QUESTIONS:

1. **Identify the statement below regarding hypothesis testing that is true:**
   - Power can be thought of as the probability of avoiding a Type II error.
   - The probability of occurrence of a Type I error is defined as the Beta (β) risk.
   - The alpha risk in hypothesis testing is analogous to the consumers risk in the world of acceptance sampling.
   - Failing to reject the null hypothesis is analogous to proving that the null hypothesis is true.

2. **Identify all of the statements below regarding hypothesis testing that are true:**
   A. Hypothesis testing is based on the initial assumption that the alternative hypothesis is true.
   B. If the p-value is less than the level of significance (alpha risk, α), you must reject the null hypothesis.
   C. The Chi-Squared Distribution is symmetric so the critical rejection criteria for the two tails are the same.
   D. The power of a hypothesis test is the probability of correctly rejecting the null hypothesis (H_0) when the null is actually false.
   E. When performing a two-tailed hypothesis test, the alpha risk is equally distributed between the two tails of the sample distribution.

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

3. **You've measure 8 units from the latest production lot to measure the length of the parts. You calculate the sample mean to be 16.5in, and the sample standard deviation to be 1.5 in. Calculate the 90% confidence interval for the population mean.**
   - 16.5 ± 1.00
   - 16.5 ± 1.50
   - 16.5 ± 1.20
   - 16.5 ± 0.36

4. Identify all of the statements below regarding hypothesis testing that are true:

A. Rejecting the null hypothesis is considered a "strong claim" and means that the sample data was significant enough to reject the starting assumption that the null hypothesis was true.

B. This null hypothesis, called H_0, is always a statement about the value of a sample statistic.

C. A type I error is generally considered the worse of the two error types.

D. When the null hypothesis is actually true but the hypothesis test rejects it, this is known as a type II error.

E. The significance level (α) of our hypothesis test is also equal to the probability of a type I error.

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

5. Match the following terms with their appropriate location on this table of Null & Alternative Hypothesis:

- Correct Decision to Fail to Reject the Null Hypothesis
- Type II Error
- Type I Error
- Correct Decision to Reject the Null Hypothesis

		The Truth	
		H_0 is True	H_0 is False
The Outcome of the Hypothesis Test	Fail to Reject H_0	A	B
	Reject H_0	C	*D*

6. You're working to assess the reliability of a new design, and you're focused on potential deficiencies associated with your product features and the interfaces between sub-systems, what type of FMEA are you doing?

- Process FMEA
- Design FMEA
- Reliability FMEA
- Safety FMEA

7. **Quality Function Deployment (QFD) is an application of which of the 7 Quality Management and Planning Tools:**
    - Prioritization Matrix
    - Matrix Diagram
    - Affinity Diagram
    - Activity Network Diagram

8. **A _____ is any resource whose capacity is equal to or less than the demand placed on it.**
    - Constraint
    - Kanban
    - Value Stream Map
    - Kaizen Blitz

9. **You're performing a hypothesis test for the population variance. You sample 10 parts and your sample variance is 900, your null hypothesis for the population variance is 841. Calculate your chi-squared test statistic:**
    - 9.63
    - 9.31
    - 10.70
    - 8.41

10. **The primary conclusion that we should make when thinking about the Taguchi loss function is what?**
    - Quality Loss only increase when a product is no longer within specifications
    - Quality Loss begins whenever a product is away from nominal, even if it's still within specification
    - Quality cannot be improved without increasing cost
    - Variation within specification does not affect cost

SOLUTIONS:

1. **Identify the statement below regarding hypothesis testing that is true:**
   - **Power can be thought of as the probability of avoiding a Type II error. (True)**
   - The probability of occurrence of a Type I error is defined as the ~~Beta (β)~~ (alpha (α)) risk. (False)
   - The alpha risk in hypothesis testing is analogous to the ~~consumers~~ (producers) risk in the world of acceptance sampling. (False)
   - Failing to reject the null hypothesis is analogous to **proving that the null hypothesis is true** – (False) *this is an incorrect interpretation of a rejection of the null hypothesis.*

2. **Identify all of the statements below regarding hypothesis testing that are true:**
   A. Hypothesis testing is based on the initial assumption that the ~~alternative~~ (null) hypothesis is true. (False)
   B. **If the p-value is less than the level of significance (alpha risk, α), you must reject the null hypothesis. (True)**
   C. The Chi-Squared Distribution is (NOT) symmetric so the critical rejection criteria for the two tails are the same. (False)
   D. **The power of a hypothesis test is the probability of correctly rejecting the null hypothesis (H_0) when the null is actually false. (True)**

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

3. **You've measure 8 units from the latest production lot to measure the length of the parts. You calculate the sample mean to be 16.5in, and the sample standard deviation to be 1.5 in. Calculate the 90% confidence interval for the population mean.**
   - **16.5 ± 1.00**
   - 16.5 ± 1.50
   - 16.5 ± 1.20
   - 16.5 ± 0.36

   Because we've only sampled 8 units and we only know the sample standard deviation (not the population standard deviation), we must use the t-distribution to create this confidence interval.

   Ok, let's see what we know after reading the problem statement:

   $$n = 8,\ s = 1.5in,\ \alpha = 0.10,\ \text{x-bar} = 16.5in$$

   (The rest of the answer is on the next page)

Before we can plug this into our equation, we need to find the t-score associated with the 90% confidence interval.

With n = 8, we can calculate our degrees of freedom (n - 1) to be 7.

Since this confidence interval is two-sided, we will split our alpha risk (10%) in half (5% or 0.05) to lookup the critical t-value of 0.950 (1 - α/2) at d.f. = 7 in the t-distribution table at 1.895.

$$Interval\ Estimate\ of\ Population\ Mean\ (unknown\ variance): \bar{x} \pm t_{\frac{\alpha}{2}} * \frac{s}{\sqrt{n}}$$

$$\bar{x} = 16.5 \text{ in}, \text{ n = 8, s = 1.5 in}, t_{\frac{\alpha}{2}} = 1.895$$

$$90\%\ Confidence\ Interval: 16.5 \pm 1.895 * \frac{1.5}{\sqrt{8}}$$

$$90\%\ Confidence\ Interval: \mathbf{16.5 \pm 1.00}$$

4. Identify all of the statements below regarding hypothesis testing that are True:

A. Rejecting the null hypothesis is considered a "strong claim" and means that the sample data was significant enough to reject the starting assumption that the null hypothesis was true. (True)

B. This null hypothesis, called H_0, is always a statement about the value of a ~~sample statistic~~ (population parameter). (False)

C. When the null hypothesis is actually true but the hypothesis test rejects it, this is known as a ~~type II error~~ (type 1 error). (False)

D. The significance level (α) of our hypothesis test is also equal to the probability of a type I error. (True)

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

5. Match the following terms with their appropriate location on this table of Null & Alternative Hypothesis:

- A - Correct Decision to Fail to Reject the Null Hypothesis
- B - Type II Error
- C - Type I Error
- D - Correct Decision to Reject the Null Hypothesis

		The Truth	
		H_0 is True	**H_0 is False**
The Outcome of the Hypothesis Test	**Fail to Reject H_0**	**Correct Decision**	**INCORRECT DECISION (Type II Error) Beta (β) Risk**
	Reject H_0	**INCORRECT DECISION (Type I Error) Alpha (α) risk**	**Correct Decision *Power (1 - β)***

6. **You're working to assess the reliability of a new design, and you're focused on potential deficiencies associated with your product features and the interfaces between sub-systems, what type of FMEA are you doing?**
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   - **Design FMEA**
   - Reliability FMEA
   - Safety FMEA

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9. **You're performing a hypothesis test for the population variance. You sample 10 parts and your sample variance is 900, your null hypothesis for the population variance is 841. Calculate your chi-squared test statistic:**
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   - 9.31
   - 10.70
   - 8.41

$$Chi\ Squared\ Test\ Statistic: X^2 = \frac{(N-1)s^2}{\sigma^2} = \frac{(10-1)900}{841} = \mathbf{9.63}$$

10. The primary conclusion that we should make when thinking about the Taguchi loss function is what?

- Quality Loss only increase when a product is no longer within specifications
- **Quality Loss begins whenever a product is away from nominal, even if it's still within specification**
- Quality cannot be improved without increasing cost
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You can see in the Taguchi loss function below that the monetary loss (Quality Loss) begins whenever a product moves away from nominal (even if it is still in specification).