

TRINITY COLLEGE DUBLIN  
School of Computer Science and Statistics

**Extra Questions**

ST3009: Statistical Methods for Computer Science

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**NOTE: There are many more example questions in Chapters 2 and 3 of the course textbook “A First Course in Probability” by Sheldon Ross.**

**Question 1.** A box contains 3 marbles: 1 red, 1 green, and 1 blue. Consider an experiment that consists of taking 1 marble from the box and then replacing it in the box and drawing a second marble from the box. Describe the sample space. Repeat when the second marble is drawn without replacing the first marble.

**Question 2.** Two dice are thrown. Let  $E$  be the event that the sum of the dice is odd, let  $F$  be the event that at least one of the dice lands on 1, and let  $G$  be the event that the sum is 5. Describe the events  $E \cap F$ ,  $E \cup F$ ,  $F \cap G$ ,  $E \cap F^c$ , and  $E \cap F \cap G$ .

**Question 3.** A committee of 5 is to be selected from a group of 6 men and 9 women. If the selection is made randomly, what is the probability that the committee consists of 3 men and 2 women?

**Question 4.** An urn contains  $n$  balls, one of which is special. If  $k$  of these balls are withdrawn one at a time, with each selection being equally likely to be any of the balls that remain at the time, what is the probability that the special ball is chosen?

**Question 5.** If a six-sided die is rolled 4 times, what is the probability that 6 comes up at least once?

**Question 6.** A coin is flipped twice. Assuming that all four points in the sample space  $S = \{(h, h), (h, t), (t, h), (t, t)\}$  are equally likely, what is the conditional probability that both flips land on heads, given that (a) the first flip lands on heads? (b) at least one flip lands on heads?

**Question 7.** Suppose that an urn contains 8 red balls and 4 white balls. We draw 2 balls from the urn without replacement. Let  $R1$  and  $R2$  denote, respectively, the events that the first and second balls drawn are red.

(a) If we assume that at each draw each ball in the urn is equally likely to be chosen, what is the probability  $P(R1 \cap R2)$  that both balls drawn are red?

(b) Using marginalisation, what is the probability  $P(R2)$  that the second ball is red.

**Question 8.** I toss a coin. If it comes up tails I throw a six-sided die and otherwise a 20-sided die.

(a) What is the probability that a 5 is thrown ?

(b) What is the probability that a 15 is thrown ?

Hint: use marginalisation

**Question 9.** An insurance company believes that people can be divided into two classes: those who are accident prone and those who are not. The company's statistics show that an accident-prone person will have an accident at some time within a fixed 1-year period with probability 0.4, whereas this probability decreases to 0.2 for a person who is not accident prone.

(a) If we assume that 30 percent of the population is accident prone, what is the probability that a new policyholder will have an accident within a year of purchasing a policy? Hint: use marginalisation.

(b) Suppose that a new policyholder has an accident within a year of purchasing a policy. What is the probability that he or she is accident prone? Hint: use Bayes rule.

**Question 10.** In answering a question on a multiple-choice test, a student either knows the answer or guesses. Let  $p$  be the probability that the student knows the answer and  $1 - p$  be the probability that the student guesses. Assume that a student who guesses at the answer will be correct with probability  $1/m$ , where  $m$  is the number of multiple-choice alternatives. What is the conditional probability that a student knew the answer to a question given that he or she answered it correctly? Hint: use Bayes rule.

**Question 11.** A bin contains 3 different types of disposable flashlights. The probability that a type 1 flashlight will give over 100 hours of use is 0.7, with the corresponding probabilities for type 2 and type 3 flashlights being 0.4 and 0.3, respectively. Suppose that 20 percent of the flashlights in the bin are type 1, 30 percent are type 2, and 50 percent are type 3. What is the probability that a randomly chosen flashlight will give more than 100 hours of use?

**Question 12.** There are 8 cards in a hat:  $1\heartsuit, 1\spadesuit, 1\diamondsuit, 1\clubsuit, 2\heartsuit, 2\spadesuit, 2\diamondsuit, 2\clubsuit$ . You draw one card uniformly at random. If its rank is 1 you stop otherwise you draw one more card. Let  $X$  be the sum of the ranks on the one or two cards drawn.

- (a) What is the probability that one card is drawn ?
- (b) What is the probability that two cards are drawn ?
- (c) Find  $Prob(X = 1)$
- (d) Find  $Prob(X = 3)$
- (e) Find  $Prob(X = 4)$ .

**Question 13.** There are four dice in a drawer, one with 4 sides, one with 6 sides and two with 8 sides. You pick one uniformly at random. Let  $S$  be the number of sides of the chosen die.

- (a) What is the probability that  $S = 4$
- (b) What is the probability that  $S = 6$
- (c) What is the probability that  $S = 8$  ?
- (d) Without looking at the die to see what type it is, suppose you throw it and observe a 3. Using Bayes Rule calculate the probability that the die was 4 sided ...
- (e) ... and the probability that it was 6-sided.
- (f) Which is the most likely die if a 6 is observed ?
- (g) And if a 7 is observed ?