Contents

The book is optimized for looking up facts. However, it contains pointers to the end of the books that give proof.

1 Probability

Sample Space and Outcome We perform random experiments and the sample space is the set of possible outcomes.
For example, consider rolling a die. The set of possible outcomes are:

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

Event An event is a subset of the sample space. An example event is rolling a die and getting an even odd outcome:

$$E = \{1, 3, 5\}$$

Disjunction of Events The event E occurs if E_1 or E_2 occur. Another way to imagine this is the union of events: $E = E_1 \cup E_2$.

Conjunction of Events The event E occurs if E_1 and E_2 occur. Another way to imagine this is the intersection of events: $E = E_1 \cap E_2$.

Mutually Exclusive Events Events E_1 and E_2 are mutually exclusive if only one of them can occur in a single experiment. For example, the event rolling an even number and the event rolling an odd number on a die are mutually exclusive events:

$$E_{even} \cap E_{odd} = \{1, 2, 3, 4, 5, 6\} \cap \{1, 3, 5\} = \varnothing$$

1.0.1 Axioms of Probability

The are the rules we accept as truth without proof. We build probability untop of these axioms.

1. $0 \leq P(E) \leq 1$, for any event E. In the smallest case, the event cannot occur which is inidicated by a probability of 0. In the largest case, the event always occurs, which is indicated by the probability of 1.

2. $P(S) = 1$, where S is the sample space. The sample space contains all possible outcomes for each experiment. It's reasonable to accept that an event from the sample space always occurs.

3. For a potentially infinite set of mutually exclusive events E_1, E_2, ...

   $$P(\cup_{i=1}^{\infty} E_i) = \sum_{i=1}^{\infty} P(E_i)$$

   It makes senses that events that do not share outcomes for a single event, can have their probabilities added to arrive at the probability of combining the outcomes from the events.

Properties From the above axioms, we get the following useful properties:

1.

2.

3.

2 Stochastic Processes

3 Derivations

3.1 Probability

3.2 Stochastic Processes