



COMSATS University Islamabad
Department of Computer Sciences
Final Examination Spring 2024

Subject: Statistics and Probability Theory

Program: BCS
Semester: 4th(A & B)
Date: 9th June 24, 08:30

Total Marks: 50
Time Allowed: 180 Minutes
Instructor: Ms. Mudassrah

Instructions:

- Attempt all questions.
- Normal distribution table and calculators are allowed but sharing is strictly prohibited.

Question No. 01: In the November 1990 issue of Chemical Engineering Progress, a study discussed the percent purity of oxygen from a certain supplier. Assume that the mean was 99.61 with a standard deviation of 0.08. Assume that the distribution of percent purity was approximately normal.

- What percentage of the purity values would you expect to be between 99.5 and 99.7?
- What purity value would you expect to exceed exactly 5% of the population? (5.5)

Question No. 02: It is known by researchers that 1 in 100 people carries a gene that leads to the inheritance of a certain chronic disease. In a random sample of 1000 individuals, what is the probability that fewer than 7 individuals

carry the gene? Use a Poisson approximation. Again, using the approximation, what is the approximate mean number of people out of 1000 carrying the gene? (5.5)

Question No. 03: The Department of Energy (DOE) puts projects out on bid and generally estimates what a reasonable bid should be. Call the estimate b . The DOE has determined that the density function of the winning (low) bid is;

$$f(y) = \begin{cases} \frac{5}{8b} & \frac{2}{5}b \leq y \leq 2b \\ 0, & \text{elsewhere} \end{cases}$$

Find distribution function $F(y)$ and use it to determine the probability that the winning bid is less than the DOE's preliminary estimate b . (5.5)

Question No. 04: The potential buyer of a particular engine requires (among other things) that the engine start successfully 10 consecutive times. Suppose the probability of a successful start is 0.990. Let us assume that the outcomes of attempted starts are independent.

- What is the probability that the engine is accepted after only 10 starts?
- What is the probability that 12 attempted starts are made during the acceptance process? (5.5)

Question No. 05: In testing a certain kind of truck tire over rugged terrain, it is found that 25% of the trucks fail to complete the test run without a blowout. Of the next 15 trucks tested, find the probability that;

- a. from 3 to 6 have blowouts;
- b. fewer than 4 have blowouts;
- c. more than 5 have blowouts.

(6)

Question No. 06: Lots of 40 components each are deemed unacceptable if they contain 3 or more defectives. The procedure for sampling a lot is to select 5 components at random and to reject the lot if a defective is found. What is the probability that exactly 1 defective is found in the sample if there are 3 defectives in the entire lot? Find the mean and variance of the random variable and then use Chebyshev's theorem to interpret the interval $\mu \pm 2s$. (5.5)

Question No. 07: The fraction X of male runners and the fraction Y of female runners who compete in marathon races are described by the joint density function;

$$f(x, y) = \begin{cases} 8xy, & 0 \leq y \leq x \leq 1 \\ 0, & \text{elsewhere.} \end{cases}$$

Find the covariance of X and Y .

(5.5)

Question No. 08: In a certain assembly plant, three machines, B1, B2, and B3, make 30%, 45%, and 25%, respectively, of the products. It is known from past experience that 2%, 3%, and 2% of the products made by each machine, respectively, are defective. Now, suppose that a finished product is randomly selected.

- a. What is the probability that it is defective?
- b. If a product was chosen randomly and found to be defective. What is the probability that it was made by machine B3?

(5.5)

Question No. 09: Suppose that an antique jewelry dealer is interested in purchasing a gold necklace for which the probabilities are 0.22, 0.36, 0.28, and 0.14, respectively, that she will be able to sell it for a profit of \$250, sell it for a profit of \$150, break even, or sell it for a loss of \$150. What is her expected profit? Also find expected variance.

(5.5)
