

MID-TERM

You can only use the faculty approved calculator with sticker.

Pens, pencils, erasers, and straight edges only. No crib sheets. NO CELL PHONES.

If you have a difficulty you may try making REASONABLE assumptions. State the assumption and how that assumption limits your answer. Justify your responses.

1. A security camera is used to monitor a particular surveillance area to report whether there is any threat present or not. The probability that the camera correctly detects an actual threat as "threat found" is 0.8. The probability that the camera correctly reports no threat as "no threat found" is 0.9. Suppose the probability of an actual threat being present in the surveillance area is 0.6.
 - a. What is the probability that the camera reports "threat found"? (4 Marks)
 - b. Given that the camera reports "threat found", what is the probability that there are actual threats in the surveillance area? (3 Marks)

Answer parts c) and d) by assuming that an actual threat is always present (i.e., probability of threat presence is 1)

- c. What is the probability that the camera reports "threat found"? (1 Mark)
 - d. An identical second camera is used to increase the accuracy of threat reporting capability. The cameras are operating independently and monitoring the same surveillance area. Find the probability that the combined system reports the threat accurately (at least one camera should report "threat found"). (2 Marks)
2. Continuous Random variables.
 - a. Assume a random variable X is normally distributed with a mean of 10 and a variance of 16. Find A such that $P(X > A) = 0.7$. (4 marks)

Now consider the probability function $g(x)$

$$g(x) = \begin{cases} kx & 0 < x < 10 \\ 0 & \text{elsewhere} \end{cases}$$

- b. Find the value of k . (3 marks)
 - c. Calculate $P(5 < X < 10)$. (3 marks)
3. Parts come off the line one by one. Since the line has just been started up it is not very good and the probability that any one part is defective is 0.1. Assume that the defectiveness of different parts is independent of one another.
 - a. What is the probability that part 14 or 15 is the 1st defective part? (3 marks)
 - b. What is the mean number of parts that one will examine before the first defective part? (2 marks)
 - c. What is the probability that part 14 or 15 will be the second defective part? (3 marks)
 - d. Consider now a new random variable Z with the following pmf $f(z)$

z	-1	0	1	2
$f(z)$	0.1	0.4	0.2	0.3

Calculate the mean of Z , $E[Z]$. (2 marks)