BM2033 - Assignment 1

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Question

Take any 2 problems from the real-world. Pick a question that is of interest. Define the probability framework (possible events, experiments, outcomes, sample space etc.).

Solution

1) **Experiment:** Bumrah bowling a cricket ball

   Sample Space: Any non-negative real number (in kmph units)

   Outcomes: The ball reaching at a speed of x kmph at the batsman's end where the value of x is any real number.

   Events: Some of the possible events are as follows:
   The ball is
   a) very slow if speed less than 100 kmph.
   b) slow if speed between 100 kmph and 120 kmph.
   c) moderately paced if speed is between 120 kmph and 135 kmph.
   d) fast if speed is between 135 kmph and 145 kmph.
   e) very fast if speed is above 145 kmph , etc.,

   An example probability of interest: Find the probability that Bumrah is bowling a very fast ball.
   Ans: $\Pr(\text{speed} \geq 145 \text{ kmph})$

   Remarks: In this experiment, the outcomes are continuous real valued. So, events are intervals between point valued outcomes. The experiment was chosen to be Bumrah (a specific bowler) bowling the cricket ball, instead of any bowler, because the notion of slow ball and fast ball changes as they are relative terms. And it is fair enough to assume that the speed value takes any non-negative real number. Here, the probability that the speed is exactly one of the real value is zero. The problem is with the infinitesimal accuracy that needs to be measured in case of a point practically it is impossible to get to a point.

2) **Experiment:** Me dialing a phone number from my phone

   Sample Space: Collection of 10-digit natural numbers

   Outcomes: Each individual 10-digit natural number. The total number of outcomes is 10^{10} as repetition is allowed

   Events: Some of the possible events are as follows:
   a) The first digit of the number so called is 9
   b) The number called is above 5000000000
   c) The last digit of the number so called is 0, etc.,

   An example probability of interest: Find the probability that the phone number called starts with a 9.
   Ans: $\Pr(\text{number} \geq 9000000000) = \frac{10^9}{10^{10}} = \frac{1}{10}$

   Remarks: In this experiment, the outcomes are discrete. I have assumed that I am calling a number in India, and hence 10-digit number. Here, since the number of outcomes is finite, events are mere collection of points in the sample space unlike the continuous case. In the discrete case, the probability of each outcome in the sample space is non-zero (each outcome is an event here).
   $\Pr(\text{Dialing a specific number}) = \frac{1}{10^{10}}$