calculate probabilities
- Understand and use Venn diagrams to draw conclusions in the context of probability.
- Evaluate conditional probability using a table.
- Use a tree diagram to model a chance process involving a sequence of outcomes.

- Calculate conditional probabilities using tree diagrams.
- Evaluate a permutation and a combination.
- Determine whether a scenario models a permutation or a combination and use permutations and combinations to solve problems.

EVIDENCE OF LEARNING

Alternate Assessments

- Portfolios
- Verbal Assessment (instead of written)
- Multiple choice
- Modified Rubrics
- Performance Based Assessments

Formative Assessments

Observations

Task completion

Student journals and notebooks

Cooperative team work

Summative Assessments

PBL assignments

Unit assessments

RESOURCES (Instructional, Supplemental, Intervention Materials)

Statistics and Probability with Applications (High School) Third Edition, Starnes & Tabor, 2016

Digital Launchpad book companion

INTERDISCIPLINARY CONNECTIONS

Educational tech applications

ACCOMMODATIONS & MODIFICATIONS FOR SUBGROUPS

See link to Accommodations & Modifications document in course folder.