**Central Limit Theorem**

**League of Legends Game Duration Investigation**

**👥 Group Information**

**Group Member 1:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Group Member 2:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Group Member 3:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Date:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**📊 Population Parameters**

*(Fill in from the interactive demo)*

**Population Size (N):** \_\_\_\_\_\_\_\_\_\_ LoL games

**Population Mean (μ):** \_\_\_\_\_\_\_\_\_\_\_\_\_ minutes

**Population Standard Deviation (σ):** \_\_\_\_\_\_\_\_\_\_\_\_\_ minutes

**📋 Instructions**

1. Use the interactive Central Limit Theorem demo with your group
2. Start with Sample Size = 10 in the demo
3. Run each simulation (10, 100, 1000, 10000 samples) and record your observations
4. For "Shape," describe what you see: Uniform, Normal, Skewed Right, Skewed Left, etc.
5. Record times in minutes:seconds format (e.g., 30:45)
6. For the difference, calculate: Mean of Sample Means - Population Mean

**📊 Data Collection Table**

| **Sample Size (n)** | **Number of Samples** | **Shape of Sampling Distribution** | **Mean of Sample Means** | **Standard Error of Means** |  | |
| --- | --- | --- | --- | --- | --- | --- |
| 10 | 10 |  |  |  |  |
| 10 | 100 |  |  |  |  |
| 10 | 1,000 |  |  |  |  |
| 10 | 10,000 |  |  |  |  |
| 30 | 10 |  |  |  |  |
| 30 | 100 |  |  |  |  |
| 30 | 1,000 |  |  |  |  |
| 30 | 10,000 |  |  |  |  |

**Shape Options:**

* Normal
* Skewed Right
* Skewed Left
* Uniform
* Bimodal
* Other: \_\_\_\_\_\_\_\_\_\_\_

**🤔 Discussion Questions**

**1. Pattern Recognition:** What happens to the shape of the sampling distribution as you increase the number of samples?

**2. Mean Behavior:** How does the **mean of sample means** compare to the population mean? What does this tell us about sampling?

**3. Standard Error:** What pattern do you notice in the standard error as you increase the number of samples? Does the standard error get larger, small or stay the same? Why?

**4. CLT Verification:** Do your results support the Central Limit Theorem? Explain with specific evidence from your data.

**5. Real-World Application:** Why is this important for analyzing gaming data or other real-world datasets?

**🔍 Extension Activity**

**Next Steps:** Try different sample sizes (n=5, n=50, 100) and observe how this affects the sampling distribution!

**Additional Observations:**

**Sample Size n=5:**

Shape: \_\_\_\_\_\_\_\_\_\_\_\_\_ Mean: \_\_\_\_\_\_\_\_\_\_\_\_\_ Standard Error: \_\_\_\_\_\_\_\_\_\_\_\_\_

**Sample Size n=50:**

Shape: \_\_\_\_\_\_\_\_\_\_\_\_\_ Mean: \_\_\_\_\_\_\_\_\_\_\_\_\_ Standard Error: \_\_\_\_\_\_\_\_\_\_\_\_\_

**Sample Size n=100:**

Shape: \_\_\_\_\_\_\_\_\_\_\_\_\_ Mean: \_\_\_\_\_\_\_\_\_\_\_\_\_ Standard Error: \_\_\_\_\_\_\_\_\_\_\_\_\_

**📝 Key Learning Outcomes**

By completing this activity, you should be able to:

☐ Describe how the Central Limit Theorem works with real data

☐ Explain why sample means approach a normal distribution

☐ Calculate and interpret standard error

☐ Understand the relationship between sample size and sampling distribution

☐ Apply CLT concepts to real-world data analysis

**Teacher Notes:** This worksheet accompanies the interactive LoL game duration Central Limit Theorem demonstration. Students should work in groups of three and use the online demo to complete their observations.