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MATH 232 · Introduction to Statistics Spring 2017 Instructor: E.M. Kiley

April 7 Cartoon Guide Questions

Please read pages 52–62 of the Cartoon Guide with your group, and answer the following questions.

Question 1. On page 53, it is stated: "If we imagine a random experiment repeated many times, we expect that the actual outcomes over time will be governed by their probabilities." In class, we had a name for this expectation (we actually called it a law). State the law, and explain it in your own words or with an example.

Question 2. The definition of a random variable given on page 54 is slightly different than what we saw in class and in the OpenStax text. In this class, we will stick to the distinction between random variables itself (which are words), and the values that random variables take on (these are numbers). Please explain the similarities and differences between the definitions of random variables in the OpenStax book and in the Cartoon Guide.

Question 3. Aside from the one mentioned on page 55, what could be another random variable associated with the experiment of rolling two dice?

Question 4. Check that the probability distributions on page 55 are actually probability distributions.

Question 5. On page 56, you will find histograms that correspond to the tables on page 55 that give the probability distributions of the random variables X and Y. Histograms or graphs are perfectly good ways of showing probability distributions! What is the difference between the two histograms on page 57? [Perhaps: What is the *only* difference between the two histograms on page 57? Which one gives the probability distribution?]

Question 6. What is the lady on page 58 doing, and why is she doing it? What should her histogram (at the bottom of the page) look like, and why?

Question 7. What is the joke at the bottom of page 59? (I don't think I get it, and am looking for leads...)

Question 8. What is the difference between $\bar{x}$ and μ for denoting means? What is the difference between s and σ for denoting standard deviations?

Question 9. The process for turning the mean of a data set into the mean of a probability distribution is shown on page 60. Explain the substitution of $P(X = x)$ for $\frac{n_x}{n}$. Check that the resulting formula is the same as the one shown in the class notes and in the OpenStax book.

Question 10. It is stated that the expected value of a random variable is the center of its histogram. What does that mean?—Is it always the same thing as the center along the horizontal axis? Draw an example or two.

Question 11. What do you expect to happen to the mad coin tosser's experimental results (shown on page 61) as she continues flipping her pair of coins more and more times? Why?

Question 12. Show why, for a probability distribution of the random variable X, $\sigma^2(X) = E[(X - \mu)^2]$, where $E[Y]$ denotes the expected value of Y, and is exactly the same thing as $\mu(Y)$.

Question 13. In the Illinois Pick 3 lottery game, you pay 50 cents to select a sequence of 3 digits, such as 314. If you select the same sequence of three digits that are drawn by the organizer, then you win and collect \$250.

(a) How many different selections are possible, and what is the probability of winning?

(b) If you win, what is your net profit? If you do not win, what is your net profit?

(c) Let X be the random variable representing your net profit. Determine the possible values that X can take on, and the probability of each; write these in a probability distribution table.

(d) Find your expected winnings—that is, find the expected value of X.

Question 14. In the New Jersey Pick 4 lottery game, you pay 50 cents to select a sequence of 4 digits, such as 3141. If you select the same sequence of four digits that are drawn by the organizer, then you win and collect \$2788. Letting X represent your net profit, what is $E[X]$ for the New Jersey Pick 4 game? What is a better value: a 50-cent ticket in the Illinois Pick 3, or a 50-cent ticket in the New Jersey Pick 4?