มหาวิทยาลัยสงขลานครินทร์

คณะวิศวกรรมศาสตร์

การสอบกลางภาค ประจำภาคการศึกษาที่ 2 ปีการศึกษา : 2548

วันที่ : 13 ธันวาคม 2548 เวลา : 13:30 – 16:30

วิชา : 240-361 Introduction to Queueing Theory ห้อง : A401

ทุจริตในการสอบ โทษขั้นต่ำคือ ปรับตกในรายวิชาที่ทุจริต และพักการเรียนหนึ่งภาคการศึกษา

คำสั่ง

1. ข้อสอบมี 7 ข้อ 10 หน้า (ไม่รวมปก)
2. ห้ามนำเครื่องคิดเลขเข้าห้องสอบ
3. แสดงวิธีทำและเขียนคำตอบให้ชัดเจน ถ้าอ่านไม่ออกถือว่าตอบผิด
4. อนุญาตให้จดบันทึกเขียนด้วยลายมือขนาด A4 เข้าห้องสอบ

รหัสนักศึกษา : ____________ ชื่อ : ____________________________ ตอน : ____

คำถาม	1	2	3	4	5	6	7	Total
คะแนน								

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1. Suppose a cellular telephone is equally likely to make zero handoffs (H_0), one handoff (H_1), or more than one handoff (H_2). Also, a caller is either on foot (F) with probability 5/12 or in a vehicle (V). Suppose we also learn that ¼ of all callers are on foot making calls with no handoffs and that 1/6 of all callers are vehicle users making calls with a single handoff. Given these additional facts, *find all possible ways to fill in the table of probabilities(e.g. find p_o, p_1, p_2, q_0, q_1, q_2).* (6 marks)

Probability table

	H_0	H_1	H_2
F	p_0	p_1	p_2
V	q_0	q_1	q_2

Answer____

2. . Given a packet is corrupted with probability ε. From the following applications, *give the name of random variable* (3marks)

   (a) Let Y denote the number of packet received in error out of 100 packets transmitted. Y has the PMF

$$P_Y(y) = \begin{cases} \binom{100}{y}(\varepsilon)^y(1-\varepsilon)^{100-y} & y = 0,1,\ldots,100 \\ 0 & otherwise \end{cases}$$

   The expected values of Y is E[Y] = 100ε

Answer____

(b) If packet arrivals with an average arrival rate of 1000 packets per second, then the number N of packets that arrive in 5 seconds has the PMF

$$P_N(n) = \begin{cases} 5000^n e^{-5000}/n! & n = 0,1,\ldots \\ 0 & otherwise \end{cases}$$

The expected value of N is E[N] =5000

Answer

(c) Let L equal the number of packets that must be received to decode 5 packets in error. L has the PMF

$$P_L(l) = \begin{cases} \binom{l-1}{4} \varepsilon^5 (1-\varepsilon)^{l-5} & l = 5,6,\ldots \\ & otherwise \\ 0 & \end{cases}$$

The expected value of L is E[L] = 5/ε

Answer

3. In a packet voice communications system, a source transmits packets containing digitized speech to a receiver. Because transmission errors occasionally occur, an acknowledgment (ACK) or a nonacknowledgment (NAK) is transmitted back to the source to indicate the status of each received packet. When the transmitter gets a NAK, the packet is retransmitted. Voice packets are delay sensitive and a packet can be transmitted a maximum of d times. If a packet transmission is an independent Bernoulli trial with success probability p, answer the following questions.

   What is the PMF of T, the number of times a packet is transmitted? (3 marks)

Answer

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4. A source wishes to transmit data packets to a receiver over a radio link. The receiver uses error detection to identify packets that have been corrupted by radio noise. When a packet is received error-free, the receiver sends an acknowledgment (ACK) back to the source. When the receiver gets a packet with errors, a negative acknowledgment (NAK) message is sent back to the source. Each time the source receives a NAK, the packet is retransmitted. We assume that each packet transmission is independently corrupted by errors with probability q.

   (a) *Find the PMF of X, the number of times that packet is transmitted by the source*

   (3 marks)

Answer____

   (b) Suppose each packet takes 1 millisecond to transmit and that the source waits an additional millisecond to receiver the acknowledgment message (ACK or NAK) before retransmitting. Let <u>*T* equal the time required until the packet is successfully received</u>. *What is the relationship between T and X?* (1 marks)

Answer____

(c) From question 4(a) *what is the PMF of T if* $T = 2X - 1$? (3 marks)

Answer

(d) *Find the expected values of the random variable T* (5 marks)

Given $\sum_{x=1}^{\infty} q^x = \frac{1}{1-q}$ and $\sum_{x=1}^{\infty} xq^x = \frac{q}{(1-q)^2}$ when $|q| < 1$

Answer

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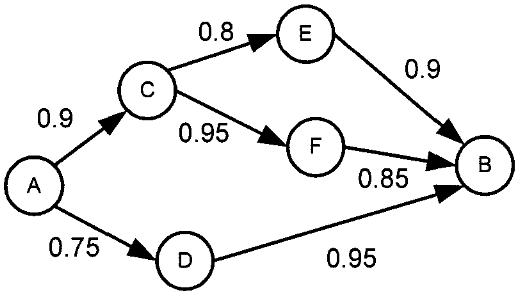
5. A computer network connects two nodes A and B through intermediate nodes C, D, E, F as shown below. For every pair of directly connected nodes, say *i* and *j*, there is a given probability p_{ij} that the link from *i* to *j* is up. We assume that link failures are independent of each other. *What is the probability that there is a path connecting A and B in which all links are up?* (6 marks)



Answer____

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6. Random variable X has the PDF:

$$f_X(x) = \begin{cases} c\dfrac{x}{2}e^{-x/2} & x \geq 0 \\ 0 & otherwise \end{cases}$$

Find the following: (10 marks)

(a) The constant c.(4 marks)

Answer

(b) The CDF $F_X(x)$. (4 marks)

Answer

(c) $P[0 \le X \le 6]$ (1 mark)

Answer

(d) $P[-4 \le X \le 4]$ (1 mark)

Answer

7. The peak temperature T, as measured in degrees Fahrenheit, on an April day in Bangkok is the Gaussian (85, 10) random variable. Find the following: (10 marks)

z	$\Phi(z)$
1	0.841
1.5	0.933
2	0.977
2.5	0.993

(a) $P[T > 100]$ (2 marks)

Answer

(b) $P[T < 60]$ (2 marks)

Answer

(c) $P[70 \leq T \leq 100]$ (3 marks)

Answer

(d) Use information from questions above, sketch *the PDF $f_T(t)$ showing the center of the bell*, the area under the bell and the height of the peak. (3 marks)

Answer