SESA6085

Advanced Aerospace Engineering Management

Author: Yusaf Sultan
Lecturer: David Toal
Word Count: 376

Contents

List of Figures

List of Tables

Definitions

$\boldsymbol{P(A)}$	Probability of a general event A occurring.	$\boldsymbol{N}$	Total number of equally likely possible outcomes in the sample space.
$\boldsymbol{n}$	Number of favorable outcomes (ways in which event A occurs)	$\boldsymbol{P(AB)}$	Probability of events $\boldsymbol{A}$ **and** $\boldsymbol{B}$ occurring.
$\boldsymbol{P(A+B)}$	Probability of events $\boldsymbol{A}$ **or** $\boldsymbol{B}$ occurring.	$\boldsymbol{P(A\vert B)}$	Probability of event $\boldsymbol{A}$ given event $\boldsymbol{B}$ has already occurred
$\boldsymbol{P(A)}$	Probability of event $\boldsymbol{A}$ given event $\boldsymbol{B}$ has already occurred	$\boldsymbol{P\left(\overline{A}\right)}$	Probability of event $\boldsymbol{A}$ not occurring.

1. Lecture 1

1.1. Probability Fundamentals, Rules and Notation

The most basic definition of the probability for a general event A occurring **is the ratio of the number of favorable outcomes n to the total number of equally likely possible outcomes N**, this is shown in a mathematical representation in **Eq. 1**.

$$P(A) = \frac{n}{N} \tag{1}$$

Where:
- $\boldsymbol{P(A)}$: The probability of outcome A.
- $\boldsymbol{N}$: Total number of equally likely possible outcomes in the sample space.
- $\boldsymbol{n}$: Number of favorable outcomes (ways in which event A occurs)

Note that **Eq. 1** is only for events of equal probability, for example rolling a dice. Instead if **N is the number of experiments** then **Eq. 2** applies, implying that the larger the number of experiments the closer to **Eq. 1** the probability becomes.

$$P(A) = \lim_{N \to \infty} \left(\frac{n}{N} \right) \tag{2}$$

This module uses the following notation for the probability of combined events, these are:

- $\boldsymbol{P(A)}$: Probability of event $\boldsymbol{A}$ occurring.
- $\boldsymbol{P(AB)}$: Probability of events $\boldsymbol{A}$ **and** $\boldsymbol{B}$ occurring.
- $\boldsymbol{P(A+B)}$: Probability of events $\boldsymbol{A}$ **or** $\boldsymbol{B}$ occurring.
- $\boldsymbol{P(A|B)}$: Probability of event $\boldsymbol{A}$ given event $\boldsymbol{B}$ has already occurred.
- $\boldsymbol{P(\overline{A})}$: Probability of event $\boldsymbol{A}$ **not** occurring (note that $P(A) = 1 - P(\overline{A})$).

1.1.1. Statical Independence

If two events are **statistically independent** (s-independent) from one another (meaning that the probability of one event occurring is completely separate from another event happening or not happening), then **Eq. 3** is true.

$$\left.\begin{aligned} P(A|B) = P\left(A|\overline{B}\right) = P(A) \\ P(B|A) = P\left(B|\overline{A}\right) = P(B) \end{aligned}\right\} \text{s-independent} \tag{3}$$

Furthermore, the joint probability of two s-independent events can be represented in the forms shown in **Eq. 4** with the further expressions derived from subbing in **Eq. 3**, **Eq. 4** is also known as the **product or series rule**.

$$P(AB) = P(A)P(B)\} \text{ s-independent} \tag{4}$$

1.1.2. Statistical Dependence

If two events are instead **statistically dependent** (s-dependent) from one another (the probability of on event happening or not happening **does** have an effect of the probability of another event), then the adjoint probability of these two events is shown in **Eq. 5**

$$\left.\begin{aligned} P(AB) &= P(A)P(B|A) \\ P(AB) &= P(A|B)P(B) \end{aligned}\right\} \text{s-dependent} \tag{5.1}$$

$$\left. P(B|A) = \tfrac{P(AB)}{P(A)} \right\} \text{s-dependent and } P(A) \neq 0 \tag{5.2}$$

1.2. Probability Fundamentals, Rules and Notation Cont.

Generally speaking the probability of one event **or** another event occurring , whether they are s-dependant or s-independent is given by equation **Eq. 6**.

$$P(A+B) = P(A) + P(B) - P(AB) \tag{6.1}$$

$$\left. P(A+B) = P(A) + P(B) - P(A)P(B) \right\} \text{s-independent} \tag{6.2}$$

Note that the $P(AB)$ in **Eq. 6** must be subtracted as it is counted twice in the first two terms.