

# EE23010 Assignment

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Question 12.13.3.11

Prove that

$$(i) \Pr(A) = \Pr(AB) + \Pr(A\bar{B})$$

$$(ii) \Pr(A + B) = \Pr(AB) + \Pr(A\bar{B}) + \Pr(\bar{A}B)$$

**Solution:** Let  $A$  and  $B$  be two events with probabilities  $\Pr(A)$  and  $\Pr(B)$  respectively.

(i) consider *RHS*:

$$\Pr(A) = \Pr(A(B + \bar{B})) \quad (1)$$

$$= \Pr(AB + A\bar{B}) \quad (2)$$

$$= \Pr(AB) + \Pr(A\bar{B}) - \Pr((AB)(A\bar{B})) \quad (3)$$

$$= \Pr(AB) + \Pr(A\bar{B}) - \Pr(AB\bar{B}) \quad (4)$$

$$= \Pr(AB) + \Pr(A\bar{B}) - 0 \quad (5)$$

$$= \Pr(AB) + \Pr(A\bar{B}) \quad (6)$$

From (6)

$$\Pr(A) = \Pr(AB) + \Pr(A\bar{B}) \quad (7)$$

$$\therefore LHS = RHS \quad (8)$$

(ii) consider *RHS*:

$$\Pr(A + B) = \Pr(A) + \Pr(B) - \Pr(AB) \quad (9)$$

$$= \Pr(AB) + \Pr(A\bar{B}) + \Pr(BA) + \Pr(\bar{A}B) - \Pr(AB) \quad (10)$$

$$= \Pr(AB) + \Pr(A\bar{B}) + \Pr(\bar{A}B) \quad (11)$$

Using the result (7), we have proved:

$$\Pr(A + B) = \Pr(AB) + \Pr(A\bar{B}) + \Pr(\bar{A}B) \quad (12)$$

$$\therefore LHS = RHS \quad (13)$$