

## M118 SECTION 8.2 – UNION, INTERSECTION, and COMPLEMENT ; ODDS

1)  $A \cup B = A \text{ or } B$                        $A \cap B = A \text{ and } B$

Ex: Experiment- Roll a fair die

$$S = \{1, 2, 3, 4, 5, 6\}$$

- a) What is the probability of rolling an odd number **and** exactly divisible by 3

Let  $A =$  event of rolling an odd number                       $B =$  exactly divisible by 3  
so  $P(\text{roll an odd number and exactly divisible by 3}) = A \cap B = \{3\}$

$$P(A \cap B) = \frac{n(A \cap B)}{n(S)} = \frac{1}{6}$$

- b) probability of odd **or** exactly divisible by 3

$$(A \cup B) = \{1, 3, 5, 6\}$$

$$P(A \cup B) = \frac{n(A \cup B)}{n(S)} = \frac{4}{6} = \frac{2}{3}$$

- c) probability of odd **and** prime

$$A = \text{event odd} = \{1, 3, 5\}$$

$$C = \text{event prime} = \{2, 3, 5\}$$

$$P(A \cap C) = \frac{2}{6} = \frac{1}{3}$$

- d) probability of odd **or** prime

$$P(A \cup C) = \frac{4}{6} = \frac{2}{3}$$

Ex: Suppose 2 fair dice are rolled:

- a) What is the probability of a sum of 7 or 11?

- b) What is the probability that both dice are same or a sum less than 5?

- c) What is the probability of a sum of 2 or 3 turns up?

d) What is the probability that both numbers are the same or sum greater than 8?

What is the probability that a number selected at random from the first 140 positive integers is exactly divisible by 4 or 6?

Suppose we divide a sample space  $S$  is divided into 2 subsets  $E$  and  $E'$  such that

$$E \cap E' = \emptyset \quad \text{and} \quad E \cup E' = S$$

Then  $E$  is called the complement of  $E'$  and

$$P(S) = P(E \cup E') = P(E) + P(E') = 1$$

so  $P(E) = 1 - P(E')$

If the probability of rain is 65% then the probability of no rain is 35% ( $1 - .65$ ).

Sometimes it is easier to find the probability of the complement than the probability of the event.

**Ex:** A shipment of 40 precision parts, including 8 that are defective, is sent to an assembly plant. The quality control division selects 10 at random for testing and rejects the whole shipment if 1 or more in the sample are found defective. What is the probability that the shipment will be rejected?

**ODDS:** In gaming situations, if we know the probability of something then we may want to know the odds for or against.

### PROBABILITY → ODDS

If  $P(E)$  is the prob of E

A) Odds **for** E is  $\frac{P(E)}{1 - P(E)} = \frac{P(E)}{P(E')}$

B) Odds **against** E is  $\frac{P(E')}{P(E)}$

Odds are expressed as a ratio of whole numbers.

a) What are the odds for rolling a sum of 8 in a single roll of 2 dice?

### ODDS → PROBABILITY

If odds for E are  $a/b$  then  $P(E) = \frac{a}{a+b}$

a) The odds for rolling a 5 before a 7 are  $2/3$ , what is the probability of rolling a 5 before a 7?

b) The odds against rollong a 6 before a 7 are  $\frac{6}{5}$ . What is the probability of rolling a 6 before a 7?

Example:

A poll was conducted preceding an election to determine the relationship between voter persuasion concerning a controversial issue and the area of the city in which the voter lives. Five hundred registered voters were interviewed from three areas of the city. The data are shown below.

Area of City	Voter Opinion		
	Favor	Oppose	No opinion
East	30	45	35
North	25	65	40
Inner	125	70	65

Compute the probability of having no opinion on the issue or living in the inner city.

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Compute the probability of a voter in favor of the issue and living in the north region of the city. \_\_\_\_\_