Unit 2: Statistical Process Control

Content Area: **Applied Technology**
Course(s):
Time Period: **Marking Period 1**
Length: **2-3 weeks**
Status: **Published**

Summary

Introduction:

Students will explore processes and develop strategies to improve them. Students will explore common cause and special cause variation. Using principles of statistical process control, students will find the standard deviation of a measurable attribute of a manufactured item. Students will determine the most significant factors affecting the assembly using Pareto analysis. Students will modify the procedures to make the assembly weight more consistent, reducing the standard deviation.

Revision Date: July 2025

Essential Questions/Enduring Understandings

Essential Questions:

How does a clear understanding of a process and its boundaries enable effective quality control and improvement?

Why is defining and documenting a process a critical first step before any statistical analysis can be performed?

How do engineers differentiate between common cause and special cause variation, and why is this distinction fundamental to statistical process control?

How do statistical measures like standard deviation and range provide engineers with the data needed to understand and control process variation?

What role do control charts play in visually representing and quantifying process variation to determine if a process is stable and predictable?

Essential Understandings:

Variation is inherent in all processes,

Variation can be a common cause or special cause.

Special cause variation can be altered.

Process control systems are implemented to regulate systems that include manufacturing processes, and corporate goals.

Learning Plan

Preview the essential questions and connect to learning throughout the unit.

Formative assessments will be conducted throughout the process using class discussion, student writing, and practice quizzes.

Formative assessments will be conducted to determine knowledge of SPC.

Lectures and lessons will be provided to develop an understanding of SPC.

The teacher may implement a situational learning strategy: students will use a teacher-defined procedure for counting parts, variation will be identified, variation will be attributed to different causes, Pareto analysis will be performed, the process will be modified. Students will develop SPC charts for the project.

Project-based learning activity: Students will form teams and make an assembly that must have a consistent weight, i.e., gluing sticks together, making sandwich cookies with frosting. Students will use balances to measure the weight and tabulate the standard deviation of the process. Students will determine if the process is in control and perform Pareto analysis to identify the factors that have the most effect on the process and alter the process accordingly with a goal of reducing variation. St

Formative assessments will be conducted throughout the design process.

Summative assessments will be conducted throughout to evaluate skills acquisition.

Design logs will be maintained to document the application of the design loop.

Summative assessment will be conducted by the student and teacher using a rubric specific to the design problem.

Complete unit test and/or quiz.

Complete writing prompt.

Assessment

Formative Assessment:

Exit Tickets

Participation in discussions on processes, process variation, statistical control etc.

Proper use of unit vocabulary

Summative assessment:

apply statistical process control to a system.

complete an analysis of a system and develop and implement a strategy using Summative assessment: Pareto analysis to improve the system to get a better outcome; e.g., a homework regimen, a wrestler's weight regimen.

complete the writing prompt: The goal was to have better scores, overall, on the final exam. We looked at the data and.…

create a flow chart for a process control system.

Writing prompts: Explain how using SPC (Statistical Process Control) and Pareto analysis relates to engineering by using resources more efficiently. Write an outline of a plan for a manufacturer to improve the quality of widgets. Write an outline of a plan for a school to improve scores in math.

answer the essential questions.

unit test

Alternate Assessment:

Research/ Presentation Statistical Process Control

Benchmark assessment:

Final exam.

Materials

Consumable materials: glue, Popsicle sticks, cookies and frosting.

Balance scales

Calipers

Online resources including a case study of SPC being applied to a medical facility.

Google Docs.

Digital Camera as necessary to document processes.

Students will use WEB 2.0 applications like Google Sheets to collaborate on projects.

Robotics computer lab equipped with Microsoft Office - EXCEL

Email and e-board

Web sites

CAD and other software programs

SmartBoard use for teacher presentation and interactive lessons

Standards

ELA.L	Language
ELA.L.SS.9–10.1	Demonstrate command of the system and structure of the English language when writing or speaking.
LA.RST.9-10	Reading Science and Technical Subjects
	Key Ideas and Details
LA.RST.9-10.1	Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions.
LA.RST.9-10.2	Determine the central ideas, themes, or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
TECH.K-12.1.4	Innovative Designer
LA.RST.9-10.3	Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
	Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions.
TECH.K-12.1.4.a	know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.
TECH.K-12.1.4.b	select and use digital tools to plan and manage a design process that considers design constraints and calculated risks.
MATH.9-12.S.IC.B	Make inferences and justify conclusions from sample surveys, experiments, and observational studies
TECH.K-12.1.4.c	develop, test and refine prototypes as part of a cyclical design process.
MATH.9-12.S.IC.B.3	Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.
TECH.K-12.1.4.d	exhibit a tolerance for ambiguity, perseverance and the capacity to work with open-ended problems.
MATH.9-12.S.IC.B.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.
TECH.K-12.1.5	Computational Thinker
MATH.9-12.S.IC.B.5	Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.

	Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.
MATH.9-12.S.IC.B.6	Evaluate reports based on data (e.g., interrogate study design, data sources, randomization, the way the data are analyzed and displayed, inferences drawn and methods used; identify and explain misleading uses of data; recognize when arguments based on data are flawed).
TECH.K-12.1.5.a	formulate problem definitions suited for technology-assisted methods such as data analysis, abstract models and algorithmic thinking in exploring and finding solutions.
MATH.9-12.S.CP	Conditional Probability and the Rules of Probability
TECH.K-12.1.5.b	collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making.
TECH.K-12.1.5.c	break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.
	Range of Reading and Level of Text Complexity
TECH.K-12.1.5.d	understand how automation works and use algorithmic thinking to develop a sequence of steps to create and test automated solutions.
MATH.9-12.S.CP.B	Use the rules of probability to compute probabilities of compound events in a uniform probability model
MATH.9-12.S.MD	Using Probability to Make Decisions
MATH.9-12.S.MD.B	Use probability to evaluate outcomes of decisions
SCI.HS-ETS1	Engineering Design
SCI.HS-ETS1-4	Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.
SCI.HS.ETS1.B	Developing Possible Solutions
	Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs.
CS.9-12.8.2.12.ED.2	Create scaled engineering drawings for a new product or system and make modification to increase optimization based on feedback.
CS.9-12.ED	Engineering Design
WRK.9.2.12.CAP	Career Awareness and Planning
WRK.9.2.12.CAP.12	Explain how compulsory government programs (e.g., Social Security, Medicare) provide insurance against some loss of income and benefits to eligible recipients.
WRK.9.2.12.CAP.13	Analyze how the economic, social, and political conditions of a time period can affect the labor market.
TECH.9.4.12.CI	Creativity and Innovation
TECH.9.4.12.CI.2	Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8).
TECH.9.4.12.CI.3	Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).
TECH.9.4.12.CT	Critical Thinking and Problem-solving
TECH.9.4.12.DC	Digital Citizenship
	Innovative ideas or innovation can lead to career opportunities.

An individual’s income and benefit needs and financial plan can change over time.

Engineering design is a complex process in which creativity, content knowledge, research, and analysis are used to address local and global problems. Decisions on trade-offs involve systematic comparisons of all costs and benefits, and final steps that may involve redesigning for optimization.

Career planning requires purposeful planning based on research, self-knowledge, and informed choices.

Engineering design evaluation, a process for determining how well a solution meets requirements, involves systematic comparisons between requirements, specifications, and constraints.

Integrated Acccommodation and Modifications...

Integrated Accommodation and Modifications, Special Education students, English Language Learners, At-Risk students, Gifted and Talented students, Career Education and those with 504s