ISE 315: Engineering Statistics

Homework 2

Class Section: F-04
Instructor: Mansur M. Arief

Due: Wednesday, 4 February 2026, 12:00 PM (Gradescope)
Department of Industrial and Systems Engineering, KFUPM

Instructions

- Show all work for full credit. Clear procedure and reasoning is needed for correct answers.
- You may use a calculator or other software to assist with calculations.
- You may also use gen AI (if you want), but **only after** you have formulated and calculated your own answers. Any work submitted must be your own and you will be responsible for it.
- Submit your solutions via Gradescope, with each subproblem marked properly.

Problem Sets

1. **(15 points)** The cycle time for a robotic arm to complete an assembly task is a random variable with mean $\mu = 12$ seconds and standard deviation $\sigma = 3$ seconds. Suppose a random sample of $n = 49$ task completions is observed. Find the probability that the average cycle time for these tasks is between 11 and 13 seconds!

2. **(15 points)** A testing facility evaluates the range of autonomous drones. A random sample of 49 drones is tested, where the flight range follows a normal distribution with mean $\mu = 40$ km and standard deviation $\sigma = 14$ km. Find the probability that the sample mean flight range falls in the interval $38 \leq \bar{X} \leq 42$ km.

3. **(10 points)** The latency of a warehouse robot's sensor system follows a normal distribution with mean $\mu = 50$ ms and variance $\sigma^2 = 64$. A reliability engineer wants the standard error of the sample mean latency to be at most 2 ms. How large must n be?

4. **(15 points)** Two warehouse automation systems (AGVs and conveyor belts) are being compared for throughput. A random sample of $n_1 = 25$ shifts from the AGV system (drawn from a normal population with mean $\mu_1 = 120$ units per hour and standard deviation $\sigma_1 = 10$) is collected. A random sample of $n_2 = 16$ shifts from the conveyor system (from a normal population with mean $\mu_2 = 110$ units per hour and standard deviation $\sigma_2 = 12$) is also collected.

   Let $\bar{X}_1$ and $\bar{X}_2$ be the sample means for AGVs and conveyors, respectively. Find the probability that $5 \leq \bar{X}_1 - \bar{X}_2 \leq 15$!

5. **(10 points)** An autonomous vehicle company evaluates the braking distance of its fleet. The braking distance (in meters) is known to follow a normal distribution. A random sample of $n = 16$ braking tests yields a sample mean of 28 m and sample variance of $S^2 = 25$ m^2. Find the probability that the deviation between the sample and true mean is more than 5 m.

6. **(15 points)** In a comparative study, $n_1 = 100$ deliveries were assigned to Drone Model A, of which $X_1 = 90$ were completed on time. Similarly, $n_2 = 100$ deliveries were assigned to Drone Model B, of which $X_2 = 75$ were completed on time.

   Let $p_1 = 0.90$ and $p_2 = 0.75$ denote the true on-time delivery probabilities for Model A and Model B, respectively.

   (a) **(5 points)** Calculate an unbiased point estimate for $p_1 - p_2$.

   (b) **(5 points)** What is the standard error of this point estimate?

   (c) **(5 points)** Using the normal approximation, find the probability that the point estimate $\hat{p}_1 - \hat{p}_2$ differs from the true difference $(p_1 - p_2)$ by more than 0.10.

AI Usage Statement: Generative AI (Claude Opus 4.5) assisted in the refinement of wording in this document. The instructor has revised, fully reviewed, and approved the content. (MMA)