Indiana Mathematics

Probability and Statistics: Grades 9, 10, 11, 12

Adopted 2020

Process Standards For Mathematics

1. **Make sense of problems and persevere in solving them.** PS.1
2. **Reason abstractly and quantitatively.** PS.2
3. **Construct viable arguments and critique the reasoning of others.** PS.3
4. **Model with mathematics.** PS.4
5. **Use appropriate tools strategically.** PS.5
6. **Attend to precision.** PS.6
7. **Look for and make use of structure.** PS.7
8. **Look for and express regularity in repeated reasoning.** PS.8

Data Analysis

1. **Create, compare, and evaluate different graphic displays of the same data, using histograms, frequency polygons, cumulative frequency distribution functions, pie charts, scatterplots, stem-and-leaf plots, and box-and-whisker plots. Draw these with and without technology.** PS.DA.1
2. **Compute and use mean, median, mode, weighted mean, geometric mean, harmonic mean, range, quartiles, variance, and standard deviation. Use tables and technology to estimate areas under the normal curve. Fit a data set to a normal distribution and estimate population percentages. Recognize that there are data sets not normally distributed for which such procedures are inappropriate.** PS.DA.2
3. **Understand the central limit theorem and use it to solve problems.** PS.DA.3
4. **Understand hypothesis tests of means and differences between means and use them to reach conclusions. Compute and use confidence intervals to make estimates. Construct and interpret margin of error and confidence intervals for population proportions.** PS.DA.4
5. **Recognize how linear transformations of univariate data affect shape, center, and spread.** PS.DA.5

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6. **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.** PS.DA.6

7. **Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation.** PS.DA.7

8. **Understand the meaning of measurement data and categorical data, of univariate and bivariate data, and of the term variable.** PS.DA.8

9. **Understand statistics and use sampling distributions as a process for making inferences about population parameters based on a random sample from that population.** PS.DA.9

10. **Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.** PS.DA.10

11. **Find linear models by using median fit and least squares regression methods to make predictions. Decide which among several linear models gives a better fit. Interpret the slope and intercept in terms of the original context. Informally assess the fit of a function by plotting and analyzing residuals.** PS.DA.11

12. **Evaluate reports based on data by considering the source of the data, the design of the study, the way the data are analyzed and displayed, and whether the report confuses correlation with causation. Distinguish between correlation and causation.** PS.DA.12

Experimental Design

1. **Formulate questions that can be addressed with data. Collect, organize, and display relevant data to answer the questions formulated.** PS.ED.1

2. **Use election theory techniques to analyze election data. Use weighted voting techniques to decide voting power within a group.** PS.ED.2

3. **Construct simulated sampling distributions of sample proportions and use sampling distributions to identify which proportions are likely to be found in a sample of a given size.** PS.ED.3

4. **Use simulations to explore the variability of sample statistics from a known population and to construct sampling distributions.** PS.ED.4

5. **Model and solve real-world problems using the geometric distribution or waiting-time distribution, with or without technology.** PS.ED.5

6. **Model and solve real-world problems involving patterns using recursion and iteration, growth and decay, and compound interest.** PS.ED.6

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7. **Understand and apply basic ideas related to the design, analysis, and interpretation of surveys and sampling, such as background information, random sampling, causality and bias.** PS.ED.7

8. **Understand how basic statistical techniques are used to monitor process characteristics in the workplace.** PS.ED.8

9. **Understand the differences among various kinds of studies and which types of inferences can legitimately be drawn from each.** PS.ED.9

Probability

1. **Understand and use the addition rule to calculate probabilities for mutually exclusive and nonmutually exclusive events.** PS.P.1

2. **Understand and use the multiplication rule to calculate probabilities for independent and dependent events. 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.** PS.P.2

3. **Understand the multiplication counting principle, permutations, and combinations; use them to solve real-world problems. Use simulations with and without technology to solve counting and probability problems.** PS.P.3

4. **Calculate the probabilities of complementary events.** PS.P.4

5. **Calculate the expected value of a random variable; interpret it as the mean of the probability distribution.** PS.P.5

6. **Analyze decisions and strategies using probability concepts. Analyze probabilities to interpret odds and risk of events.** PS.P.6

7. **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.** PS.P.7

8. **Develop a probability distribution for a random variable defined for a sample space in which theoretical probabilities can be calculated; Compute and interpret the expected value of random variables.** PS.P.8

9. **Derive the binomial theorem by combinatorics. Use combinatorial reasoning to solve problems.** PS.P.9

10. **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.** PS.P.10