

PROBABILITY RULES

◆ **Complement Rule:** $P(E') = 1 - P(E)$

◆ **Addition Rule for OR (Union \cup) Events:** $P(E \cup F) = P(E) + P(F) - P(E \cap F)$
 $P(E \text{ OR } F) = P(E) + P(F) - P(E \text{ AND } F)$
IF AND ONLY IF events are MUTUALLY EXCLUSIVE: $P(A \text{ or } B) = P(A) + P(B)$

◆ **Multiplication Rule for AND (Intersection \cap) Events:** $P(E \text{ and } F) = P(E | F) P(F)$
 $P(E \cap F) = P(E | F) P(F)$
IF AND ONLY IF events are INDEPENDENT (Sect. 8.5) $P(E \text{ and } F) = P(E \cap F) = P(E) P(F)$

◆ **Conditional Probability Rule:** $P(A|B) = \frac{P(A \cap B)}{P(B)} = \frac{P(A \text{ AND } B)}{P(B)}$
("given that", "if")

EXAMPLE 17: CONDITIONAL PROBABILITY RULE

In a certain town: 70% of households have Cable TV (*event C*)

55% of households have Netflix (*event N*)

These figures include the fact that 42% of households subscribe to both.

a. Find the probability that a household subscribes to Netflix **given that** the household has Cable TV

b. Find the probability that a household has Cable TV **if** the household subscribes to Netflix

EXAMPLE 18: Multiplication Rule for \cap AND Events

At a college: 45% of all students take Statistics.

70% of all students intend to Transfer.

Of the students who intend to Transfer, 60% of them take Statistics.

Find the probability that a student intends to Transfer AND takes Statistics.

EXAMPLE 19: Multiplication Rule for \cap AND Events

At a fast food restaurant: 75% of customers order burgers (*event B*)

70% of customers order fries (*event F*)

Of the customers who order burgers, 80% also order fries.

Find the probability that a customer orders both a burger and fries.

EXAMPLE 20: OPTIONAL EXTRA PRACTICE: Multiplication Rule for \cap AND Events

(Hint: Read carefully to understand information given in the "story")

For job listings on a job posting website : 30% require professional certification (*event C*)

65% require a college degree (*event D*)

50% require 5+ years of related job experience (*event E*)

14% of job listings requiring a college degree also require professional certification.

Find the probability that a job requires both professional certification and a college degree.

EXAMPLE 21: OPTIONAL EXTRA PRACTICE: CONDITIONAL PROBABILITY RULE

Big Shoe Wearhouse is concerned about customer satisfaction with online purchases.

40% of all shoe sales are online on their website. 60% of all shoe sales are in their stores. Overall, 15% of all shoe purchases are returned. 10% of all shoe purchases were made on the website **and** were returned.

Events: S = purchased in store

W = purchased on website

R = item is returned

a. Find the probability that a shoe purchase was made on the website **given that** it is returned.

b. Find the probability that a shoe purchase is returned **if** it was purchased on the website