Is there a difference between quality for a manufactured product and quality for a service? Give some specific examples discussed during class

Quality for a manufactured product focuses on Performance, Reliability, Durability, and Serviceability

Quality for a service focuses on Responsiveness, Professionalism, Attentiveness.

What is meant by quality planning, quality assurance, and quality control and improvement?

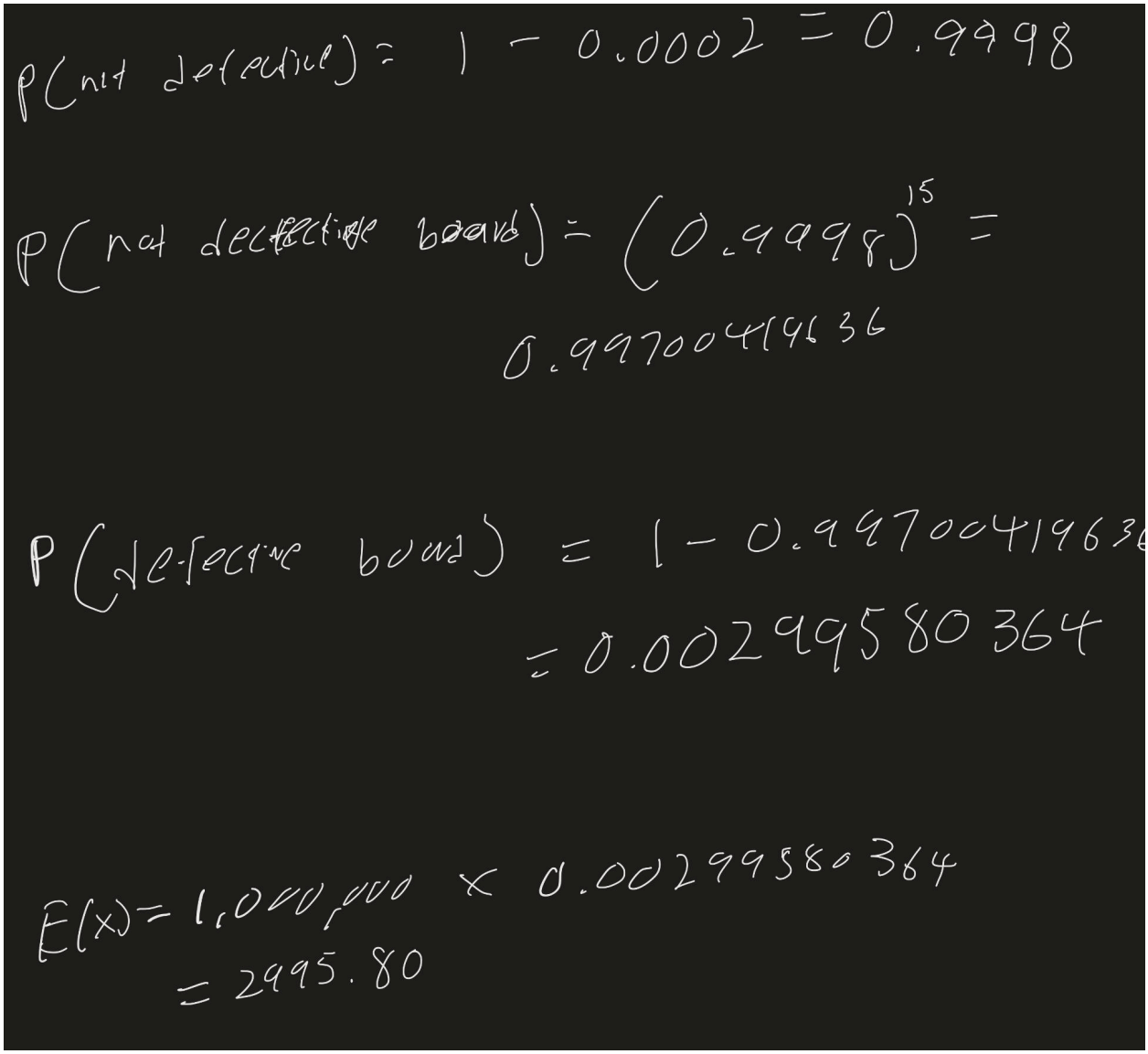
Quality planning involves identifying customers and their needs.

Quality assurance ensures the quality levels of products and services are properly maintained.

Quality control and improvement ensures that the products and services meet requirements and are improved on a continuous basis.

Suppose a circuit board consists of 15 components. Assume the components are independent, and that all components must be non-defective in order for the circuit board to operate as intended.

(a) Assume that 0.02% of components are defective. What is the probability that the circuit board is defective? If one million circuit boards are produced, what is the expected number of defective boards



(b) Suppose variability is reduced so that the rate of defective components decreases to 0.01%. What is the probability that the circuit board is defective?

p(component is defective) = 0.0001
p(not defective) = 1 - 0.0001 = 0.9999
p(board is not defective) = (0.9999)^15 = 0.99850104954
p(board is defective) = 1 - 0.99850104954 = 0.00149895046
Ppm = 1,000,000 * 0.00149895046 = 1498.95046

(c) Suppose the circuit boards from part (b) are shipped in packages of 3. What is the probability that an entire package consists of working circuit boards? Assume independence of circuit boards.
(0.99850104954)^3 = 0.99550988581

What are the main differences between Six Sigma and Design for Six Sigma?

Six Sigma focuses on reducing variability product quality characteristics to the level at which defects are extremely unlikely. While Design for Six Sigma is a process that focuses on variability reduction and process improvement.

Problem 5.

(a) Assume the mean value of a certain CTQ characteristic is equal to the target, and that the process is currently running at ± 2.5-Sigma, i.e., the lower and upper specification limits are $\text{LSL} = \text{Target} - 2.5\sigma$ and $\text{USL} = \text{Target} + 2.5\sigma$, respectively. After some quality improvement measures are implemented, variability is reduced so that the process runs at ± 4-Sigma, i.e., the lower and upper specification limits are at $\text{LSL} = \text{Target} - 4\sigma'$ and $\text{USL} = \text{Target} + 4\sigma'$, where σ' is the new lower process standard deviation. Calculate the impact this improvement has on the ppm defective, i.e., the number of products out of one million that do not meet specifications.

(b) Repeat part (a), but rather than assuming the mean is equal to the target, assume the mean is within 1.5 standard deviations of target.

LSL = -2.5σ USL = $+2.5\sigma$

$P(Z < -2.5) = 0.006210$

$P(Z > 2.5) = 0.006210$

$P(\text{defective}) = 0.006210 + 0.006210 = 0.013242$

defective ppm $= 0.013242 \times 1{,}000{,}000$

$= 13242$

LSL = -4σ, USL = $+4\sigma$

$P(Z < -4) = 0.00003$

$P(Z > 4) = 0.00003$

defective ppm $= 0.00006 \times 1{,}000{,}000$

$= 60$

Reduction in defectives $= 13242 - 60 =$

13182 ppm

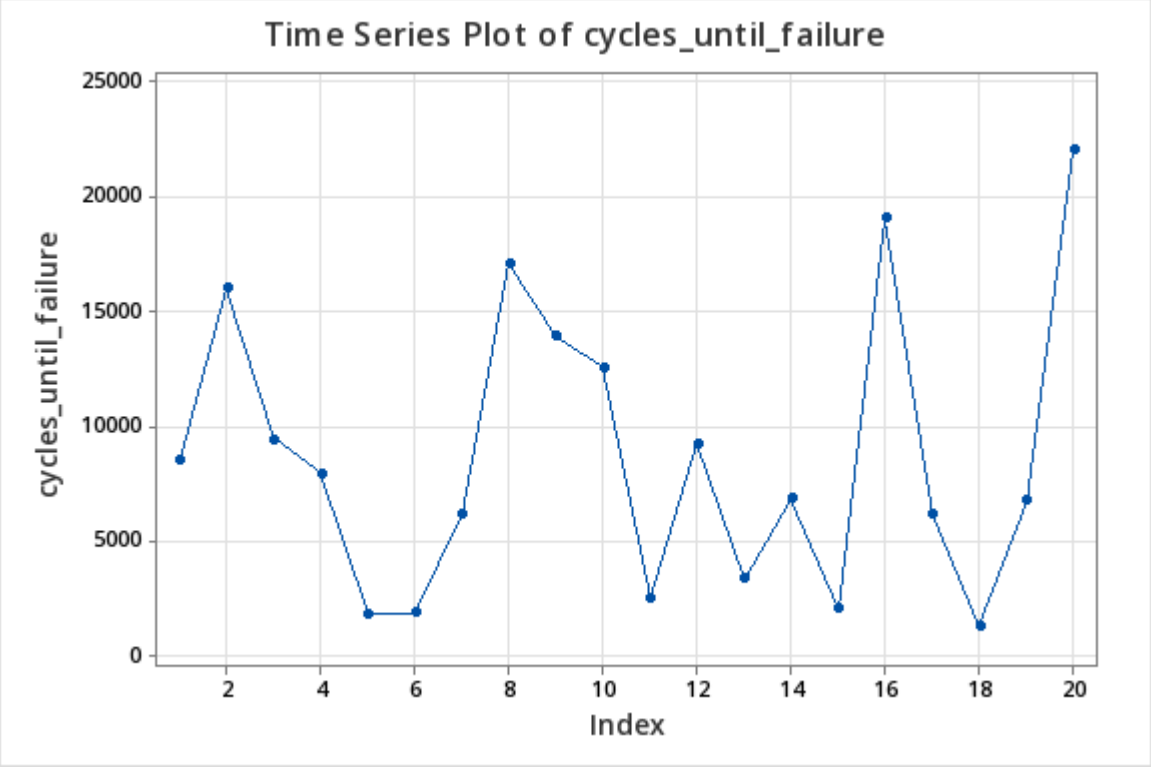
Problem 1. Use the variable `cycles_until_failure` in `hw_data.xlsx` for this question, which gives the number of cycles until failure for a certain aluminum component.

(a) Determine the sample average and the sample standard deviation.

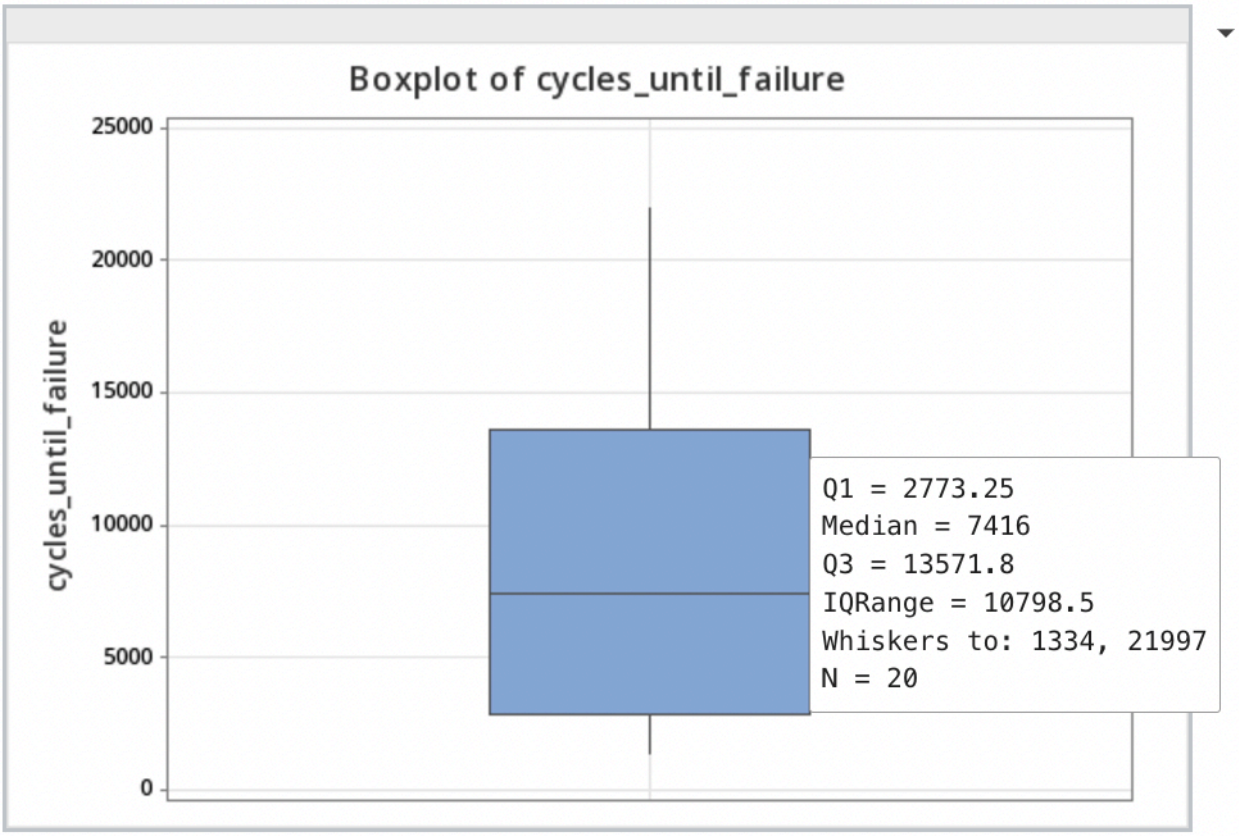
Statistics

Variable	N	N*	Mean	SE Mean	StDev	Minimum	Q1	Median	Q3	Maximum
cycles_until_fail ure	2 0	0	8750. 25	1383.0 3	6185. 10	1334	2773. 25	7416	1357 1.8	21997

(b) Assuming the data is in time order, construct and interpret a marginal (or time-series) plot.



(c) Construct and interpret a boxplot for this data. Label all the important quantities on the boxplot.



Problem 2. A production process operates with 5% nonconforming output. Each hour, a sample of 20 units is taken and the number of nonconforming units counted

(a) What is the expected number of nonconforming items in a sample?

$E(x) = 0.05 * 20 = 1$

(b) Suppose the process is stopped if two or more nonconforming items are found in a sample. The quality control technician must search for the cause before production can be resumed. Determine the probability that production is stopped

$P(X > 2)$

$P(X = 1) = 0.735840$
$P(X > 2) = 1 - 0.735840 = 0.26416$

The tensile strength of a metal part is normally distributed with mean 125 pounds and standard deviation 5 pounds.
(a) Suppose the lower specification limit for this part is 115 pounds tensile strength. If one million parts are produced, how many parts do we expect to NOT meet the minimum required tensile strength?

$Z = (115 - 125)/5 \Rightarrow -2$

$P(Z < -2) = 0.02275$

$Ppm = 1{,}000{,}000 * 0.02275 = 22{,}750$

(b) Suppose we decide to offer a warranty on this part. If the tensile strength is less than or equal to x , the part will be replaced. If the expectation is that we will have to replace 0.25% of parts under the warranty, determine x.

$p(z < x) = 0.0025$

1. The 8 dimensions of quality and the 3 additional dimensions of quality for the service industry

Dimensions of Quality of Manufacturing - Performance, Reliability, Durability, Serviceability, Aesthetics, Features, Perceived quality, Conformance to standards.

Dimensions of Quality for Service - Responsiveness, Professionalism, Attentiveness

2. What is the single biggest factor that affects quality? In this regard, what is the main goal of quality improvement? Hint: it is reducing something…

The biggest factor that affects quality is variability. The main goal of quality improvement is the reduce variability.

3. From a variability standpoint, what is the goal of Six Sigma? Draw a picture to illustrate.

Six Sigma focuses on reducing variability product quality characteristics to the level at which defects are extremely unlikely. While Design for Six Sigma is a process that focuses on variability reduction and process improvement.

4. Briefly describe each step in the DMAIC process.

Define - What is the problem that needs to be improved?
Measure - Collect data to measure performance
Analyze - Develop solution to reduce variability
Improve - Implement that solution
Control - Maintain and monitor

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