QUESTIONS:

1. **Fill in the blank: A _____ is one where all of the treatments have the same number of observations or replications.**
   - Balanced Design
   - Full Factorial Design
   - Fractional Factorial
   - Random Design

2. **Identify all the statements below regarding DOE that are true:**
   A. Every process has 3 common features: inputs, the process and technical requirements.
   B. The full factorial DOE is the best design to use when your objective is to screen out critical and non-critical factors.
   C. Replication increases the sample size and the degrees of freedom allow us to analyze interaction effects using ANOVA.
   D. Reducing experimental error increases the accuracy of your conclusions about the effect of each factor in a DOE.
   - A, B
   - C, D
   - A, C
   - B, D

3. **What are the three types of variation that a Multi-Vari Chart characterizes?**
   - Positional, Common, Precision variation
   - Accuracy, Precision, Special variation
   - Positional, Cyclical and Temporal variation
   - Common, Special and Part-to-Part variation

4. **Error in your measurement system is an example of which type of experimental error in a DOE:**
   - Operator Error
   - Systematic Error
   - Random Error
   - Technical Error

5. **Identify all the statements below regarding DOE that are true:**
    A. A process can have input factors that are uncontrollable.
    B. The order of a design refers to the chronological sequence in which you execute the various experiment.
    C. A level refers to specific settings of a response variable.
    D. One large DOE is considered better than multiple smaller DOE's.
    - A, B
    - C, D
    - A, C
    - B, D

6. **You have a process that has three major process steps, with individual yields of 93%, 99%, and 96%. What is the rolled throughput yield for the entire process?**
    - 99%
    - 93%
    - 88%
    - 96%

7. **In DOE, this term reflects a unique combination of factors and levels within an experiment:**
    - Power
    - Replication
    - Block
    - Treatment

8. **Identify all the statements below regarding DOE that are true:**
    A. A treatment is a unique combination of factors and levels within an experiment.
    B. There are three types of experimental error associated with a DOE - random error, systematic error, and technical error.
    C. Replicating a design increases the degrees of freedom of the ANOVA analysis to ensure the ability to analyze all interactions.
    D. Interactions can be fully analyzed in a fractional factorial experiment where all possible combinations of levels and factors are studied.
    - A, B
    - C, D
    - A, C
    - B, D

9. **You're calculating the 95% confidence interval for the population mean, where the Z-score is 1.96. You've taken 80 samples and the population standard deviation is 3.5. What is the margin of error for this confidence interval?**
    - 0.77
    - 0.39
    - 0.65
    - 0.41

10. **Fill in the blank: _____ is the act of performing a designed experiment all over again.**
    - Randomization
    - Power
    - Replication
    - Robustness

SOLUTIONS:

1. **Fill in the blank: A _____ is one where all of the treatments have the same number of observations or replications.**
   - **Balanced Design**
   - Full Factorial Design
   - Fractional Factorial
   - Random Design

2. **Identify all the statements below regarding DOE that are true:**
   A. Every process has 3 common features: inputs, the process and technical requirements. (False)
   B. The full factorial DOE is the best design to use when your objective is to screen out critical and non-critical factors. (False)
   C. **Replication increases the sample size and the degrees of freedom allow us to analyze interaction effects using ANOVA. (True)**
   D. **Reducing experimental error increases the accuracy of your conclusions about the effect of each factor in a DOE. (True)**
   - A, B
   - **C, D**
   - A, C
   - B, D

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   - Positional, Common, Precision variation
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   - **A. A process can have input factors that are uncontrollable. (True)**
   - **B. The order of a design refers to the chronological sequence in which you execute the various experiment. (True)**
   - C. A level refers to specific settings of a response variable. (False)
   - D. One large DOE is considered better than multiple smaller DOE's. (False)

   - **A, B**
   - C, D
   - A, C
   - B, D

6. **You have a process that has three major process steps, with individual yields of 93%, 99%, and 96%. What is the rolled throughput yield for the entire process?**
   - 99%
   - 93%
   - **88%**
   - 96%

$$Rolled\ Throughput\ Yield = Y_1 * Y_2 * Y_3 \dots \dots * Y_n$$

$$Rolled\ Throughput\ Yield = 93\% * 99\% * 96\% = \mathbf{88\%}$$

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   - Power
   - Replication
   - Block
   - **Treatment**

8. **Identify all the statements below regarding DOE that are true:**
   - **A. A treatment is a unique combination of factors and levels within an experiment. (True)**
   - B. There are three types of experimental error associated with a DOE - random error, systematic error, and technical error. (False)
   - **C. Replicating a design increases the degrees of freedom of the ANOVA analysis to ensure the ability to analyze all interactions. (True)**
   - D. Interactions can be fully analyzed in a fractional factorial experiment where all possible combinations of levels and factors are studied. (False)

   - A, B
   - C, D
   - **A, C**
   - B, D

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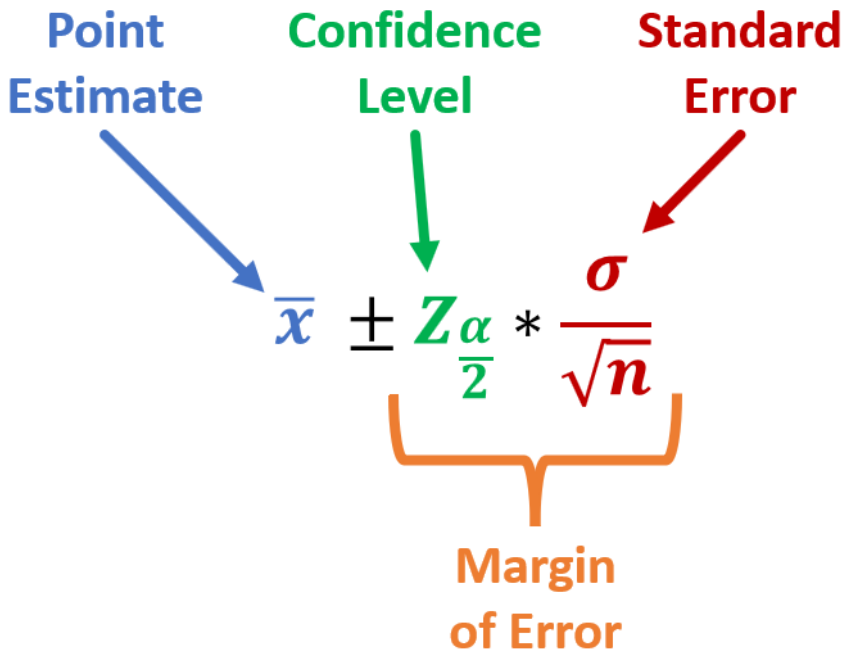

$$The\ margin\ of\ error\ of\ the\ distribution\ of\ standard\ means = Z_{\frac{\alpha}{2}} * \frac{\sigma}{\sqrt{n}}$$

$$Margin\ of\ Error = 1.96 * \frac{3.5}{\sqrt{80}} = \mathbf{0.77}$$

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- Power
- **Replication**
- Robustness