Statistics (IMRA)

Subject: Mathematics
Grade: 10
Expectations: 44
Breakouts: 110

(a) Introduction.

1. The desire to achieve educational excellence is the driving force behind the Texas essential knowledge and skills for mathematics, guided by the college and career readiness standards. By embedding statistics, probability, and finance, while focusing on fluency and solid understanding, Texas will lead the way in mathematics education and prepare all Texas students for the challenges they will face in the 21st century.

2. The process standards describe ways in which students are expected to engage in the content. The placement of the process standards at the beginning of the knowledge and skills listed for each grade and course is intentional. The process standards weave the other knowledge and skills together so that students may be successful problem solvers and use mathematics efficiently and effectively in daily life. The process standards are integrated at every grade level and course. When possible, students will apply mathematics to problems arising in everyday life, society, and the workplace. Students will use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution. Students will select appropriate tools such as real objects, manipulatives, paper and pencil, and technology and techniques such as mental math, estimation, and number sense to solve problems. Students will effectively communicate mathematical ideas, reasoning, and their implications using multiple representations such as symbols, diagrams, graphs, and language. Students will use mathematical relationships to generate solutions and make connections and predictions. Students will analyze mathematical relationships to connect and communicate mathematical ideas. Students will display, explain, or justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

3. In Statistics, students will build on the knowledge and skills for mathematics in Kindergarten-Grade 8 and Algebra I. Students will broaden their knowledge of variability and statistical processes. Students will study sampling and experimentation, categorical and quantitative data, probability and random variables, inference, and bivariate data. Students will connect data and statistical processes to real-world situations. In addition, students will extend their knowledge of data analysis.

4. Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(b) Knowledge and Skills Statements

(1) Mathematical process standards. The student uses mathematical processes to acquire and demonstrate mathematical understanding. The student is expected to:

(A) apply mathematics to problems arising in everyday life, society, and the workplace;

(i) apply mathematics to problems arising in everyday life

(ii) apply mathematics to problems arising in society

(iii) apply mathematics to problems arising in the workplace

(B) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution;

(i) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process

(ii) use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the reasonableness of the solution

(C) select tools, including real objects, manipulatives, paper and pencil, and technology as appropriate, and techniques, including mental math, estimation, and number sense as appropriate, to solve problems;

(i) select tools, including real objects as appropriate, to solve problems

(ii) select tools, including manipulatives as appropriate, to solve problems

(iii) select tools, including paper and pencil as appropriate, to solve problems

(iv) select tools, including technology as appropriate, to solve problems

(v) select techniques, including mental math as appropriate, to solve problems

(vi) select techniques including estimation as appropriate, to solve problems

(vii) select techniques, including number sense as appropriate, to solve problems

(D) communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate;

(i) communicate mathematical ideas using multiple representations, including symbols as appropriate

(ii) communicate mathematical ideas using multiple representations, including diagrams as appropriate

(iii) communicate mathematical ideas using multiple representations, including graphs as appropriate

(iv) communicate mathematical ideas using multiple representations, including language as appropriate

(v) communicate mathematical reasoning using multiple representations, including symbols as appropriate

(vi) communicate mathematical reasoning using multiple representations, including diagrams as appropriate

(vii) communicate mathematical reasoning using multiple representations, including graphs as appropriate

(viii) communicate mathematical reasoning using multiple representations, including language as appropriate

(ix) communicate [mathematical ideas'] implications using multiple representations, including symbols as appropriate

(x) communicate [mathematical ideas'] implications using multiple representations, including diagrams as appropriate

(xi) communicate [mathematical ideas'] implications using multiple representations, including graphs as appropriate

(xii) communicate [mathematical ideas'] implications using multiple representations, including language as appropriate

(xiii) communicate [mathematical reasoning's] implications using multiple representations, including symbols as appropriate

(xiv) communicate [mathematical reasoning's] implications using multiple representations, including diagrams as appropriate

(xv) communicate [mathematical reasoning's] implications using multiple representations, including graphs as appropriate

(xvi) communicate [mathematical reasoning's] implications using multiple representations, including language as appropriate

(E) create and use representations to organize, record, and communicate mathematical ideas;

(i) create representations to organize mathematical ideas

(ii) create representations to record mathematical ideas

(iii) create representations to communicate mathematical ideas

(iv) use representations to organize mathematical ideas

(v) use representations to record mathematical ideas

(vi) use representations to communicate mathematical ideas

(F) analyze mathematical relationships to connect and communicate mathematical ideas; and

(i) analyze mathematical relationships to connect mathematical ideas

(ii) analyze mathematical relationships to communicate mathematical ideas

(G) display, explain, or justify mathematical ideas and arguments using precise mathematical language in written or oral communication.

(i) display mathematical ideas using precise mathematical language in written or oral communication

(ii) display mathematical arguments using precise mathematical language in written or oral communication

(iii) explain mathematical ideas using precise mathematical language in written or oral communication

(iv) explain mathematical arguments using precise mathematical language in written or oral communication

(v) justify mathematical ideas using precise mathematical language in written or oral communication

(vi) justify mathematical arguments using precise mathematical language in written or oral communication

(2) Statistical process sampling and experimentation. The student applies mathematical processes to apply understandings about statistical studies, surveys, and experiments to design and conduct a study and use graphical, numerical, and analytical techniques to communicate the results of the study. The student is expected to:

(A) compare and contrast the benefits of different sampling techniques, including random sampling and convenience sampling methods;

(i) compare and contrast the benefits of different sampling techniques including random sampling method

(ii) compare and contrast the benefits of different sampling techniques including convenience sampling method

(B) distinguish among observational studies, surveys, and experiments;

(i) distinguish among observational studies, surveys and experiments

(C) analyze generalizations made from observational studies, surveys, and experiments;

(i) analyze generalizations made from observational studies

(ii) analyze generalizations made from surveys

(iii) analyze generalizations made from experiments

(D) distinguish between sample statistics and population parameters;

(i) distinguish between sample statistics and population parameters

(E) formulate a meaningful question, determine the data needed to answer the question, gather the appropriate data, analyze the data, and draw reasonable conclusions;

(i) formulate a meaningful question

(ii) determine the data needed to answer the question

(iii) gather the appropriate data

(iv) analyze the data

(v) draw reasonable conclusions

(F) communicate methods used, analyses conducted, and conclusions drawn for a data-analysis project through the use of one or more of the following: a written report, a visual display, an oral report, or a multi-media presentation; and

(i) communicate methods used for a data-analysis project through the use of one or more of the following: a written report, a visual display, an oral report, or a multi-media presentation

(ii) communicate analyses conducted for a data-analysis project through the use of one or more of the following: a written report, a visual display, an oral report, or a multi-media presentation

(iii) communicate conclusions drawn for a data-analysis project through the use of one or more of the following: a written report, a visual display, an oral report, or a multi-media presentation

(G) critically analyze published findings for appropriateness of study design implemented, sampling methods used, or the statistics applied.

(i) critically analyze published findings for appropriateness of study design implemented, sampling methods used, or the statistics applied

(3) Variability. The student applies the mathematical process standards when describing and modeling variability. The student is expected to:

(A) distinguish between mathematical models and statistical models;

(i) distinguish between mathematical models and statistical models

(B) construct a statistical model to describe variability around the structure of a mathematical model for a given situation;

(i) construct a statistical model to describe variability around the structure of a mathematical model for a given situation

(C) distinguish among different sources of variability, including measurement, natural, induced, and sampling variability; and

(i) distinguish among different sources of variability including measurement variability

(ii) distinguish among different sources of variability including natural variability

(iii) distinguish among different sources of variability including induced variability

(iv) distinguish among different sources of variability including sampling variability

(D) describe and model variability using population and sampling distributions.

(i) describe variability using population distributions

(ii) describe variability using sampling distributions

(iii) model variability using population distributions

(iv) model variability using sampling distributions

(4) Categorical and quantitative data. The student applies the mathematical process standards to represent and analyze both categorical and quantitative data. The student is expected to:

(A) distinguish between categorical and quantitative data;

(i) distinguish between categorical and quantitative data

(B) represent and summarize data and justify the representation;

(i) represent data

(ii) summarize data

(iii) justify the representation

(C) analyze the distribution characteristics of quantitative data, including determining the possible existence and impact of outliers;

(i) analyze the distribution characteristics of quantitative data including determining the possible existence of outliers

(ii) analyze the distribution characteristics of quantitative data including determining the possible impact of outliers

(D) compare and contrast different graphical or visual representations given the same data set;

(i) compare and contrast different graphical or visual representations given the same data set

(E) compare and contrast meaningful information derived from summary statistics given a data set; and

(i) compare and contrast meaningful information derived from summary statistics given a data set

(F) analyze categorical data, including determining marginal and conditional distributions, using two-way tables.

(i) analyze categorical data, including determining marginal distributions, using two-way tables

(ii) analyze categorical data, including determining conditional distributions, using two-way tables

(5) Probability and random variables. The student applies the mathematical process standards to connect probability and statistics. The student is expected to:

(A) determine probabilities, including the use of a two-way table;

(i) determine probabilities including the use of a two-way table

(B) describe the relationship between theoretical and empirical probabilities using the Law of Large Numbers;

(i) describe the relationship between theoretical and empirical probabilities using the Law of Large Numbers

(C) construct a distribution based on a technology-generated simulation or collected samples for a discrete random variable; and

(i) construct a distribution based on a technology generated simulation or collected samples for a discrete random variable

(D) compare statistical measures such as sample mean and standard deviation from a technology-simulated sampling distribution to the theoretical sampling distribution.

(i) compare statistical measures from a technology simulated sampling distribution to the theoretical sampling distribution

(6) Inference. The student applies the mathematical process standards to make inferences and justify conclusions from statistical studies. The student is expected to:

(A) explain how a sample statistic and a confidence level are used in the construction of a confidence interval;

(i) explain how a sample statistic [is] used in the construction of a confidence interval

(ii) explain how a a confidence level [is] used in the construction of a confidence interval

(B) explain how changes in the sample size, confidence level, and standard deviation affect the margin of error of a confidence interval;

(i) explain how changes in the sample size affect the margin of error of a confidence interval

(ii) explain how changes in the confidence level affect the margin of error of a confidence interval

(iii) explain how changes in the standard deviation affect the margin of error of a confidence interval

(C) calculate a confidence interval for the mean of a normally distributed population with a known standard deviation;

(i) calculate a confidence interval for the mean of a normally distributed population with a known standard deviation

(D) calculate a confidence interval for a population proportion;

(i) calculate a confidence interval for a population proportion

(E) interpret confidence intervals for a population parameter, including confidence intervals from media or statistical reports;

(i) interpret confidence intervals for a population parameter, including confidence intervals from media or statistical reports

(F) explain how a sample statistic provides evidence against a claim about a population parameter when using a hypothesis test;

(i) explain how a sample statistic provides evidence against a claim about a population parameter when using a hypothesis test

(G) construct null and alternative hypothesis statements about a population parameter;

(i) construct null hypothesis statements about a population parameter

(ii) construct alternative hypothesis statements about a population parameter

(H) explain the meaning of the p-value in relation to the significance level in providing evidence to reject or fail to reject the null hypothesis in the context of the situation;

(i) explain the meaning of the p-value in relation to the significance level in providing evidence to reject or fail to reject the null hypothesis in the context of the situation

(I) interpret the results of a hypothesis test using technology-generated results such as large sample tests for proportion, mean, difference between two proportions, and difference between two independent means; and

(i) interpret the results of a hypothesis test using technology generated results

(J) describe the potential impact of Type I and Type II Errors.

(i) describe the potential impact of Type I Errors

(ii) describe the potential impact of Type II Errors

(7) Bivariate data. The student applies the mathematical process standards to analyze relationships among bivariate quantitative data. The student is expected to:

(A) analyze scatterplots for patterns, linearity, outliers, and influential points;

(i) analyze scatterplots for patterns

(ii) analyze scatterplots for linearity

(iii) analyze scatterplots for outliers

(iv) analyze scatterplots for influential points

(B) transform a linear parent function to determine a line of best fit;

(i) transform a linear parent function to determine a line of best fit

(C) compare different linear models for the same set of data to determine best fit, including discussions about error;

(i) compare different linear models for the same set of data to determine best fit, including discussions about error

(D) compare different methods for determining best fit, including median-median and absolute value;

(i) compare different methods for determining best fit, including median-median

(ii) compare different methods for determining best fit, including absolute value

(E) describe the relationship between influential points and lines of best fit using dynamic graphing technology; and

(i) describe the relationship between influential points and lines of best fit using dynamic graphing technology

(F) identify and interpret the reasonableness of attributes of lines of best fit within the context, including slope and y - intercept.

(i) identify the reasonableness of attributes of lines of best fit within the context, including slope

(ii) identify the reasonableness of attributes of lines of best fit within the context, including y-intercept

(iii) interpret the reasonableness of attributes of lines of best fit within the context, including slope

(iv) interpret the reasonableness of attributes of lines of best fit within the context, including y-intercept