


# Choose the Right Probability Distribution (Molecular, Cellular & Medical Biology)

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These exercises assume you are familiar with the basics of  **probability distributions**. That means that you should know when the following distributions are good approximations or not:

- The normal distribution
- The Poisson distribution
- The binomial distribution

For these questions, you have to **identify the outcome** from a short description of a study, and **choose the appropriate probability distributions** that could be used in the analysis.

## Q1 — Antibiotic Resistance

Bacteria can become resistant to antibiotics by spontaneous mutations. These occur at different rates in different species, which might explain why some bacteria develop resistance more easily than others. To estimate these differences, scientists count the number of mutations that occur in one generation for a large number of bacteria of 4 different species. What is the outcome here, and with which probability distribution could it be approximated?

Answer:

## Q2 — Vasodepressor

A plant extract is evaluated for its potential vasodepressant activity (lowering blood pressure). 20 rats are randomly divided into 2 equally sized groups and given either the plant extract, or a placebo. Write down the outcome and which probability distribution could be used to approximate it.

Answer:

### **Q3 — Diets**

Three different diets are compared in terms of changes in mean fat mass, mean fat free mass and adherence (i.e., do participants stick with their prescribed diet?). The three outcomes are already given, but what probability distributions could they be approximated with?

Answer:

### **Q4 — Phase II Clinical Trial**

In phase II clinical trials, one of the primary goals is to assess the potential side effects of a drug, and how common they are. If researchers want to assess whether headaches are less common than in an existing drug, what would be the outcome and which probability distribution could be used to approximate it?

Answer:

### **Q5 — Mask Effectiveness**

To what extent do N95 respirators reduce the spread of SARS-CoV-2? A simple study (of questionable ethics) could compare infections after 6h spent in public buildings, where one of three rules are in effect: No masks, only medical masks, or only N95 respirators. What outcome could be used to compare these three categories, and what probability distribution could be used to approximate it?

Answer:

### **Q6 — Life Expectancy**

Studies comparing life expectancy for different groups (e.g., males and females), often compare the 5-year survival, or 10-year survival. In addition, you could simply compare the average life expectancy. What are the advantages and disadvantages of each of these outcomes, and what probability distributions could be used to approximate them?

Answer: