ECI114: Probabilistic Systems Analysis for Engineers

HW # 6, Due: 05Jun2023, by midnight on Canvas.

Problem:

1. A research engineer for a tire manufacturer is investigating tire life for a new rubber compound and has built 16 tires and tested them to end-of-life in a road test. The sample mean and standard deviation are 60139.7 and 3645.94 kilometers. Find a 95% confidence interval on mean tire life.

2. During the 1999 and 2000 baseball seasons, there was much speculation that the unusually large number of home runs hit was due at least in part to a livelier ball. One way to test the "liveliness" of a baseball is to launch the ball at a vertical surface with a known velocity V_L and measure the ratio of the outgoing velocity V_0 of the ball to V_L . The ratio $R = V_O/V_L$ is called the coefficient of restitution. Following are measurements of the coefficient of restitution for 40 randomly selected baseballs. The balls were thrown from a pitching machine at an oak surface.

   0.6248 0.6237 0.6118 0.6159 0.6298 0.6192
   0.6520 0.6368 0.6220 0.6151 0.6121 0.6548
   0.6226 0.6280 0.6096 0.6300 0.6107 0.6392
   0.6230 0.6131 0.6223 0.6297 0.6435 0.5978
   0.6351 0.6275 0.6261 0.6262 0.6262 0.6314
   0.6128 0.6403 0.6521 0.6049 0.6170
   0.6134 0.6310 0.6065 0.6214 0.6141

   (a) Is there evidence to support the assumption that the coefficient of restitution is normally distributed?

   (b) Find a 99% CI on the mean coefficient of restitution.

   (c) Find a 99% prediction interval on the coefficient of restitution for the next baseball that will be tested.

   (d) Find an interval that will contain 99% of the values of the coefficient of restitution with 95% confidence.

   (e) Explain the difference in the three intervals computed in parts (2), (3), and (4).

3. A textile fiber manufacturer is investigating a new drapery yarn, which the company claims has a mean thread elongation of 12 kilograms with a standard deviation of 0.5 kilograms. The

company wishes to test the hypothesis $H_0 : \mu = 12$ against $H_1 : \mu < 12$, using a random sample of four specimens.

(a) What is the type I error probability if the critical region is defined as $\bar{x} < 11.5$ kilograms?

(b) Find β for the case in which the true mean elongation is 11.25 kilograms.

(c) Find β for the case in which the true mean is 11.5 kilograms.

4. In previous problem calculate the probability of a type II error if the true mean elongation is 11.5 kilograms and

(a) $\alpha = 0.05$ and $n = 4$

(b) $\alpha = 0.05$ and $n = 16$

(c) Compare the values of β calculated in the previous parts. What conclusion can you draw?