

AARHUS UNIVERSITY

COMPUTER-SCIENCE

INTRODUCTION TO PROBABILITY AND STATISTICS

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# Handin 1

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## Problem 14

Let A and B be two events such that

$$P(A) = 0.4 \quad P(B) = 0.7 \quad P(A \cup B) = 0.9$$

**Question (a) find  $P(A \cap B)$**

We use the 'inclusion-exclusion-principle'

$$P(A \cap B) = P(A) + P(B) - P(A \cup B)$$

$$0.2 = 0.4 + 0.7 - 0.9$$

**Question (b) find  $P(A^c \cap B)$**

$P(A^c \cap B)$  can be rewritten as  $P(B) - P(A \cap B)$ , this can be found from the equation in figure 1.16, which is values we know

$$P(A^c \cap B) = P(B) - P(A \cap B)$$

$$0.5 = 0.7 - 0.2$$

**Question (c) find  $P(A - B)$**

$P(A - B)$  is just another way to write  $P(A \cap B^c)$ , which is noted in figure 1.8 from the book, hence we get

$$P(A - B) = P(A) - P(A \cap B)$$

$$0.2 = 0.4 - 0.2$$

**Question (d) find  $P(A^c - B)$**

Again another way to write  $P(A^c \cap B^c)$ .

We can use De-morgans law

$$P(A^c \cap B^c) = P((A \cup B)^c)$$

We can remove the 'complement' by subtracting 1

$$P((A \cup B)^c) = 1 - P(A \cup B)$$

Now we can derive the probability since we already know the probability of  $P(A \cup B)$

$$0.1 = 1 - 0.9$$

**Question (e) find  $P(A^c \cup B)$**

We use the 'inclusion-exclusion-principle' again

$$P(A^c \cup B) = P(A^c) + P(B) - P(A^c \cap B)$$

$$0.8 = 0.6 + 0.7 - 0.5$$

**Question (f) find  $P(A \cap (B \cup A^c))$**

We use the distributive law

$$P(A \cap (B \cup A^c)) = P((A \cap B) \cup (A \cap A^c))$$

The set  $(A \cap A^c)$  is the empty set  $\phi$  so we are left with the set  $(A \cap B)$ , and we know the probability of this set from (a)

$$P(A \cap (B \cup A^c)) = P(A \cap B) = 0.2$$