King Fahd University of Petroleum and Minerals

College of Computing and Mathematics

Information and Computer Science Department

ICS 560: Foundations of Quantum Computing

Semester 251 Quiz #3

Name: ..... Answer Key ..... ID #..... Date: 17/10/2025

Show all the necessary steps to earn full marks.

Q1: A fair six-sided die is rolled twice.

a) What is the probability that the sum of the two rolls equals 8?

b) What is the probability that at least one roll shows a number greater than 4?

Sample space : $6 \times 6 = 36$

(a) $\text{Sum}(a,b) = 8 : (2,6), (3,5), (4,4), (5,3), (6,2)$

$\therefore P(\text{Sum}=8) = \frac{5}{36}$

(b) $P(\text{number} > 4) = 1 - P(\text{number} \leq 4)$

$P(\text{number} \leq 4) = \left(\frac{4}{6}\right)^2 = \frac{16}{36} = \frac{4}{9}$

$\therefore P(\text{number} > 4) = 1 - \frac{4}{9} = 5/9$ *

Q2: A communication channel transmits bits with an error probability of 0.1.

If **5 bits** are transmitted independently,

a) What is the probability that exactly one bit is received in error?

b) Find the probability that at most two bits are received in error.

$pr(\text{error}) = 0.1$ $\quad n = 5$

$pr(\text{correct}) = 0.9$

(a) $k = 1$

$\therefore P(x=k) = C(n,k)\, p^k q^{n-k}$

$P(x=1) = C(5,1)\,(0.1)^1 (0.9)^4$

$= 5(0.1)(0.9)^4$

$= 5(0.1)(0.6561) = 0.32805$

(b) $P(x \leq 2) = P(x=0) + P(x=1) + P(x=2)$

$= C(5,0)(0.1)^0 (0.9)^5 + 0.32805 + C(5,2)(0.1)^2 (0.9)^3$

$= 0.59049 + 0.32805 + 0.0729$

$= 0.99144$

Q3: A fair coin is tossed **three times**. Let the random variable X denote the **number of tails** observed.

a) Determine the **probability distribution** of X.
b) Compute the **expected value** $E[X]$.

Let X be number of tails observed.

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X	P(x)	X P(x)
3	1/8	3/8
2	3/8	6/8
1	3/8	3/8
0	1/8	0

$$\therefore \text{(b)}\quad E(x) = \sum_{X=0}^{3} X P(X) = \frac{3}{8} + \frac{6}{8} + \frac{1}{8} + 0 = \frac{12}{8} = 1.5$$

Q4: Multiple Choice Questions

1) A fair six-sided die is rolled once. What is the probability of getting a number greater than 4?

A. 1/6

B. 1/3

C. 1/2

D. 2/3

2) The probability that it rains on a given day is 0.3. What is the probability that it does not rain on that day?

A. 0.2

B. 0.5

C. 0.7

D. 0.9

3) A bag contains 5 red and 3 blue balls. Two balls are drawn without replacement. The probability that the second ball is blue, given that the first ball drawn is red is:

A. 3/7

B. 3/8

C. 4/7

D. 5/8

Given, the first ball drawn is red.
remaining balls = 7
remaining blue = 3

$= P(2^{nd} \text{ blue} \mid 1^{st} \text{ red}) = \frac{3}{7}$