

# Stat 260 R Assignment 2-Spring 2025

Dr. J. Yu

Due Date: March 13, 2025

## INSTRUCTION:

1. If you complete your assignment in R or R Studio, please copy and paste the commands and the output into a Word document and then print it to pdf.
  2. Execute each line of code separately to ensure that it works properly.
  3. Submit the pdf file to Crowdmark in the R Assignment 2 activity.
  4. Total marks [20].
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**Question 1** (3 marks) A radioactive object emits particles according to a Poisson process at an average rate of 7.5 particles per second. We observe the object for a total of 5 seconds. Suppose it is known that at least 20 particles will be emitted during this interval, what is the probability that no more than 25 particles will be emitted during this interval?

**Question 2** (2 marks) A manufacturer of ceramic blades estimates that 2.8% of all blades produced are too brittle to use. Suppose we take a random sample of 400 blades and test them for brittleness. What is the probability that at least 8 blades but no more than 10 blades will be too brittle to use?

**Question 3** The fracture toughness (in MPa $\sqrt{m}$ ) of a particular steel alloy is known to be normally distributed with a mean of 28.3 and a standard deviation of 0.77. We select one sample of this alloy at random and measure its fracture toughness.

(a) (2 marks) What is the probability that the fracture toughness will be between 29 and 40.3?

(b) (3 marks) Given that the fracture toughness is at least 27, what is the probability that the fracture toughness will be between 29 and 40.3?

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**Example** Suppose that random variable  $X \sim N(\mu = (3)(0.5) + 2.5^2, \sigma = \frac{\sqrt{57}}{\sqrt{12}})$ . If we want to calculate  $P(X \leq 9.1)$ . By using R, we could enter the following:

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> pnorm(9.1, mean = 3 * 0.5 + 2.5^2, sd = sqrt(57)/sqrt(12))  
[1] 0.732181
```

Note that multiplication must be explicitly indicated by \*. If we had entered (3)(0.5) rather than 3\*0.5, we would have received an error message.

In R, we could also have assigned the parameter values to variables as following, which might be useful if we had to answer several questions about  $X$ :

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> mean.of.x = 3 * 0.5 + 2.5^2
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> sd.of.x = sqrt(57)/sqrt(12)
> pnorm(9.1, mean=mean.of.x, sd = sd.of.x)
[1] 0.732181
```

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**Question 4** (2 marks) The daily rainfall in Victoria is known to have a mean of 12.3 mm and a standard deviation of 3.9 mm. Suppose we take a random sample of 60 days. What is the probability that the total rainfall for the 60 days will be between 750 mm and 800 mm?

**Question 5** (3 marks) In a factory, it is assumed that the probability any individual item will be defective is 0.03. Each day, we select 50 items, and count the number of defective items in the group of 50. Suppose we examine the results of a random sample of 75 days. What is the probability that the average number of defective items per day over the 75 days is 1 or less?

**Question 6** A particular item is handmade in two stages by two workers, first by Laverne and then by Shirley. The time it takes Laverne to finish her part is normally distributed with a mean of 1.2 hours and a standard deviation of 0.3 hours. The time it takes Shirley to finish her part is normally distributed with a mean of 0.9 hours and a standard deviation of 0.2 hours. Assume the work times for Laverne and Shirley are independent of each other

(a) (2 marks) What is the probability that the total time it takes to make an item will be no more than 2 hours?

(b) (3 marks) Laverne is paid a wage of \$25 per hour, and Shirley is paid a wage of \$40 per hour. What is the probability that the total amount paid to the two employees to make one item will be no more than \$75?