

Unit 2 – Discrete Distributions

Practice Problems

Due: Thursday September 19, 2024

Last Date to Submit for Credit (-20 points): Thursday September 26, 2024

1. *Source: Rosner B. Fundamentals of Biostatistics, second edition. Boston: Duxbury Press, 1986. Chapter 4 problem 4.29, page 93. Dear Class – You do NOT need to go to this source. Everything you need is here.*

Suppose that the expected number of deaths due to bladder cancer for all workers at a tire plant on January 1, 1964, over the next 20 years (1/1/64-12/31/83) based on US mortality rates is 1.8. If the Poisson distribution is assumed to hold and there are 6 reported deaths due to bladder cancer among the tire workers, then how unusual is this event? In developing your answer, compute the probability of exactly 6 deaths using the appropriately defined Poisson distribution model.

2. *Source: Rosner B. Fundamentals of Biostatistics, second edition. Boston: Duxbury Press, 1986. Chapter 4 problem 4.30, page 93-94. Again – You do NOT need to go to this source. Everything you need is here.*

The rate of myocardial infarction (MI) in 50–59-year-old disease-free women is approximately 2 per 1000 per year or 10 per 1000 over 5 years. Suppose that 3 MI's are reported over 5 years among 1000 women initially disease-free who have been taking postmenopausal hormones.

- (a). Use the binomial distribution to see if this experience represents an unusually small number of events based on the overall rate. That is, compute the probability of 3 or fewer events of MI using the appropriately defined Binomial distribution model.
- (b). Answer exercise “a” using the Poisson approximation to the binomial distribution.
- (c). Compare your answers to “a” and “b”.

3. *Source: Fisher LD and Van Belle G. Biostatistics: A Methodology for the Health Sciences. New York: Wiley, 1993. Chapter 6 problem 5, page 232.*

Smith, Delgado and Rutledge (1976) report data on ovarian carcinoma. Individuals had different numbers of courses of chemotherapy. The 5-year survival data for those with 1-4 and 10 or more courses of chemotherapy are:

Courses	Five Year Status	
	Dead	Alive
1-4	21	2
$\geq 10$	2	8

Using Fisher's Exact test, is there a statistically significant association ( $p < .05$ ) in this table? In 1-2 sentences, write a clear interpretation of your hypothesis test.

4. *Source: Vu J and Harrington D. Introductory Statistics for the Life and Biomedical Sciences, First Edition. OpenIntro, 2020. Chapter 3 problem 10, page 187.*

The US CDC estimates that 90% of Americans have had chickenpox by the time they reach adulthood. Consider a sample of 120 American adults.

- How many people in this sample would you expect to have had chickenpox in their childhood?
- What is the standard deviation?
- What is the probability that 105 or fewer people in this sample have had chicken pox in their childhood?

5. *Source: Whitlock MC and Schluter D. The Analysis of Biological Data, Second Edition. WH Freeman, 2015. Chapter 8 problem 19, page 230.*

Hurricanes hit the United States often and hard, causing some loss of life and enormous economic costs. They are ranked in severity by the Saffir-Simons scale, which ranges from Category 1 to Category 5, with 5 being the worst. In some years, as many as three hurricanes that rate a Category 3 or higher hit the U.S. coastline. In other years, no hurricane of this severity hit the United States. The following table lists the number of years that had 0, 1, 2, 3, or more hurricanes of at least Category 3 in severity of the 100 years of the 20th century (Blake et al 2005).

Number of hurricanes with severity Category 3 or higher	Number of Years Observed
0	50
1	39
2	7
3	4
More than 3	0

- Calculate the mean number of severe (Category 3 or higher) hurricanes to hit the United States per year during the 100 years of the 20th century.
- Define all terms in the probability distribution model that would be used to describe the distribution of hurricanes per year during the 100 years of the 20th century under the assumptions that hurricanes hit independently of each other and the probability of a hurricane hit is the same every year.