

## 1 Sets

The universal set ( $\mathcal{U}$ ) contains everything. The empty set ( $\emptyset$ ) contains nothing. Some assignments:

$$\mathcal{B}_1 = \{1, 3, 5, 7\}, \quad \mathcal{B}_2 = \{2, 4, 6, 8\}, \quad \mathcal{B}_3 = \{9, 10\}$$

Define:

$$\mathcal{A} = \bigcup_{i=1}^3 \mathcal{B}_i = \{1, \dots, 10\}$$

The cardinality of a set  $\mathcal{S}$  is denoted  $|\mathcal{S}|$  and is the number of elements in the set.

$$|\mathcal{B}_1| = 4, \quad |\mathcal{B}_2| = 4, \quad |\mathcal{B}_3| = 2, \quad |\mathcal{B}_1 \cup \mathcal{B}_2| = 8, \quad |\emptyset| = 0$$

## 2 Spaces

A number space (denoted  $\mathbb{S}$ ) is characterised by a set of entities with a set of axioms. For example:

$$\mathbb{N} = \{x : x \text{ is positive integer}\}$$

$$\mathbb{Z} = \{x : x \text{ is an integer}\}$$

$$\mathbb{R} = \{x : x \text{ is a real number}\}$$

## 3 Vectors and Matrices

A matrix (denoted  $\mathbf{M}$ ) is a rectangular array of values. A vector (denoted  $\mathbf{v}$ ) is a column or row of values (that is a one-dimensional matrix).

$$\mathbf{I}\mathbf{x} = \mathbf{x}, \quad \mathbf{A}\mathbf{A}^{-1} = \mathbf{I}, \quad \mathbf{x}^{-1}\mathbf{1} = \sum_i x_i$$

## Glossary

|                   |                               |                 |                                    |
|-------------------|-------------------------------|-----------------|------------------------------------|
| $\mathbf{I}$      | the identity matrix.          | $\mathbb{Z}$    | the set of integers.               |
| $\mathbf{M}^{-1}$ | the inverse of $\mathbf{M}$ . | $\mathbb{N}$    | the set of natural numbers.        |
| $\mathbf{M}$      | a matrix.                     | $\mathbb{R}$    | the set of real numbers.           |
| $\mathbf{v}$      | a vector.                     | $ \mathcal{S} $ | the cardinality of $\mathcal{S}$ . |
| $\mathbf{1}$      | the vector of 1s.             | $\emptyset$     | the empty set.                     |
| $\sum \sum$       | $n$ -ary summation.           | $\mathcal{S}$   | a set.                             |
| $\bigcup \bigcup$ | $n$ -ary union.               | $\{\dots\}$     | set contents.                      |
| $\mathbb{S}$      | a number space.               | $\{x : \dots\}$ | set membership.                    |
|                   |                               | $\mathcal{U}$   | the universal set.                 |