Indiana Department of Education

Indiana Academic Standards for Mathematics – Probability and Statistics
Adopted April 2014 – Standards Correlation Guide Document 5-28-2014

	Indiana Academic Standard for Probability and Statistics Mathematics Adopted April 2014	Indiana Academic Mathematics Standard Adopted 2000	Common Core State Standard for Mathematics	Differences From Previous Standards
		Process Standards		
MA.PS.PS.1: Make sense of problems and persevere in solving them.	Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway, rather than simply jumping into a solution attempt. They consider analogous problems and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, “Does this make sense?” and "Is my answer reasonable?" They understand the approaches of others to solving complex problems and identify correspondences between different approaches. Mathematically proficient students understand how mathematical ideas interconnect and build on one another to produce a coherent whole.	Connections Connecting mathematical concepts includes linking new ideas to related ideas learned previously, helping students to see mathematics as a unified body of knowledge whose concepts build upon each other. Major emphasis should be given to ideas and concepts across mathematical content areas that help students see that mathematics is a web of closely connected ideas (algebra, geometry, the entire number system). Mathematics is also the common language of many other disciplines (science, technology, finance, social science, geography) and students should learn mathematical concepts used in those disciplines. Finally, students should connect their mathematical learning to appropriate real-world contexts.	1 Make sense of problems and persevere in solving them. Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, “Does this make sense?” They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.	IAS 2014 removes criteria involving a graphing calculator and does not distinguish between younger and older students.
MA.PS.PS.2: Reason abstractly and quantitatively.	Mathematically proficient students make sense of quantities and their relationships in problem situations. They bring two complementary abilities to bear on problems involving quantitative relationships: the ability to decontextualize—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents—and the ability to contextualize, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects.		2 Reason abstractly and quantitatively. Mathematically proficient students make sense of the quantities and their relationships in problem situations. Students bring two complementary abilities to bear on problems involving quantitative relationships: the ability to decontextualize—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents—and the ability to contextualize, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects.	IAS 2014 is similar to common core, both expand upon IAS 2000 by having the student decontextualize problems and develop quantitative reasoning.

Indiana Department of Education

Indiana Academic Standards for Mathematics – Probability and Statistics
Adopted April 2014 – Standards Correlation Guide Document 5-28-2014

	Indiana Academic Standard for Probability and Statistics Mathematics Adopted April 2014	Indiana Academic Mathematics Standard Adopted 2000	Common Core State Standard for Mathematics	Differences From Previous Standards
MA.PS.PS.3: Construct viable arguments and critique the reasoning of others.	Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments. They make conjectures and build a logical progression of statements to explore the truth of their conjectures. They analyze situations by breaking them into cases and recognize and use counterexamples. They organize their mathematical thinking, justify their conclusions and communicate them to others, and respond to the arguments of others. They reason inductively about data, making plausible arguments that take into account the context from which the data arose. Mathematically proficient students are also able to compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in an argument—explain what it is. They justify whether a given statement is true always, sometimes, or never. Mathematically proficient students participate and collaborate in a mathematics community. They listen to or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments.	Communication The ability to read, write, listen, ask questions, think, and communicate about math will develop and deepen students' understanding of mathematical concepts. Students should read text, data, tables, and graphs with comprehension and understanding. Their writing should be detailed and coherent, and they should use correct mathematical vocabulary. Students should write to explain answers, justify mathematical reasoning, and describe problem-solving strategies. Mathematical Reasoning and Problem Solving In a general sense, mathematics is problem solving. In all of their mathematics, students use problem-solving skills: they choose how to approach a problem, they explain their reasoning, and they check their results. At this level, students apply these skills to investigating limits and applying them to continuity, differentiability, and integration.	3 Construct viable arguments and critique the reasoning of others. Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments. They make conjectures and build a logical progression of statements to explore the truth of their conjectures. They are able to analyze situations by breaking them into cases, and can recognize and use counterexamples. They justify their conclusions, communicate them to others, and respond to the arguments of others. They reason inductively about data, making plausible arguments that take into account the context from which the data arose. Mathematically proficient students are also able to compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in an argument—explain what it is. Elementary students can construct arguments using concrete referents such as objects, drawings, diagrams, and actions. Such arguments can make sense and be correct, even though they are not generalized or made formal until later grades. Later, students learn to determine domains to which an argument applies. Students at all grades can listen or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments.	IAS 2014 is similar to common core, both expand upon IAS 2000 by having students construct arguments , use counterexamples, and critique others arguments. IAS 2014 does not distinguish between younger and older students.
MA.PS.PS.4: Model with mathematics.	Mathematically proficient students apply the mathematics they know to solve problems arising in everyday life, society, and the workplace using a variety of appropriate strategies. They create and use a variety of representations to solve problems and to organize and communicate mathematical ideas. Mathematically proficient students apply what they know and are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.	Representation The language of mathematics is expressed in words, symbols, formulas, equations, graphs, and data displays. The concept of one-fourth may be described as a quarter, , one divided by four, 0.25, + , 25 percent, or an appropriately shaded portion of a pie graph. Higher-level mathematics involves the use of more powerful representations: exponents, logarithms, π, unknowns, statistical representation, algebraic and geometric expressions. Mathematical operations are expressed as representations: +, =, divide, square. Representations are dynamic tools for solving problems and communicating and expressing mathematical ideas and concepts.	4 Model with mathematics. Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.	IAS 2014 has removed examples and does not distinguish between younger and older students.

Indiana Department of Education

Indiana Academic Standards for Mathematics – Probability and Statistics
Adopted April 2014 – Standards Correlation Guide Document 5-28-2014

	Indiana Academic Standard for Probability and Statistics Mathematics Adopted April 2014	Indiana Academic Mathematics Standard Adopted 2000	Common Core State Standard for Mathematics	Differences From Previous Standards
MA.PS.PS.5: Use appropriate tools strategically.	Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. Mathematically proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. Mathematically proficient students identify relevant external mathematical resources, such as digital content, and use them to pose or solve problems. They use technological tools to explore and deepen their understanding of concepts and to support the development of learning mathematics. They use technology to contribute to concept development, simulation, representation, reasoning, communication and problem solving.		5 Use appropriate tools strategically. Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. For example, mathematically proficient high school students analyze graphs of functions and solutions generated using a graphing calculator. They detect possible errors by strategically using estimation and other mathematical knowledge. When making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data. Mathematically proficient students at various grade levels are able to identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems. They are able to use technological tools to explore and deepen their understanding of concepts.	IAS 2014 does not distinguish between younger and older students. Both IAS 2014 and CCSS expand upon IAS 2000 by having students consider more than just graphing.
MA.PS.PS.6: Attend to precision.	Mathematically proficient students communicate precisely to others. They use clear definitions, including correct mathematical language, in discussion with others and in their own reasoning. They state the meaning of the symbols they choose, including using the equal sign consistently and appropriately. They express solutions clearly and logically by using the appropriate mathematical terms and notation. They specify units of measure and label axes to clarify the correspondence with quantities in a problem. They calculate accurately and efficiently and check the validity of their results in the context of the problem. They express numerical answers with a degree of precision appropriate for the problem context.	Communication The ability to read, write, listen, ask questions, think, and communicate about math will develop and deepen students' understanding of mathematical concepts. Students should read text, data, tables, and graphs with comprehension and understanding. Their writing should be detailed and coherent, and they should use correct mathematical vocabulary. Students should write to explain answers, justify mathematical reasoning, and describe problem-solving strategies.	6 Attend to precision. Mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose, including using the equal sign consistently and appropriately. They are careful about specifying units of measure, and labeling axes to clarify the correspondence with quantities in a problem. They calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context. In the elementary grades, students give carefully formulated explanations to each other. By the time they reach high school they have learned to examine claims and make explicit use of definitions.	IAS 2014 does not distinguish between younger and older students.

Indiana Department of Education

Indiana Academic Standards for Mathematics – Probability and Statistics
Adopted April 2014 – Standards Correlation Guide Document 5-28-2014

	Indiana Academic Standard for Probability and Statistics Mathematics Adopted April 2014	Indiana Academic Mathematics Standard Adopted 2000	Common Core State Standard for Mathematics	Differences From Previous Standards
MA.PS.PS.7: Look for and make use of structure.	Mathematically proficient students look closely to discern a pattern or structure. They step back for an overview and shift perspective. They recognize and use properties of operations and equality. They organize and classify geometric shapes based on their attributes. They see expressions, equations, and geometric figures as single objects or as being composed of several objects.		7 Look for and make use of structure. Mathematically proficient students look closely to discern a pattern or structure. Young students, for example, might notice that three and seven more is the same amount as seven and three more, or they may sort a collection of shapes according to how many sides the shapes have. Later, students will see 7 × 8 equals the well remembered 7 × 5 + 7 × 3, in preparation for learning about the distributive property. In the expression x2 + 9x + 14, older students can see the 14 as 2 × 7 and the 9 as 2 + 7. They recognize the significance of an existing line in a geometric figure and can use the strategy of drawing an auxiliary line for solving problems. They also can step back for an overview and shift perspective. They can see complicated things, such as some algebraic expressions, as single objects or as being composed of several objects. For example, they can see 5 – 3(x – y)2 as 5 minus a positive number times a square and use that to realize that its value cannot be more than 5 for any real numbers x and y.	IAS 2014 has removed examples and does not distinguish between younger and older students. Both IAS 2014 and CCSS expand upon IAS 2000 by having students discern patterns, structure, geometric figures, and composition of objects.
MA.PS.PS.8: Look for and express regularity in repeated reasoning.	Mathematically proficient students notice if calculations are repeated and look for general methods and shortcuts. They notice regularity in mathematical problems and their work to create a rule or formula. Mathematically proficient students maintain oversight of the process, while attending to the details as they solve a problem. They continually evaluate the reasonableness of their intermediate results.		8 Look for and express regularity in repeated reasoning. Mathematically proficient students notice if calculations are repeated, and look both for general methods and for shortcuts. Upper elementary students might notice when dividing 25 by 11 that they are repeating the same calculations over and over again, and conclude they have a repeating decimal. By paying attention to the calculation of slope as they repeatedly check whether points are on the line through (1, 2) with slope 3, middle school students might abstract the equation (y – 2)/(x – 1) = 3. Noticing the regularity in the way terms cancel when expanding (x – 1)(x + 1), (x – 1)(x2 + x + 1), and (x – 1)(x3 + x2 + x + 1) might lead them to the general formula for the sum of a geometric series. As they work to solve a problem, mathematically proficient students maintain oversight of the process, while attending to the details. They continually evaluate the reasonableness of their intermediate results.	IAS 2014 has removed examples and does not distinguish between younger and older students.
Data Analysis				
MA.PS.DA.1:	PS.DA.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.1.1 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 by hand or use a computer spreadsheet program.	S-ID.1 Represent data with plots on the real number line (dot plots, histograms, and box plots).	IAS2014 Has Students integrate technology into the data analysis and graphing.

Indiana Department of Education

Indiana Academic Standards for Mathematics – Probability and Statistics
Adopted April 2014 – Standards Correlation Guide Document 5-28-2014

	Indiana Academic Standard for Probability and Statistics Mathematics Adopted April 2014	Indiana Academic Mathematics Standard Adopted 2000	Common Core State Standard for Mathematics	Differences From Previous Standards
MA.PS.DA.2:	PS.DA.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.1.2 Compute and use mean, median, mode, weighted mean, geometric mean, harmonic mean, range, quartiles, variance, and standard deviation. PS.2.8 Use and apply the normal distribution.	S-ID.4 Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.	
MA.PS.DA.3:	PS.DA.3: Understand the central limit theorem and use it to solve problems.	PS.2.9 Understand the central limit theorem and use it to solve problems.		
MA.PS.DA.4:	PS.DA.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.3.2 Understand hypothesis tests of means and differences between means and use them to reach conclusions.	S-IC.4 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.	IAS2014 Combines the IAS2000 and the CCSS
MA.PS.DA.5:	PS.DA.5: Recognize how linear transformations of univariate data affect shape, center, and spread.			This standard is NEW
MA.PS.DA.6:	PS.DA.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.		S-CP.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.	CCSS Gives specific examples of the types of problems to apply this standard
MA.PS.DA.7:	PS.DA.7: Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation.		S-IC.2 Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?	CCSS Gives and specific example.
MA.PS.DA.8:	PS.DA.8: Understand the meaning of measurement data and categorical data, of univariate and bivariate data, and of the term variable.			This standard is NEW
MA.PS.DA.9:	PS.DA.9: Understand statistics and use sampling distributions as a process for making inferences about population parameters based on a random sample from that population.		S-IC.1 Understand statistics as a process for making inferences to be made about population parameters based on a random sample from that population.	
MA.PS.DA.10	PS.DA.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.			This standard is NEW
MA.PS.DA.11	PS.DA.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.3.3 Use the principle of least squares to find the curve of best fit for a set of data.		IAS2014 Goes much further having students make predictions, use context, and residuals

Indiana Department of Education

Indiana Academic Standards for Mathematics – Probability and Statistics
Adopted April 2014 – Standards Correlation Guide Document 5-28-2014

	Indiana Academic Standard for Probability and Statistics Mathematics Adopted April 2014	Indiana Academic Mathematics Standard Adopted 2000	Common Core State Standard for Mathematics	Differences From Previous Standards
MA.PS.DA.12	PS.DA.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.		S-IC.6 Evaluate reports based on data.	IAS2014 goes into much more details on how the students should evaluate the reports based on the data
		Experimental Design		
MA.PS.ED.1:	PS.ED.1: Formulate questions that can be addressed with data. Collect, organize, and display relevant data to answer the questions formulated.			This standard is NEW
MA.PS.ED.2:	PS.ED.2: Use election theory techniques to analyze election data. Use weighted voting techniques to decide voting power within a group.	DM.5.1 Use election theory techniques to analyze election data. DM.5.2 Use weighted voting techniques to decide voting power within a group.		IAS2014 Combines the two IAs200 standards
MA.PS.ED.3:	PS.ED.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.		S-MD.4 Develop a probability distribution for a random variable defined for a sample space in which probabilities are assigned empirically; find the expected value. For example, find a current data distribution on the number of TV sets per household in the United States, and calculate the expected number of sets per household. How many TV sets would you expect to find in 100 randomly selected households?	CCSS Gives an example of what this standards is expecting students to show
MA.PS.ED.4:	PS.ED.4: Use simulations to explore the variability of sample statistics from a known population and to construct sampling distributions.			This standard is NEW
MA.PS.ED.5:	PS.ED.5: Model and solve real-world problems using the geometric distribution or waiting-time distribution, with or without technology.			This standard is NEW
MA.PS.ED.6:	PS.ED.6: Model and solve real-world problems involving patterns using recursion and iteration, growth and decay, and compound interest.			This standard is NEW
MA.PS.ED.7:	PS.ED.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.			This standard is NEW
MA.PS.ED.8:	PS.ED.8: Understand how basic statistical techniques are used to monitor process characteristics in the workplace.			This standard is NEW
MA.PS.ED.9:	PS.ED.9: Understand the differences among various kinds of studies and which types of inferences can legitimately be drawn from each.			This standard is NEW
		Probability		
MA.PS.P.1:	PS.P.1: Understand and use the addition rule to calculate probabilities for mutually exclusive and non-mutually exclusive events.	PS.2.2 Understand and use the addition rule to calculate probabilities for mutually exclusive and non-mutually exclusive events.		

Indiana Department of Education

Indiana Academic Standards for Mathematics – Probability and Statistics
Adopted April 2014 – Standards Correlation Guide Document 5-28-2014

	Indiana Academic Standard for Probability and Statistics Mathematics Adopted April 2014	Indiana Academic Mathematics Standard Adopted 2000	Common Core State Standard for Mathematics	Differences From Previous Standards
MA.PS.P.2:	PS.P.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.			This standard is NEW
MA.PS.P.3:	PS.P.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.2.1 Understand the counting principle, permutations, and combinations and use them to solve problems. DM.1.2 Use the fundamental counting principle to find the number of outcomes in a problem situation.	S-CP.9 Use permutations and combinations to compute probabilities of compound events and solve problems.	IAS2014 Expects students to use simulations and technology to solve the problems
MA.PS.P.4:	PS.P.4: Calculate the probabilities of complementary events.			This standard is NEW
MA.PS.P.5:	PS.P.5: Calculate the expected value of a random variable; interpret it as the mean of the probability distribution.	PS.2.7 Compute and interpret the mean and variance of a probability distribution.	S-MD.2 Calculate the expected value of a random variable; interpret it as the mean of the probability distribution.	
MA.PS.P.6:	PS.P.6: Analyze decisions and strategies using probability concepts. Analyze probabilities to interpret odds and risk of events.		S-MD.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.PS.P.7:	PS.P.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.2.6 Use discrete random variables and probability distributions, including the binomial and geometric distributions.	S-MD.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.	
MA.PS.P.8:	PS.P.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.2.6 Use discrete random variables and probability distributions, including the binomial and geometric distributions.	S-MD.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.	IAS2014 Expects students to compute and interpret the values
MA.PS.P.9:	PS.P.9: Derive the binomial theorem by combinatorics. Use combinatorial reasoning to solve problems.	DM.1.3 Use combinatorial reasoning to solve problems.		IAS2014 Has the students derive the binomial theorem
MA.PS.P.10:	PS.P.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.		S-CP.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").	

	Unaligned Indiana Academic Mathematics Standard Adopted 2000	Unaligned Common Core State Standard for Mathematics	
	PS.2.5 Understand conditional probability and Bayes' Theorem and use them to solve problems.		
	PS.3.1 Compute and use confidence intervals to make estimates.		

Indiana Department of Education

Indiana Academic Standards for Mathematics – Probability and Statistics
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	Indiana Academic Standard for Probability and Statistics Mathematics Adopted April 2014	Indiana Academic Mathematics Standard Adopted 2000	Common Core State Standard for Mathematics	Differences From Previous Standards