Marietta City Schools

2023–2024 District Unit Planner

Geometry: Concepts & Connections

Unit title	Unit 8: Investigating Probability and Statistics	**MYP year**	*5*	**Unit duration (hrs)**	25 hours

Mastering Content and Skills through INQUIRY (Establishing the purpose of the Unit): ***What will students learn?***

GA DoE Standards

Standards

G.PR.10: Solve problems involving the probability of compound events to make informed decisions; interpret expected value and measures of variability to analyze probability distributions.

G.PR.10.1 Describe categories of events as subsets of a sample space using unions, intersections, or complements of other events. Apply the Addition Rule conceptually, P(A or B)= P(A) + P(B)-P(A and B), and interpret the answers in context.

Fundamentals

- Students should be able to communicate informed decisions by applying the Addition Rule to a problem involving the probability of compound events.
- The focus and emphasis should be on the understanding of the Addition Rule conceptually with limited emphasis on the manipulation of the equation.

Strategies and Methods

- Students should have opportunities using various tools such as Venn Diagrams and two-way tables to help visualize events.
- Two-way tables can be used to reveal all the sample space. Venn diagrams can be used to show intersections of two or more variables.

G.PR.10.2 Apply and interpret the general Multiplication Rule conceptually to independent events of a sample space, P(A and B) = [P(A)]x[P(B|A)] =[P(B)]x[P(A|B)] using contingency tables or tree diagrams.

Fundamentals

- Students should be able to relate the conditional probability back to the conceptual interpretation of probability studied in previous courses.
- The focus and emphasis should be on the understanding of the Multiplication Rule conceptually with limited emphasis on the manipulation of the equation.

Strategies and Methods

- Tree diagrams may be used to help students visualize events and probabilities of those events.

G.PR.10.3 Use conditional probability to interpret risk in terms of decision-making and investigate questions such as those involving false positives or false negatives from screening tests.

Fundamentals

- Relevant questions should be answered based on the appropriate risk measures.
- Students should be able to explain how studies and/or models were used to determine the risk measures.
- Students should be able to recognize that the chances of a false positive or a false negative are not the same as the chances of having the condition or not having the condition given the test result.
- Students should be able to interpret and communicate the consequences of making the false positive or false negative errors.
- Students should be able to interpret the notation for conditional probability in context.

Terminology

• A false positive is the probability of a positive result given the condition is not present.
• A false negative is the probability of a negative result given the condition is present.

Examples

• Given a positive test result, what are the chances the person has the illness measured in the screening test?
• Given that a person has the illness, what are the chances of them getting a positive test result on the screening test.

G.PR.10.4 Define permutations and combinations and apply this understanding to compute probabilities of compound events and solve meaningful problems.

Fundamentals

• Students should understand the terms permutation and combination and be able to solve simple problems involving selection and arrangements of objects in a line, including those involving repetition and restriction.
• The emphasis should be on the conceptual understanding and application of combinations and permutations.
• Students should be able to use and interpret formal notation to communicate about combinations and permutations (e.g., ${}_nP_r$ and ${}_nC_r$ to represent choosing r objects from n distinct objects).

Terminology

• A permutation is a special case of an arrangement.
• A combination is a special case of a selection.
• Repetition is a type of permutation where a repeat of elements from the set is allowed.
• Restriction is a type of permutation where each element is used only once, and a certain order is required.

Examples

• The Georgia Department of Transportation (GDOT) is creating new license plates. How many plates can they create using the symbols L, M, T, O, 3, 4. Students should recognize this problem as an example of a permutation and be able to determine the number of unique license plates that can be produced.
• There are five students in a group that need to form a straight line. Students A and B cannot stand next to each other. How many ways can they stand in line?

G.PR.10.5 Interpret the probability distribution for a given random variable and interpret the expected value.

Fundamentals

• Students should be able to understand that the probabilities in a distribution are between 0 and 1, and that they should sum to 1.
• Students should define random variable and understand that the sample space consists of all the values the random variable can take.
• Through mathematically applicable explorations, students should develop an understanding that the expected value is the mean of the probability distribution.
• Students should be presented with culturally relevant problems where they are given the expected value and can interpret its meaning within context.

G.PR.10.6 Develop a probability distribution for variables of interest using theoretical and empirical (observed) probabilities and calculate and interpret the expected value.

Fundamentals

• Students should be able to calculate the probability of all possible outcomes of a given event and display the probability of each graphically.
• Students should understand that the sum of all the probabilities within one distribution will be 1 (100%).

Strategies and Methods

• A chart showing every outcome and the resulting probabilities might be useful in graphing the probability distribution.
• Utilizing notation X as a discrete random variable denoting an outcome, P(X) is the probability the outcome occurs.
• Students should be able to find the probability of a certain quantity (e.g., P(X = 2)), and also the probability of a range of quantities (e.g., P(X > 2)).

Example

• Define X as the number of “tails” we get after three flips of a fair coin, students should first realize that in 3 flips, they could get X=0 tails, X=1 tail, X=2 tails, or X=3 tails. Using the sample space, (HHH, HHT, HTH, HTT, THH, THT, TTH, TTT) students calculate P(X), the probability of each X value, above. P(0) = 0.125, P(1)=0.375, P(2)=0.375, and P(3)=0.125. Students would show this distribution graphically

G.PR.10.7 Calculate the expected value of a random variable and interpret it as the mean of a given probability distribution.

Fundamentals

• Students should be able to use the expected value of a random variable to make informed decisions.
• Students should calculate the expected value of a random variable as the sum of each X_n * $P(X_n)$, and understand that this sum is the weighted average of the outcomes (weighted by the probability).
Example • Using the probability distribution that represents the number of tails you flip in three flips of a coin, the probability distribution would be (0)(0.125)+(1)*(0.375)+(2)(0.375)+(3)*(0.12 5)=1.5. So, on average, in three flips of the fair coin, you will get 1.5 tails. Students should realize that it is not possible to get 1.5 tails, and that 1.5 is exactly halfway between 1 and 2, and therefore it is just as likely to get 1 tail in 3 flips as it is to get 2 tails.

G.PR.10.8 Compare the payoff values associated with the probability distribution for a random variable and make informed decisions based on expected value and measures of variability.

Fundamentals
• Students should consider net value or payoff when making decisions about real-life problems.
• Students should understand that two probability distributions can have the same expected value, but one may vary more than the other, and this should be considered in decision-making.
• It is not necessary to calculate the standard deviation of the probability distribution.

Examples
• Students can compute and interpret expected values for games of chance, insurance policies, and other real-life situations.

G.DSR.11: Examine real-life situations presented in a two-way frequency table to calculate probabilities, to model categorical data, and to explain real-life phenomena.

G.DSR.11.1 Construct and summarize categorical data for two categories in two-way frequency tables.

Fundamentals
• Students should be able to identify, calculate, and interpret joint, marginal, and conditional relative frequencies in context of the data.
• Students should have opportunities to analyze meaningful, real-life data and recognize possible associations and trends in the data.
• Students should understand and apply concepts of sample space to describe categorical data.

G.DSR.11.2 Use categorical data in two-way frequency tables to calculate and interpret probabilities based on the investigation.

Terminology
• Respective symbolic notation: P(A and B) = P(A∩B) and P(A or B) = P(A ∪ B).

Fundamentals
• Students should be able to use two-way frequency tables to find probabilities for unions and intersections.
• Students should have opportunities to use two-way frequency tables to compute conditional probabilities

G.MM.1: Apply mathematics to real-life situations; model real-life phenomena using mathematics.

G.MM.1.1 Explain mathematically applicable problems using a mathematical model.

Fundamentals
• Students should be provided with opportunities to learn mathematics through the exploration of real-life problems.
• Mathematically applicable problems are those presented in context where the context makes sense, realistically and mathematically, and allows for students to make decisions about how to solve the problem (model with mathematics).

G.MM.1.2 Create mathematical models to explain phenomena that exist in the natural sciences, social sciences, liberal arts, fine and performing arts, and/or humanities contexts.

Fundamentals
• Students should be able to use the content learned in this course to create a mathematical model to explain real-life phenomena.

G.MM.1.3 Using abstract and quantitative reasoning, make decisions about information and data from a mathematically applicable situation.

Fundamentals
• Students should be able to connect learning of geometric shapes and their properties to describe objects.

• Students should be able to apply geometric methods and data to make decisions about structures and solve real-world problems.

G.MM.1.4 Use various mathematical representations and structures with this information to represent and solve real-life problems.

Fundamentals

• Students should be able to construct a model by selecting and creating algebraic and geometric representations that describe relationships between variables in context.

Concepts/Skills to support mastery of standards

Vocabulary

Additional Rule	Chance	Combination	Complement	Compound Event	Conditional Probability
Empirical Rule	Expected Value	Experimental Probability	Intersection	Measures of Variability	Multiplication Rule
Permutation	Probability	Probability Distribution	Sample Space	Subset	Theoretical Probability
Two-way Frequency Table	Union				

Notation

Key concept	Related concept(s)	Global context
Logic	Generalization, Justification	Scientific and Technical Innovation

Statement of inquiry

Using logic to analyze models and validity of data, students can determine the fairness of human capability and development.

Inquiry questions

Factual—

What is the difference between Permutation and Combination?

What is conditional probability and how can we calculate it?

What is probability and how can we calculate probability?

How can I use a venn diagram to organize various sets of data?

Conceptual—

Given probabilities, how can we determine if two events are dependent or independent?

What connections exist within different probabilities?

Debatable-

How can we use calculated probabilities to make decisions in real life?

MYP Objectives	**Assessment Tasks**	
*What specific MYP **objectives** will be addressed during this unit?*	***Relationship** between summative assessment task(s) and statement of inquiry:*	*List of common formative and summative assessments.*
No MYP objectives will be addressed during this unit	Students will collect and analyze data to determine the validity of probability claims. They will use compound and conditional probability to compare various results.	**Formative Assessment(s):** - **Quiz** **Summative Assessment(s):** - **Unit 8 Test**
Approaches to learning (ATL)		
Category: Research **Cluster:** Creative-thinking **Skill Indicator:** Use brainstorming and visual diagrams to generate new ideas and inquiries. Practice visible thinking strategies and techniques.		

Learning Experiences Add additional rows below as needed.		
Objective or Content	**Learning Experiences**	**Personalized Learning and Differentiation**
● G.PR.10.5 Interpret the probability distribution for a given random variable and interpret the expected value. ● G.PR.10.8 Compare the payoff values associated with the probability distribution for a random variable and make informed decisions based on expected value and measures of variability.	**What Do You Expect? (Engage, Explore, Apply, Formative) GA DOE** **Description:** In this learning plan, students will determine the probability of winning in a game of chance and determine the payoff. They will use expected values to compare the benefits of playing a game of chance. They will then create their own game of chance with the given criteria. **Learning Goal:** ● I can calculate the expected value. ● I can compare payoff values of probability distributions. ● I can interpret the probability distribution based on a given context. ● I can interpret the expected value and make informed decisions about a given event.	- Using dice, cards, or other tangible materials. - Extend: ask students to change one of the games that are not considered fair, so it becomes fair. Is there more than one way to make the change?

Content Resources

Textbook Correlation: enVision A|G|A - Geometry

G.PR.10.1 - Lesson 12-2
G.PR.10.2 - Lesson 12-1, Topic 12 - Mathematical Modeling in 3 Acts
G.PR.10.3 - Lesson 12-2, 12-6
G.PR.10.4 - Lesson 12-3
G.PR.10.5 - Lesson 12-4, 12-6
G.PR.10.6 - Lesson 12-4, 12-6
G.PR.10.7 - Lesson 12-5, 12-6
G.PR.10.8 - Lesson 12-5, 12-6

G.DSR.11.1 - Grade 8: Lesson 4-4, 4-5
G.DSR.11.2 - Lesson 12-2; Grade 8: Lesson 4-5