Data Analysis, Probability, and Statistics 2

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(K-4) Elementary School Learning Targets

E.DPS-2

Conduct simple probability experiments and characterize the outcomes in words, diagrams, or numerically.

(5-8) Middle School Learning Targets

M.DPS-2

Conduct probability experiments:

- Generate random samples to characterize variability in estimates and predictions.
- Analyze and build models of the association between two variables.

(9-12) High School Learning Targets

H.DPS-2

Use the rules of probability to interpret data, develop explanations, and address real-world problems.

Grade Differentiation

Middle School Progress Indicators

Progress Indicator: M.DPS.2a conducting simple probability experiments and expressing results in terms of relative frequencies or proportions as first estimate of probability

Progress Indicator: E.DPS.2d describing the probability of events as being certain, likely, equally likely, unlikely, or impossible
7.DPS.2d1 Describe the probability of events as being certain or impossible, likely, less likely or equally likely
Statistics and Probability
7 SP Investigate chance processes and develop, use, and evaluate probability models.
7.SP.C.5 Understand that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. Larger numbers indicate greater likelihood. A probability near 0 indicates an unlikely event, a probability around ½ indicates an event that is neither unlikely nor likely, and a probability near 1 indicates a likely event.

7.DPS.2d2 State the theoretical probability of events occurring in terms of ratios (words, percentages, decimals)
Statistics and Probability
7 SP Investigate chance processes and develop, use, and evaluate probability models.
7.SP.C.5 Understand that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. Larger numbers indicate greater likelihood. A probability near 0 indicates an unlikely event, a probability around ½ indicates an event that is neither unlikely nor likely, and a probability near 1 indicates a likely event.

Progress Indicator: M.DPS.2b describing and representing (e.g., tree diagrams) all possible outcomes (sample space) and the theoretical probabilities of each outcome (as proportion of a specific outcome relative to all possible outcomes) in simple probability experiments
7.DPS.2b1 Identify sample space for a single event (coin, spinner, die)

Progress Indicator: M.DPS.2d identifying sample spaces for multi-stage probability experiments (independent events) and determining the theoretical probabilities of specific event combinations
7.DPS.2d3 Using a tree diagram, represent all possible outcomes of a situation, with up to 3 compound events with 2 or 3 possibilities per category (selecting the color of shirt, pants, type of shoes)

7.DPS.2d4 Make a prediction regarding the probability of an event occurring; conduct simple probability experiments
Statistics and Probability
7 SP Investigate chance processes and develop, use, and evaluate probability models.
7.SP.C.6 Approximate the probability of a chance event by collecting data on the chance process that produce it and observing its long-run relative frequency and predict the approximate relative frequency given the probability. *For example, when rolling a number cube 600 times, predict that a 3 or 6 would be rolled roughly 200 times, but probably not exactly 200 times.*

7.DPS.2d5 Compare actual results of simple experiment with theoretical probabilities
Statistics and Probability
7 SP Investigate chance processes and develop, use, and evaluate probability models.
7.SP.C.7 Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy.
a) Develop a uniform probability model by assigning equal probability to all outcomes and use the model to determine probabilities of events. *For example, if a student is selected at random from a class, find the probability that Jane will be selected and the probability that a girl will be selected.*
b) Develop a probability model (which may not be uniform) by observing frequencies in data generated from a chance process. *For example, find the approximate probability that a spinning penny will land heads up or that a tossed paper cup will land open-end down. Do the outcomes for the spinning penny appear to be equally likely based on the observed frequencies?*

Progress Indicator: M.DPS.2e designing and conducting multi-stage (compound) probability experiments (independent events) and comparing the results with theoretical probabilities
7.DPS.2e1 Determine the theoretical probability of multi-stage probability experiments (2 coins, 2 dice)
Statistics and Probability
7 SP Investigate chance processes and develop, use, and evaluate probability models.
7.SP.C.8 Find probabilities of compound events using organized lists, tables, tree diagrams, and simulation.
a) Understand that, just as with simple events, the probability of a compound event is the fraction of outcomes in the sample space for which the compound event occurs.
b) Represent sample spaces for compound events using methods such as organized lists, tables and tree diagrams. For an event described in everyday language (e.g., "rolling double sixes"), identify the outcomes in the sample space which compose the event.
c) Design and use a simulation to generate frequencies for compound events. *For example, use random digits as a simulation tool to approximate the answer to the question: If 40% of donors have type A blood, what is the probability that it will take at least 4 donors to find one with type A blood?*

7.DPS.2e2 Collect data from multi-stage probability experiments (2 coins, 2 dice)
Statistics and Probability
7 SP Investigate chance processes and develop, use, and evaluate probability models.
7.SP.C.8 Find probabilities of compound events using organized lists, tables, tree diagrams, and simulation.
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7.DPS.2e3 Compare actual results of multi-stage experiment with theoretical probabilities
Statistics and Probability
7 SP Investigate chance processes and develop, use, and evaluate probability models.
7.SP.C.8 Find probabilities of compound events using organized lists, tables, tree diagrams, and simulation.
a) Understand that, just as with simple events, the probability of a compound event is the fraction of outcomes in the sample space for which the compound event occurs.
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Progress Indicator: M.DPS.2f distinguishing between association of two variables and cause and effect relationship between two variables

Progress Indicator: M.DPS.2e designing and conducting multi-stage (compound) probability experiments (independent events) and comparing the results with theoretical probabilities

8.DPS.2e4 Determine the theoretical probability of multi-stage probability experiments (2 coins, 2 dice)

Statistics and Probability

7 SP Investigate chance processes and develop, use, and evaluate probability models.

7.SP.C.8 Find probabilities of compound events using organized lists, tables, tree diagrams, and simulation.

a) Understand that, just as with simple events, the probability of a compound event is the fraction of outcomes in the sample space for which the compound event occurs.

b) Represent sample spaces for compound events using methods such as organized lists, tables and tree diagrams. For an event described in everyday language (e.g., "rolling double sixes"), identify the outcomes in the sample space which compose the event.

c) Design and use a simulation to generate frequencies for compound events. *For example, use random digits as a simulation tool to approximate the answer to the question: If 40% of donors have type A blood, what is the probability that it will take at least 4 donors to find one with type A blood?*

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Statistics and Probability

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c) Design and use a simulation to generate frequencies for compound events. *For example, use random digits as a simulation tool to approximate the answer to the question: If 40% of donors have type A blood, what is the probability that it will take at least 4 donors to find one with type A blood?*

8.DPS.2e6 Compare actual results of multi-stage experiment with theoretical probabilities
Statistics and Probability
7 SP Investigate chance processes and develop, use, and evaluate probability models.
7.SP.C.8 Find probabilities of compound events using organized lists, tables, tree diagrams, and simulation.
a) Understand that, just as with simple events, the probability of a compound event is the fraction of outcomes in the sample space for which the compound event occurs.
b) Represent sample spaces for compound events using methods such as organized lists, tables and tree diagrams. For an event described in everyday language (e.g., "rolling double sixes"), identify the outcomes in the sample space which compose the event.
c) Design and use a simulation to generate frequencies for compound events. *For example, use random digits as a simulation tool to approximate the answer to the question: If 40% of donors have type A blood, what is the probability that it will take at least 4 donors to find one with type A blood?*

Progress Indicator: M.DPS.2g using simple lines to model association between two numerical variables in a bivariate data set
8.DPS.2g1 Distinguish between a linear and non-linear association when analyzing bivariate data on a scatter plot
Statistics and Probability
8 SP Investigate patterns of association in bivariate data.
8.SP.A.2 Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line.

8.DPS.2g2 Interpret the slope and the y-intercept of a line in the context of a problem
Statistics and Probability
8 SP Investigate patterns of association in bivariate data.
8.SP.A.3 Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. *For example, in a linear model for a biology experiment, interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height.*

High School Progress Indicators

Progress Indicator: H.DSP.2b exploring (framing effects) the degree to which we rate something as "good" or "bad"/"desirable" or "undesirable" when numerical information is presented positively (75% lean) or negatively (25% fat)
H.DPS.2b1 Identify and describe the degree to which something is rated "good" or "bad," desirable or undesirable based on numerical information
Using Probability to Make Decisions
S MD Use probability to evaluate outcomes of decisions.
HSS.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).

Progress Indicator: H.DSP.2c designing and conducting multi-stage (compound) probability experiments (independent events) and comparing the results with theoretical probabilities
H.DPS.2c1 Determine the theoretical probability of multi-stage probability experiments
Using Probability to Make Decisions
S MD Calculate expected values and use them to solve problems.
HSS.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. *For example, find the theoretical probability distribution for the number of correct answers obtained by guessing on all five questions of a multiple-choice test where each question has four choices, and find the expected grade under various grading schemes.*

H.DPS.2c2 Collect data from multi-stage probability experiments
Using Probability to Make Decisions
S MD Calculate expected values and use them to solve problems.
HSS.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. *For example, find the theoretical probability distribution for the number of correct answers obtained by guessing on all five questions of a multiple-choice test where each question has four choices, and find the expected grade under various grading schemes.*

H.DPS.2c3 Compare actual results of multi-stage experiment with theoretical probabilities
Using Probability to Make Decisions
S MD Calculate expected values and use them to solve problems.
HSS.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. *For example, find the theoretical probability distribution for the number of correct answers obtained by guessing on all five questions of a multiple-choice test where each question has four choices, and find the expected grade under various grading schemes.*

Progress Indicator: H.DSP.2d constructing and interpreting two-way frequency tables when two categories are associated with each object being classified
H.DPS.2d1 Select or make an appropriate statement based on a two-way frequency table
Conditional Probability and the Rules of Probability
S CP Understand independence and conditional probability and use them to interpret data.
HSS.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. *For example, collect data from a random sample of students in your school on their favorite subject among math, science, and English. Estimate the probability that a randomly selected student from your school will favor science given that the student is in tenth grade. Do the same for other subjects and compare the results.*

Progress Indicator: H.DSP.2e researching and finding real-world examples and explaining the concept of conditional probability (e.g., compare the chances of having lung cancer if you are a smoker with the chances of being a smoker if you have lung cancer)
H.DPS.2e1 Select or make an appropriate statement based on real world examples of conditional probability
Conditional Probability and the Rules of Probability
S CP Understand independence and conditional probability and use them to interpret data.
HSS.CP.A.5 Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. *For example, compare the chance of having lung cancer if you are a smoker with the chance of being a smoker if you have lung cancer.*