AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING

CREDIT HOURS ENGINEERING PROGRAMS

CHEP BLDG / CESS / MCTA / MANF / ERGY Programs

Mid Term Exam

Spring 2019 ***Exam Date :*** ***Exam Time 01:00 H.***

Statistics and Probability for Engineeing – PHM 114

The Exam Consists of **Four** Questions in **Four** Pages ***Total Marks: 25 Marks***

Name:		ID:
Major:	Group:	Section:

Answer all Questions

Question1: (8 Marks)

i) (4marks) A batch of 500 containers for frozen orange juice contains 5 that are defective. Two are selected, at random, without replacement from the batch.

a) What is the probability that the second one selected is defective given that the first one was defective?

b) What is the probability that both are defective?

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ii)(4marks) In a semiconductor manufacturing process, three wafers from a lot are tested. Each wafer is classified as pass or fail. Assume that the probability that a wafer passes the test is 0.8 and that wafers are independent.

(a)Determine the probability mass function of the number of wafers from a lot that pass the test.

(b) Find mean and standard deviation

Question2: (6 Marks)

Suppose that a day's production of 850 manufactured parts contains 50 parts that do not conform to customer requirements.

Two parts are selected at random, without replacement, from the batch.

Let the random variable X equal the number of nonconforming parts in the sample.

What is the cumulative distribution function of X?

Question 3: (6 Marks)

(a)(2marks)The range of the random variable X is $\{0, 1, 2, 3, x\}$, where x is unknown .If each value is equally likely and the mean of X is 6 , determine x.

(b)(4 marks)Determine the cumulative distribution function of a binomial random variable with n=3 and p = $\frac{1}{2}$.

Question 4: (5 Marks)

(a)(3 marks) If A and B are events in a sample space S for which
P(A) = 0.5, P(B) = 0.4, P(A ∪ B) = 0.8.

Find (i) P(A∩B) (ii) P(A $|B'$) (iii) P(A' $|B'$)

(b) (2marks) Suppose that $P(A|B) = 0.2$, $P(A|B') = 0.3$ and $P(B) = 0.8$
What is P(A) ?

GOOD LUCK

Examination Committee :Prof .Salwa Ishak, Prof. Hamdy Ahmed , *Dr. Mahmoud Abd-Almo'men*
Dr. Tamer Ismail

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Mid Term Exam **Model answer**

Spring 2019 ***Exam Date :*** ***Exam Time 01:00 H.***

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Name:		ID:
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Answer all Questions

Question1: (8 Marks)

i) (4marks) A batch of 500 containers for frozen orange juice contains 5 that are defective. Two are selected, at random, without replacement from the batch.

a) What is the probability that the second one selected is defective given that the first one was defective?

b) What is the probability that both are defective?

a) 4/499 = 0.0080
b) (5/500)(4/499) = 0.000080

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b)(4marks) In a semiconductor manufacturing process, three wafers from a lot are tested. Each wafer is classified as pass or fail. Assume that the probability that a wafer passes the test is0.8 and that wafers are independent.

(i)Determine the probability mass function of the number of wafers from a lot that pass the test.

(ii) Find mean and standard deviation

X = number of wafers that pass

$P(X=0) = (0.2)^3 = 0.008$

$P(X=1) = 3(0.2)^2(0.8) = 0.096$

$P(X=2) = 3(0.2)(0.8)^2 = 0.384$

$P(X=3) = (0.8)^3 = 0.512$

Mean and variance for random variable in exercise 3-22

$$\mu = E(X) = 0f(0) + 1f(1) + 2f(2) + 3f(3)$$
$$= 0(0.008) + 1(0.096) + 2(0.384) + 3(0.512) = 2.4$$

$$V(X) = 0^2 f(0) + 1^2 f(1) + 2^2 f(2) + 3^2 f(3) - \mu^2$$
$$= 0^2(0.008) + 1(0.096) + 4(0.384) + 9(0.512) - 2.4^2 = 0.48$$

Standard deviation=$\sqrt{0.48}$

Question2: (6 Marks)

Suppose that a day's production of 850 manufactured parts contains 50 parts that do not conform to customer requirements. Two parts are selected at random, without replacement, from the batch. Let the random variable X equal the number of nonconforming parts in the sample.

What is the cumulative distribution function of X?

$$P(X = 0) = \frac{800}{850} \cdot \frac{799}{849} = 0.886$$
$$P(X = 1) = 2 \cdot \frac{800}{850} \cdot \frac{50}{849} = 0.111$$
$$P(X = 2) = \frac{50}{850} \cdot \frac{49}{849} = 0.003$$

Therefore,

$$F(0) = P(X \le 0) = 0.886$$
$$F(1) = P(X \le 1) = 0.886 + 0.111 = 0.997$$
$$F(2) = P(X \le 2) = 1$$

Question 3: (6 Marks)

(a)(2marks)The range of the random variable X is$\{0, 1, 2, 3, x\}$, where x is unknown .If each value is equally likely and the mean of X is 6 ,determine x.

Determine x where range is [0,1,2,3,x] and mean is 6.

$$\mu = E(X) = 6 = 0f(0) + 1f(1) + 2f(2) + 3f(3) + xf(x)$$

$$6 = 0(0.2) + 1(0.2) + 2(0.2) + 3(0.2) + x(0.2)$$

$$6 = 1.2 + 0.2x$$

$$4.8 = 0.2x$$

$$x = 24$$

(b)(4 marks)Determine the cumulative distribution function of a binomial random variable with n=3 and p = $\frac{1}{2}$.

3-60 n=3 and p=0.5

$$F(x) = \begin{cases} 0 & x < 0 \\ 0.125 & 0 \le x < 1 \\ 0.5 & 1 \le x < 2 \\ 0.875 & 2 \le x < 3 \\ 1 & 3 \le x \end{cases}$$ where

$$f(0) = \left(\frac{1}{2}\right)^3 = \frac{1}{8}$$

$$f(1) = 3\left(\frac{1}{2}\right)\left(\frac{1}{2}\right)^2 = \frac{3}{8}$$

$$f(2) = 3\left(\frac{1}{4}\right)^2\left(\frac{3}{4}\right) = \frac{3}{8}$$

$$f(3) = \left(\frac{1}{4}\right)^3 = \frac{1}{8}$$

Question 4: (5 Marks)

(a)(3 marks) If A and B are events in a sample space S for which

P(A) = 0.5, P(B) = 0.4, P(A ∪ B) = 0.8.

Find (i) P(A∩B) (ii) P(A \ B) (iii) P(A′ \ B′)

(i) $P(A \cap B) = \mathrm{P(A)} + \mathrm{P(B)} - \mathrm{P(A \cup B)} = 0.5 + 0.4 - 0.8 = 0.1$

(ii) $P(A|B) = \frac{P(A \cap B)}{P(B)} = \frac{0.1}{0.4} = \frac{1}{4}$

(iii) $P(A'|B') = \frac{P(A' \cap B')}{P(B')} = \frac{1-0.8}{0.6} = \frac{1}{3}$

(b) (2marks) Suppose that

$P(A|B) = 0.2$, $P(A|B') = 0.3$ **and** $P(B) = 0.8$ **. What is P(A) ?**

(b) $P(A) = P(A \cap B) + P(A \cap B') = P(A|B)\,P(B) + P(A|B)')$
=(0.2)(0.8)+(0.3)(0.2) =0.22

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