Normal Distribution Worksheet

Question 1 – Standard Normal Distribution

Find the probability for the following z-scores, sketch the normal distribution and associated probability. You may use R to get the probabilities.

Part A: probability $Z < -1$ (Z is less than -1)

Part B: probability $Z < 2.35$

Part C: probability $Z < 0$

Part D: probability $Z > 0$

Part E: probability $Z > -0.76$

Part F: probability $Z > 2.35$

Part G: probability $-1 < Z < 2.35$

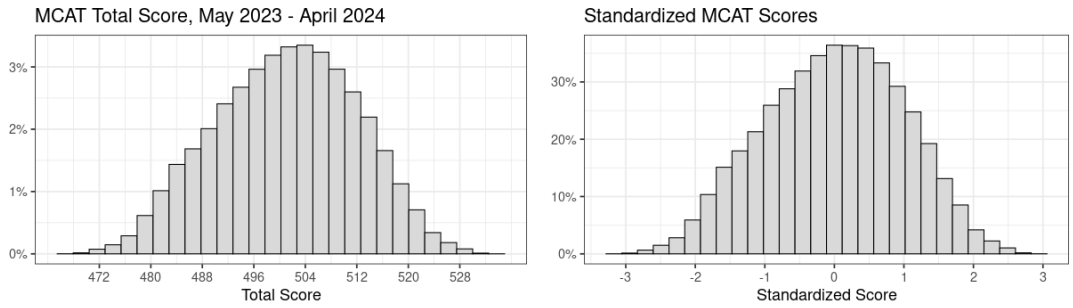
Part H: probability $-0.76 < Z < 0$

Question 2 – 68/95/99.7% rule

Verify the 68/95/99.7% rule by sketching a standard Normal distribution, and finding the probability between 1, 2, and 3 standard deviations from the mean.

Question 3 – MCAT Data

The following is a distribution of MCAT scores, an exam frequently used in selection for medical schools. The mean score is 501 and the standard deviation is 11. MCAT scores are not perfectly Normal, but we can use the Normal distribution to get estimates of probabilities/percentages.



Part A: Some schools have an MCAT admission cutoff of 494. What is the chance of picking a person who got a score less than 494?

Part B: University of Iowa's College of Medicine's students have an average MCAT of 515. Roughly what overall percent of people got an MCAT score of 515 or more?

Part C: Roughly what score would someone need to be in the top 25% of test-takers?

Question 4 – Mercury in Fish

Mercury is a chemical that is toxic to humans (and many others animals). From the smokestacks of power plants to the discharges from wastewater treatment plants, and other places, mercury in the form of the compound methylmercury exists in the enviroment, and it can settle to the seafloor and be taken up by tiny organisms that live or feed on bottom sediments.

These compounds aren't digested, they accumulate within the animals that ingest them, and become more and more concentrated as they pass along the food chain as animals eat and then are eaten in turn. This is biomagnification, and it means that higher-level predators-fish, birds, and marine mammals-build up greater and more dangerous amounts of toxic materials than animals lower on the food chain.

The U.S. Food and Drug Administration recommends avoiding eating fish with mercury levels higher than 0.46 μg/g (micro-grams mercury per gram of fish), as they may be harmful.

Suppose the population of yellowfin tuna follows a Normal distribution with an average mercury level of 0.354 μg/g , and a variance of 0.02.

Part A: What is the standard deviation of this population?

Part B: Compute the Z-score for a fish with a mercury level of 0.46 μg/g.

Part C: Use the z-score in Part C to answer: What is the probability of catching a yellowfin tuna with an unsafe amount of mercury? Suppose you enjoy eating yellowfin tuna – would you frequently eat yellowfin tuna knowing this information?

Part D: Suppose the standard deviation is acutally .03 instead. Find the probability of catching a yellowfin tuna with an unsafe amount of mercury. Does this change your answer to whether or not you would frequently eat yellowfin tuna?

Part E: Why do different values for the std. dev. give different probabilities in part C and D? Making a sketch may help your understanding.