Name: _____   **Date:** _____

Practice Problems: Probability Distributions

Binomial, Poisson, and Normal Distributions

Part I: Binomial Distribution

Hint: Look for a fixed number of trials (n) and a constant probability of success (p).

Q1. The Free Throw Shooter
A basketball player has a consistent free-throw accuracy of 70% ($p = 0.7$). During a game, she takes 5 shots. What is the probability that she makes **exactly 3** of them?

Q2. The Multiple Choice Test
A student is taking a short quiz with 4 questions. Each question has 4 options (A, B, C, D), and the student guesses randomly on every question (Probability of correct guess = 0.25). What is the probability that the student gets **exactly 0** answers correct?

Part II: Poisson Distribution

Hint: Look for an average rate (λ) over a time interval or space.

Q3. The Website Traffic
A small blog receives an average of 3 visitors per minute during peak hours ($\lambda = 3$). What is the probability that in the next minute, the blog receives **exactly 5 visitors**?

Q4. Typos in a Book
A proofreader finds that a specific author averages 2 typos per page. What is the probability that a randomly selected page from this author's new book contains **0 typos**?

Part III: Normal Distribution

Hint: Look for Mean (μ), Standard Deviation (σ), and continuous data.

Q5. The Math Exam (Empirical Rule)

The scores on a statewide math exam follow a normal distribution with a Mean (μ) of 75 and a Standard Deviation (σ) of 10. According to the empirical rule (68-95-99.7), what percentage of students scored **between 65 and 85**?

Q6. Factory Weights

A machine fills cereal boxes. The weight of the boxes is normally distributed with a Mean (μ) of 500g and a Standard Deviation (σ) of 5g. What is the probability that a box weighs **more than 505g**?

Teacher Answer Key

Q1. Binomial (Basketball)

- **Given:** $n = 5, k = 3, p = 0.7$.
- **Calculation:** $P(X = 3) = \binom{5}{3}(0.7)^3(0.3)^2$
- $10 \times 0.343 \times 0.09 = 0.3087$
- **Answer: 30.9%**

Q2. Binomial (Quiz)

- **Given:** $n = 4, k = 0, p = 0.25$.
- **Calculation:** $P(X = 0) = \binom{4}{0}(0.25)^0(0.75)^4$
- $1 \times 1 \times 0.3164 = 0.3164$
- **Answer: 31.6%**

Q3. Poisson (Website)

- **Given:** $\lambda = 3, k = 5$.
- **Calculation:** $P(X = 5) = \frac{3^5 e^{-3}}{5!}$
- $\frac{243 \times 0.0498}{120} \approx 0.1008$
- **Answer: 10.1%**

Q4. Poisson (Typos)

- **Given:** $\lambda = 2, k = 0$.
- **Calculation:** $P(X = 0) = \frac{2^0 e^{-2}}{0!}$
- $\frac{1 \times 0.1353}{1} = 0.1353$
- **Answer: 13.5%**

Q5. Normal (Math Exam)

- **Given:** $\mu = 75, \sigma = 10$. Range: 65 to 85.
- **Logic:** 65 is $\mu - 1\sigma$ and 85 is $\mu + 1\sigma$.
- The Empirical Rule states that 68% of data falls within 1 standard deviation.
- **Answer: 68%**

Q6. Normal (Cereal)

- **Given:** $\mu = 500$, $\sigma = 5$. Target: > 505.

- **Logic:** 505 is exactly $+1\sigma$.

- We know 50% of data is above the mean. We know 34% is between Mean and $+1\sigma$.

- Area beyond $+1\sigma = 50\% - 34\% = 16\%$.

- **Answer: 16%**