Q1 (10 pts: 15 min) Please state whether each of the following statements is True/False. Please correct the false part.

Statement	Answer/Correction
The cost incurred for materials and services consumed in testing belongs to appraisal costs.	True.
The Motorola Six Sigma concept, the ± 3 σ results in 66810 parts per million non-defective. (66810 parts per million defective)	False
Control charts aim to discover the key variables influencing quality characteristics of interest in the process. (designed experiments)	False
The cost of retesting products that have undergone rework or other modifications is classified as prevention costs. (internal failure cost)	False
The cost of correcting nonconforming units so that they meet specifications is considered a prevention cost. (internal failure cost)	False.
Quality characteristics are often evaluated relative to variability. (physical, sensory, time orientation)	False.
Paint containers that are overfilled because of excessive variability in the filling equipment result in quality losses. (cost losses)	False
The net losses of labor and overhead resulting from defective products that cannot be repaired are prevention costs. (internal failure costs)	False
DFSS is the set of activities that ensures the quality levels of products and services are properly maintained and that supplier and customer quality issues are properly resolved. (Quality assurance)	False.
Items in a rejected lot may be reworked or replaced with good units. This is often called ongoing inspection. (rectifying inspection)	False.
The "fitness for use" definition has become associated more with the design aspect of quality than conformance. (conformance more than design aspect)	False
Reliability is a sensory critical-to-quality characteristic. (time orientation)	False.
The cost of preshipment operation of the product to prevent early-life failures in the field is an example of internal failure costs. (prevention costs)	False.
In Generation II, Six Sigma focuses on creating value throughout the organization and for its stakeholders. (Generation III)	False.
The cost incurred during product design that is intended to improve the overall quality of the product belongs to appraisal quality costs. (Prevention costs (Quality planning + engineering))	False.
GAMs software is used to plot box plots and histograms. (Minitab)	False.

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(Q2: 20 min) Please answer the following questions. conforming $p=0.8$ $M=1$

(a: 2.5 pts) A random sample of size *n* products was randomly selected from an infinite lot. It is known that the probability that a specific component is conforming = 0.80. If the mean of the distribution = 1. Estimate the probability of finding at least one nonconforming product. $p=0.2$ (nonconforming)

Answer = 0.2624	Distribution: Binomial

$M=np$ so $\rightarrow 1=n\times 0.2$ $\boxed{n=5}$ $\boxed{P(x\geq 1)}$

$1-P(x\leq 1) = 1-(P(x=0)+P(x=1))$

$1-\left(\binom{5}{0}\times 0.2^0\times 0.8^5+\binom{5}{1}\times 0.2^1\times 0.8^4\right) = 1-(0.328+0.4096)$

0.2624

(b: 2.5 pts) A random sample was randomly collected from a production lot. The quality control has decided to continue the inspection process till finding 2 nonconforming units. If the mean of the distribution = 20. Calculate the probability that the inspector inspects exactly 10 units. $r=2$ $M=20$

Answer = 0.03874.	Distribution: Negative Binomial

$P(x=10)=\binom{9}{1}\times 0.1^2\times 0.9^8=$

$9\times 4.305\times 10^{-3}=0.03874$

$M=\frac{r}{p}=20=\frac{2}{p}$ $\boxed{p=0.1}$

(c: 2.5 pts) A production process operates with 2% nonconforming output. Every hour a sample of n units of product is taken, and then the sample fraction defective is calculated. The variance of the distribution = 0.00196. Calculate the probability that the sample fraction defective is at most 0.15. $p=0.02$ $\sigma_{\hat{p}}^2=0.00196$

Answer = 0.998	Distribution: Binomial (sample fraction defective)

$P(\hat{p}\leq 0.15)=P\left(\frac{x}{n}\leq 0.15\right)=P(x\leq 0.15)$ $\sigma_{\hat{p}}^2=\frac{p(1-p)}{n}=0.00196=\frac{0.02\times 0.98}{n}$

$P(x\leq 0.15)=\sum_{x=0}^{x=[0.15]} P(x=0)$ $n=1.018\simeq 1$

$\binom{1}{0}\times 0.02^0\times 0.998^1=0.998$

(d: 2.5 pts) An electronic display is subjected to a final functional test. Defects occur randomly at a variance of 0.005 per bottle. Calculate the probability that a display has more than 2 defects. $\sigma^2=0.005$ $\lambda=0.005$

Answer = 1.246×10^{-5}	Distribution: Poisson.

$P(x>2)=1-P(x<2)$

$1-(P(x=0)+P(x=1))$

$1-\left(\frac{e^{-0.005}\times 0.005^0}{0!}+\frac{e^{-0.005}\times 0.005^1}{1!}\right)=1.246\times 10^{-5}$