

Statistical Ecology and Environmental Probability

Statistics & Probability · Answer Key · 16 Questions

1. What is the typical unit of measurement for biodiversity indices like the Shannon Diversity Index when applied to an insect community?

- A) Individuals per square meter
- B) Species richness (number of species)
- C) Bits per individual**
- D) Nectar volume per flower

2. In a study of migratory bird flight patterns, if researchers observe a mean flight speed of 35 km/h with a standard deviation of 5 km/h, what is the probability, assuming a normal distribution, that a randomly selected bird flies at a speed between 30 km/h and 40 km/h?

- A) Approximately 0.34
- B) Approximately 0.68**
- C) Approximately 0.95
- D) Approximately 0.997

3. The concept of 'ecological carrying capacity' is most closely related to which statistical model?

- A) Poisson distribution
- B) Logistic growth model**
- C) Geometric distribution
- D) Exponential decay model

4. When analyzing the spatial distribution of a plant species, if the variance-to-mean ratio is significantly greater than 1, what type of spatial pattern is most likely indicated?

- A) Uniform (regular) distribution
- B) Random distribution
- C) Clumped (aggregated) distribution**
- D) Even distribution

5. In a mark-recapture study to estimate the population size of a fish species, the Lincoln-Petersen estimator is used. If 150 fish are initially marked and released, and later 200 fish are captured, with 30 of them being marked, what is the estimated population size?

- A) 750
- B) 1000**
- C) 1500
- D) 2000

6. The Kruskal-Wallis H test is a non-parametric statistical test used to compare medians across multiple independent groups. In ecology, it might be used to compare which of the following?

- A) The mean biomass of different forest types
- B) The distribution of nesting sites for different bird species
- C) The growth rates of a plant species under varying nutrient levels**
- D) The species composition of benthic invertebrates in streams with different levels of pollution

7. What is the primary statistical assumption underlying the use of the chi-squared test for independence when analyzing the association between the presence of a specific pollinator and the abundance of a particular flower?

- A) The data are normally distributed.
- B) The expected frequencies in each cell are sufficiently large (e.g., > 5).**
- C) The sample size is small.
- D) The two categorical variables are ordinal.

8. In environmental monitoring, if the detection limit of a pollutant is $0.01 \mu\text{g/L}$, and a sample has a concentration below this value, it is often reported as 'non-detect'. Statistically, how should these 'non-detect' values be handled for calculating the mean concentration of the pollutant?

- A) They should be excluded from the calculation.
- B) They should be treated as zero.
- C) They should be replaced with the detection limit.
- D) They should be replaced with a value half the detection limit or imputed using statistical methods.**

9. The concept of 'species accumulation curves' in biodiversity assessment is primarily used to estimate:

- A) The average lifespan of a species.
- B) The rate at which new species are discovered with increasing sampling effort.**
- C) The total biomass of an ecosystem.
- D) The genetic diversity within a population.

10. When assessing the long-term trends of a threatened species population, what statistical concept is crucial for determining if observed changes are significant and not due to random fluctuations?

- A) Correlation coefficient
- B) Hypothesis testing**
- C) Regression analysis
- D) Descriptive statistics

11. In a study of predator-prey dynamics, if the population of prey follows a geometric distribution, what does this imply about the probability of an individual prey surviving from one time interval to the next?

- A) It increases with population size.
- B) It is constant and independent of population size.**
- C) It decreases as the population size increases.
- D) It is zero.

12. What type of statistical distribution is often used to model the number of rare environmental events, such as volcanic eruptions or extreme weather events, occurring in a fixed interval of time or space?

- A) Binomial distribution
- B) Normal distribution
- C) Poisson distribution**
- D) Uniform distribution

13. When applying regression analysis to model the relationship between annual rainfall and forest fire frequency, what does a p-value of 0.01 for the rainfall coefficient typically indicate?

- A) The relationship is positive.
- B) There is a 1% chance the observed relationship is due to random chance.**
- C) The correlation coefficient is 0.01.
- D) The model explains 99% of the variation in fire frequency.

14. In the context of conservation genetics, what statistical measure quantifies the loss of genetic variation in a small, isolated population over time due to random drift?

- A) Heritability
- B) Effective population size (N_e)**
- C) Genetic drift
- D) Allele frequency

15. When analyzing the spatial clustering of trees in a forest, the 'nearest neighbor analysis' uses a statistic to compare the observed average distance between individuals to the expected distance under what type of distribution?

- A) Clumped distribution
- B) Uniform distribution
- C) Random distribution**
- D) Normal distribution

16. If a researcher is testing the hypothesis that a new pollutant has no effect on the growth rate of algae, what is the null hypothesis (H0) in statistical terms?

- A) The pollutant has a positive effect on algae growth.
- B) The pollutant has a negative effect on algae growth.
- C) The pollutant has no statistically significant effect on algae growth.**
- D) The pollutant has a significant effect on algae growth.