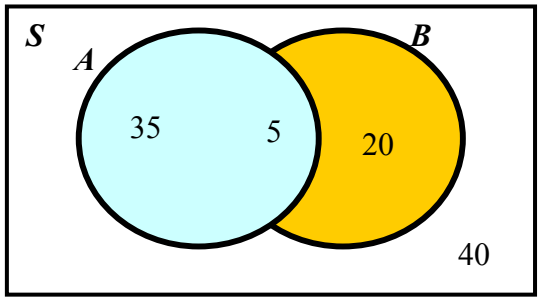
University of Maryland, College Park
Department of Civil & Environmental Engineering

Quiz 2, **Closed book & notes, for 15 minutes**
October 5, 2001

ENCE 302
Probability and Statistics for Civil Engineers **Name:**_____

Problem 1

Refer to the Venn diagram shown below for event A and B in the sample space S. Find each of the indicated probabilities.



a. $P(A)$ and $P(\overline{A})$

$$P(A) = \frac{35+5}{35+5+20+40} = \frac{40}{100} = 0.4$$

$$P(\overline{A}) = 1 - 0.4 = 0.6$$

b. $P(B)$ and $P(\overline{B})$

$$P(B) = \frac{5+20}{35+5+20+40} = \frac{25}{100} = 0.25$$

$$P(\overline{B}) = 1 - 0.25 = 0.75$$

c. $P(A \cap B)$ and $P(\overline{A} \cap \overline{B})$

$$P(A \cap B) = \frac{5}{35+5+20+40} = \frac{5}{100} = 0.05$$

$$P(\overline{A} \cap \overline{B}) = \frac{40}{35+5+20+40} = \frac{40}{100} = 0.4$$

d. $P(\overline{A} \cap B)$ and $P(A \cap \overline{B})$

$$P(\overline{A} \cap B) = \frac{20}{100} = 0.20 \quad \text{and} \quad P(A \cap \overline{B}) = \frac{35}{100} = 0.35$$

e. $P(A \cup B)$ and $P(\overline{A \cup B})$

$$P(A \cup B) = P(A) + P(B) - P(A \cap B) = 0.40 + 0.25 - 0.05 = 0.6$$

$$P(\overline{A \cup B}) = 1 - P(A \cup B) = 1 - 0.60 = 0.40, \text{ Also, } P(\overline{A \cup B}) = P(\overline{A} \cap \overline{B}) = 0.4$$

Problem 2

If the sample space $S = \{0, 1, 2, 3, 4, 5, 6, 7, 8, 9\}$ and $A = \{0, 2, 4, 6, 8\}$, $B = \{1, 3, 5, 7, 9\}$, $C = \{2, 3, 4, 5\}$, and $D = \{1, 6, 7\}$, list the elements of the sets corresponding to the following events:

a) $A \cup C$

$$A \cup C = \{0,2,3,4,5,6,8\}$$

b) $A \cap B$

$$A \cap B = \varnothing = \text{empty set or impossible event}$$

c) $\overline{C}$

$$\overline{C} = \{0,1,6,7,8,9\}$$

d) $\left(\overline{C} \cap D\right) \cup B$

$$\left(\overline{C} \cap D\right) \cup B = \{1,6,7\} \cup B = \{1,3,5,6,7,9\}$$

e) $\overline{S \cap C}$

$$\overline{S \cap C} = \overline{S} \cup \overline{C} = \varnothing \cup \overline{C} = \{0,1,6,7,8,9\}$$

Formulas

Rule Type	Operations
Identity Laws	$A\cup\varnothing = A,\ A\cap\varnothing = \varnothing,\ A\cup S = S,\ A\cap S = A$
Idem potent Laws	$A\cup A = A,\ A\cap A = A$
Complement Laws	$A\cup\overline{A} = S,\ A\cap\overline{A} = \varnothing,\ \overline{\overline{A}} = A,\ \overline{S} = \varnothing,\ \overline{\varnothing} = S$
Commutative Laws	$A\cup B = B\cup A,\ A\cap B = B\cap A$
Associative Laws	$(A\cup B)\cup C = A\cup(B\cup C),\ (A\cap B)\cap C = A\cap(B\cap C)$
Distributive Laws	$(A\cup B)\cap C = (A\cap C)\cup(B\cap C)$ $(A\cap B)\cup C = (A\cup C)\cap(B\cup C)$
De Morgan's Law	$\overline{(A\cup B)} = \overline{A}\cap\overline{B},\ \overline{(E_1\cup E_2\ldots\cup E_n)} = \overline{E_1}\cap\overline{E_2}\ldots\cap\overline{E_n}$ $\overline{(A\cap B)} = \overline{A}\cup\overline{B},\ \overline{(E_1\cap E_2\cap\ldots\cap E_n)} = \overline{E_1}\cup\overline{E_2}\cup\ldots\cup\overline{E_n}$
Combinations of Laws	$\overline{(A\cup(B\cap C))} = \overline{A}\cap\overline{(B\cap C)} = (\overline{A}\cap\overline{B})\cup(\overline{A}\cap\overline{C})$

$$\overline{X} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

$$COV = \frac{\text{standard deviation}}{\text{mean (or average)}} = \frac{S}{\overline{X}}$$

$$S^2 = \frac{1}{n-1}\sum_{i=1}^{n}(x_i - \overline{X})^2$$

$$S^2 = \frac{1}{n-1}\left[\sum_{i=1}^{n} x_i^2 - \frac{1}{n}\left(\sum_{i=1}^{n} x_i\right)^2\right]$$

OR

$$S^2 = \frac{1}{n-1}\left[\sum_{i=1}^{n} x_i^2 - n\overline{X}^2\right]$$