Michigan Mathematics

High School — Statistics and Probability

Adopted 2010

Standards for Mathematical Practice

1. **Make sense of problems and persevere in solving them.** CCSS.MATH.PRACTICE.MP1
2. **Reason abstractly and quantitatively.** CCSS.MATH.PRACTICE.MP2
3. **Construct viable arguments and critique the reasoning of others.** CCSS.MATH.PRACTICE.MP3
4. **Model with mathematics.** CCSS.MATH.PRACTICE.MP4
5. **Use appropriate tools strategically.** CCSS.MATH.PRACTICE.MP5
6. **Attend to precision.** CCSS.MATH.PRACTICE.MP6
7. **Look for and make use of structure.** CCSS.MATH.PRACTICE.MP7
8. **Look for and express regularity in repeated reasoning.** CCSS.MATH.PRACTICE.MP8

Interpreting Categorical and Quantitative Data

A. **Summarize, represent, and interpret data on a single count or measurement variable** CCSS.MATH.CONTENT.HSS-ID.A

1. Represent data with plots on the real number line (dot plots, histograms, and box plots). CCSS.MATH.CONTENT.HSS-ID.A.1
2. Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets. CCSS.MATH.CONTENT.HSS-ID.A.2
3. Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers). CCSS.MATH.CONTENT.HSS-ID.A.3
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. CCSS.MATH.CONTENT.HSS-ID.A.4

B. **Summarize, represent, and interpret data on two categorical and quantitative variables** CCSS.MATH.CONTENT.HSS-ID.B

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5. Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data. CCSS.MATH.CONTENT.HSS-ID.B.5
6. Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. CCSS.MATH.CONTENT.HSS-ID.B.6
   a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data. CCSS.MATH.CONTENT.HSS-ID.B.6A
   b. Informally assess the fit of a function by plotting and analyzing residuals. CCSS.MATH.CONTENT.HSS-ID.B.6B
   c. Fit a linear function for a scatter plot that suggests a linear association. CCSS.MATH.CONTENT.HSS-ID.B.6C

C. Interpret linear models CCSS.MATH.CONTENT.HSS-ID.C

7. Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data. CCSS.MATH.CONTENT.HSS-ID.C.7
8. Compute (using technology) and interpret the correlation coefficient of a linear fit. CCSS.MATH.CONTENT.HSS-ID.C.8
9. Distinguish between correlation and causation. CCSS.MATH.CONTENT.HSS-ID.C.9

Making Inferences and Justifying Conclusions

A. Understand and evaluate random processes underlying statistical experiments CCSS.MATH.CONTENT.HSS-IC.A

1. Understand statistics as a process for making inferences about population parameters based on a random sample from that population. CCSS.MATH.CONTENT.HSS-IC.A.1
2. Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. CCSS.MATH.CONTENT.HSS-IC.A.2

B. Make inferences and justify conclusions from sample surveys, experiments, and observational studies CCSS.MATH.CONTENT.HSS-IC.B

3. Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each. CCSS.MATH.CONTENT.HSS-IC.B.3
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. CCSS.MATH.CONTENT.HSS-IC.B.4
5. Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant. CCSS.MATH.CONTENT.HSS-IC.B.5
6. Evaluate reports based on data. CCSS.MATH.CONTENT.HSS-IC.B.6

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Understand independence and conditional probability and use them to interpret data CCSS.MATH.CONTENT.HSS-CP.A

Probability

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"). CCSS.MATH.CONTENT.HSS-CP.A.1
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. CCSS.MATH.CONTENT.HSS-CP.A.2
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. CCSS.MATH.CONTENT.HSS-CP.A.3
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. CCSS.MATH.CONTENT.HSS-CP.A.4
5. Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. CCSS.MATH.CONTENT.HSS-CP.A.5

B. Use the rules of probability to compute probabilities of compound events in a uniform probability model CCSS.MATH.CONTENT.HSS-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. CCSS.MATH.CONTENT.HSS-CP.B.6
7. Apply the Addition Rule, P(A or B) = P(A) + P(B) - P(A and B), and interpret the answer in terms of the model. CCSS.MATH.CONTENT.HSS-CP.B.7
8. (+) Apply the general Multiplication Rule in a uniform probability model, P(A and B) = P(A)P(B|A) = P(B)P(A|B), and interpret the answer in terms of the model. CCSS.MATH.CONTENT.HSS-CP.B.8
9. (+) Use permutations and combinations to compute probabilities of compound events and solve problems. CCSS.MATH.CONTENT.HSS-CP.B.9

Using Probability to Make Decisions

A. Calculate expected values and use them to solve problems CCSS.MATH.CONTENT.HSS-MD.A

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. CCSS.MATH.CONTENT.HSS-MD.A.1
2. (+) Calculate the expected value of a random variable; interpret it as the mean of the probability distribution. CCSS.MATH.CONTENT.HSS-MD.A.2
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. CCSS.MATH.CONTENT.HSS-MD.A.3

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4. (+) Develop a probability distribution for a random variable defined for a sample space in which probabilities are assigned empirically; find the expected value. CCSS.MATH.CONTENT.HSS-MD.A.4

B. Use probability to evaluate outcomes of decisions CCSS.MATH.CONTENT.HSS-MD.B

5. (+) Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values. CCSS.MATH.CONTENT.HSS-MD.B.5
   a. Find the expected payoff for a game of chance. CCSS.MATH.CONTENT.HSS-MD.B.5A
   b. Evaluate and compare strategies on the basis of expected values. CCSS.MATH.CONTENT.HSS-MD.B.5B
6. (+) Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator). CCSS.MATH.CONTENT.HSS-MD.B.6
7. (+) Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game). CCSS.MATH.CONTENT.HSS-MD.B.7