Homework 2

P8130 Fall 2025

Due: September 30, 2025 at 11:59pm

Guidelines for Submitting Homework

- Your homework must be submitted through Courseworks. No email submissions!

- Only one PDF file should be submitted, including all derivations, graphs, output, and interpretations. When handwriting is allowed (this will be specified), scan the derivations and merge ALL PDF files (http: //www.pdfmerge.com/).

- You are encouraged to use R for calculations, but you must show all mathematical formulas and derivations. Please include the important parts of your R code in the PDF file but also submit your full, commented code as a separate R/RMD file.

- To best follow these guidelines, we suggest using Word (built in equation editor), R Markdown, Latex, or embedding a screenshot or scanned picture to compile your work.

REMINDER: You are encouraged to collaborate on homework, explain things to each other, and test each other's knowledge. But **everyone must complete their own assignment and write their own solutions.**

Problem 1 (10 points)

Suppose the probability that a randomly selected adult receives at least one flu shot during a single flu season is 68%. A sample of 30 adults is observed. For part (a) you should work "by hand" and show all calculations and intermediate steps. For parts (b)-(e) you can use tables or statistical software.

a)   What is the probability that **exactly** 18 of these 30 adults receive at least one flu shot?

b)   What is the probability that **at least** 18 of these adults receive at least one flu shot (exact calculations)?

c)   For part (b), is it appropriate to use an approximation method? If yes, compute the probabilities using an approximation (with continuity correction) and compare to the exact values.

d)   What is the expected number of adults who receive at least one flu shot?

e)   What is the standard deviation of the number who receive at least one flu shot?

Problem 2 (10 points)

During peak flu season, a city health department records an average of 15 new laboratory-confirmed influenza cases per day. Assume the daily number of new cases follows a Poisson distribution with parameter $\lambda = 15$. For part (a) you should work "by hand" and show all calculations and intermediate steps. For parts (b)-(d) you can use tables or statistical software.

a) What is the probability that the city will record exactly 15 new cases tomorrow?
b) What is the probability that the city will record fewer than 3 new influenza cases tomorrow?
c) What is the probability that the city will record more than 20 new cases tomorrow?
d) The Poisson distribution can sometimes be approximated by a normal distribution. Calculate approximations based on a $N(\lambda, \lambda)$ distribution for each of (a)-(c) (with continuity correction). Does the approximation seem good?

Problem 3 (10 points)

Assume the systolic blood pressure of 20-29 year old American males is normally distributed with population mean 128 and population standard deviation 10.2.

a) What is the probability that a randomly selected American male between 20 and 29 years old has a systolic blood pressure above137?
b) What is the probability that the sample mean blood pressure of 50 males between 20 and 29 years old will be less than 125?
c) What is the 90th percentile of the sampling distribution of the sample mean with a sample size of 40?

Problem 4 (10 points)

Some researchers are interested in the mean pulse rate of young women suffering from fibromyalgia. A random sample of 40 gave a sample mean of 80 and a sample standard deviation of 10.

a) Compute the 95% confidence interval for the population mean pulse rate of young females suffering from fibromyalgia and provide the correct interpretation of the interval.
b) Suppose the researchers now want to test the null hypothesis that the mean pulse of young women suffering from fibromyalgia is equal to 70, against the alternative that the mean pulse is not equal to 70, at the $\alpha = 0.01$ significance level. Conduct this hypothesis test and interpret the results.