Basic Probability Definitions: Joint Probabilities

1 Introduction

Definition

joint probability —probability that two separate events with separate probability distribu- tions are both true

$P(A \text{ and } B)$ is written $P(A, B)$, and read "the joint probability of A and B" or "the prob- ability that A is true and B is true."

2 Order of joint probabilities

For probability distributions X and Y:

$$X = \{x_1, x_2, x_3, \ldots, x_n\}$$

$$Y = \{y_1, y_2, y_3, \ldots, y_n\}$$

Ordering does not matter in joint probabilities, for either the probability distributions or the individual events.

$$P(X, Y) = P(Y, X)$$
$$P(x_1, y_1) = P(y_1, x_1)$$

3 Independence

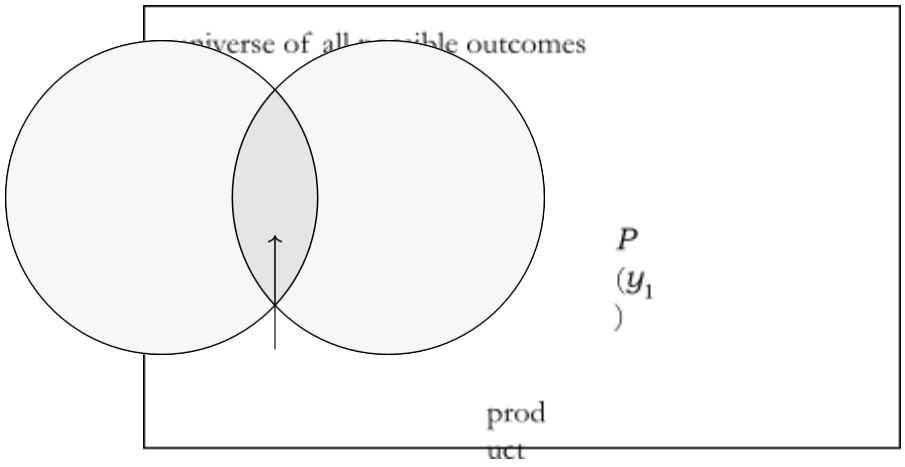
Definition

independence—knowing the outcome of one event does not change the probability of the other

The probability of two independent events:

$$\underbrace{P(x_1, y_1)}_{\text{"joint distribution"}} = \underbrace{P(x_1)P(y_1)}_{\text{"product distribution"}}$$

Venn diagrams—show the intersection and union of sets



OR probability

Probability that either of two events occurs:

$$P(x_1 \text{ or } y_1) = P(x_1) + P(y_1) - P(x_1, y_1)$$

Venn diagram: