CS 498 Probability and Statistics for Computer Science Undergraduates

Instructor: D.A. Forsyth

Midterm Exam 2014

NAME	NETID

Instructions:

1) Please fill in your name and netid

2) Then fill in the right answers and return.

Information: You have 50 mins. If you answer every question correctly, you will get 34 marks. We will mark this exam out of 30, so you can miss some answers and still get full marks. Good luck.

By submitting this exam for grading, you are asserting that the answers are your own unaided work.

Question	Out of	Marks
1	5	
2	5	
3	5	
4	4	
5	4	
6	5	
7	6	

Q1: In a population, the correlation coefficient between family income and child IQ is 0.30. The mean family income was $60, 000. The standard deviation in income is $20, 000. IQ is measured on a scale such that the mean is 100, and the standard deviation is 15.

a) Using this information, predict the expected IQ of a child whose family income is $70, 000 (2)

b) How reliable do you expect this prediction to be? Why? (your answer should be a property of correlation, not an opinion about IQ) (2)

c) The family income now rises — does the correlation predict that the child will have a higher IQ? Why? (1)

Q2: A coin game that is occasionally played is “odd person out”. In this game, there are rounds. In a round, each person flips a coin. There is an odd person out in that round if all but one have H and the other has T, OR all but one have T and the last has H.

a) Three people play one round. What is the probability that there is an odd person out? (1)

b) Now four people play one round. What is the probability that there is an odd person out? (2)

c) Five people play until there is an odd person out. What is the expected number of rounds that they will play? (2)

Q3: You take a standard deck of playing cards, and remove a red 3 and a black 5. You then draw a single card.

a) Write A for the event you draw a 6. What is P(A)? (1)

b) Write B for the event you draw a red card. What is P(B)? (1)

c) Are A and B independent? Why? (1)

d) Write C for the event you draw a 3. What is P(C)? (1)

e) Are B and C independent? Why? (1)

Q4: You roll a die 1000 times. Using the normal approximation to the binomial distribution, write an expression for the probability that you roll a six between 100 and 200 times. (4)

Q5: You observe a random number generator. You know that it can produce the values -2, -1, 0, 1, or 2. You are told that it has been adjusted so that

(1) the mean value it produces is zero and

(2) the standard deviation of the numbers it produces is 1/2.

a) Write A for the event that the number generator produces a number that is not 0. Use Chebyshev's inequality to bound P(A) (2)

b) Write B for the event that the number generator produces -2 or 2. Use Chebyshev's inequality to bound P(B) (2)

Q6: You roll two six sided dice. Write A for the event that the first die produces an even number. Write B for the event that the second die produces an odd number. Write S for the event the sum of values is even.

a) What is P(A)? (1)

b) What is P(B)? (1)

c) What is P(B|A)? (1)

d) What is P(S|B)? (1)

e) What is P(S|A, B)? (1)

Q7: A student takes a multiple choice test. Each question has N answers. If the student knows the answer to a question, the student gives the right answer, and otherwise guesses uniformly and at random. The student knows the answer to 70% of the questions. Write K for the event a student knows the answer to a question and R for the event the student answers the question correctly.

a) What is P(K)? (1)

b) What is P(R|K)? (1)

c) What is P(R)? (1)

c) What is P(K|R), as a function of N? (2)

d) What values of N will ensure that P(K|R)>.99? (2)