MATH 338

MIDTERM 1 - LECTURE PORTION

THURSDAY, OCTOBER 4, 2018

Your name: _____

Your scores (to be filled in by Dr. Wynne):

Problem 1: ____/3.5

Problem 2: ____/7

Problem 3: ____/5

Problem 4: ____/5

Problem 5: ____/6.5

Total: ____/27

You have 75 minutes to complete this exam.

You may refer to your (single-sided, prepared in advance) formula sheet. You may ask Dr. Wynne to clarify what a question is asking for. You may not ask other people for help or use any other resources.

For full credit, show all work except for final numerical calculations (which can be done using a scientific or graphing calculator).

1. Circle the most correct answer to the following multiple choice questions [0.5 pts each].

A) Which of the following graph types would not be appropriate for displaying the distribution of a categorical variable?

a) Pie chart
b) Bar chart
c) Stem plot
d) All of these would be appropriate

B) The variable *y* has a mean of 50 and a standard deviation of 10. The variable $z = 100 + 3y$ has…

a) Mean 150 and standard deviation 30
b) Mean 250 and standard deviation 30
c) Mean 150 and standard deviation 130
d) Mean 250 and standard deviation 130

C) Which of the following numbers is not a valid probability?

a) 0
b) 20%
c) 3/8
d) -0.6

D) If the random variable *X* takes the value 3 with probability 0.4 and the value 6 with probability 0.6, then the expected value of *X* is:

a) 2.16
b) 4.5
c) 4.8
d) 6.0

E) Which of the following statements is not true about the normal density curve?

a) The total area under the curve is 1
b) The mean and median of the curve are equal
c) The curve never goes below the x-axis
d) All of these statements are true

F) If $W \sim N(200, 50)$, then the standard deviation of the sample mean $\overline{W}$ of 25 iid draws from *W* is:

a) 2
b) 10
c) 50
d) we don't have enough information to find it

G) Which of the following statements is true about the Central Limit Theorem?

a) It applies to both continuous and discrete random variables

b) It applies to populations with infinite standard deviations

c) It guarantees that the sampling distribution of the sample mean is approximately normal, as long as the sample size is at least 30

d) It guarantees that the sample mean is a biased estimator of the population mean

2. In a certain distribution, a value of 80 corresponds to a z-score of -2.

A) [1.5 pts] You do not have enough information to find the population mean exactly. Is it possible that the population mean is 70? Explain your answer.

B) [2.5 pts] If you knew that the population distribution was normal, could you estimate the probability of randomly selecting an individual with a value less than 80? If so, estimate it or (if you need software to do it) explain how you would estimate it. If not, explain why not.

C) [3 pts] If you did not know the shape of the distribution, but did know the value and corresponding z-score for a second case, could you find the population mean? If so, explain how. If not, explain why not.

3. Let Event A and Event B be arbitrary independent events. The probability of Event A is 0.3 and the probability of Event B is 0.8.

A) [1 pt] What is $P(A^C)$?

B) [1.5 pts] What is $P(A \cup B)$?

C) [1 pt] What is $P(A \mid B)$?

D) [1.5 pts] Can A and B be disjoint? Justify your answer.

4. A game on the HQ Trivia app consists of 12 multiple-choice questions. Each question has 3 possible answers. The game ends as soon as you get a question wrong; for example, if you get question 6 wrong, you don't see questions 7-12. Your young nephew has gotten a hold of your phone and is touching answers completely at random.

Let X be the number of questions your nephew answers correctly.

A) [1 pt] Explain why X cannot be a binomial random variable.

B) [1 pt] Explain how to change the HQ Trivia rules so that X can be a binomial random variable.

C) [1.5 pts] Using your solution to part (B), identify the parameters n and p of the distribution of X.

D) [1.5 pts] Using your solution to part (C), how many questions would you expect your nephew to answer correctly?

5. Read the following excerpt from an Ig Nobel Prize-winning paper:

“The analysis included 64 participants who had travelled over speed bumps on their journey to hospital. Of these, 34 had a confirmed histological diagnosis of appendicitis, 33 of whom reported increased pain over speed bumps. The sensitivity was 97%...the specificity was 30%...the positive predictive value was 61%...”

A. [1 pt] What was a case in this study?

B. [0.5 pts] The proportion of the 64 patients who were diagnosed with appendicitis is a… (circle one)

a) sample proportion

b) population proportion

c) conditional probability

d) population proportion *and* conditional probability

C) [1 pt] What proportion of patients who reported increased pain over speed bumps were diagnosed with appendicitis?

D) [4 pts] From the data, estimate the negative predictive value of the speed bump test for appendicitis. Give your answer rounded to the nearest percent.