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Chapter 3: Dependent and Independent Events, Mutually Exclusive Events Applying Matrices to Probability Problems

1. If the weather is nice, Vicky is 80% likely to go jogging outdoor. If it is raining, she is only 50% likely to go. The forecast for tomorrow indicates a 30% chance of rain. What is the percent probability that she will go jogging outdoor tomorrow?

2. What is the probability of not throwing 7 or doubles for six consecutive throws with a pair of dice?

3. In a junior football league, 55% of the players come from Western Canada and 45% come from Eastern Canada. From this league, 17% of the Western Players and 11% of the Eastern Players go on to the CFL. If a randomly chosen junior league player who goes on to CFL is selected, what is the probability that he came from Eastern Canada, to the nearest tenth of a percent?

4. How likely is it for a group of five friends to have the same birth month? State any assumptions you make for your calculation.

5. Nine members of a baseball team are randomly assigned field positions. There are three outfielders, four infielders, a pitcher, and a catcher. Troy is happy to play any position except catcher or outfielder. Determine the probability that Troy will be assigned to play
   a) catcher
   b) outfielder
   c) a position he does not like.

6. The Tigers are leading the Storm one game to none in a best-of-five playoff series. After a playoff win, the probability of the Tigers winning the next game is 60%, while after a loss, their probability of winning the next game drops by 5%. The first team to win three games takes the series. Assume there are no ties. What is the probability of the Storm coming back to win the series?

7. A computer manufacturer knows that, in a box of 1000 computer chips, 3 will be defective. Alicia will draw 2 chips, at random, from the box of 1000 chips. Determine the probability that she will draw two defective chips.

8. For a particular breed of cat, the odds against a kitten being born with either green eyes or white spots are 3:1. If the probability of a kitten exhibiting only one of these traits is equal and the probability of exhibiting both traits is 10%, what are the odds in favour of a kitten having green eyes?

9. A standard deck of cards is shuffled and three cards are selected. What is the probability that the third card is either a red face card or a king if the king of diamonds and the king of spades are selected as the first two cards?

10. Two competing companies, Instax and Polaroid Snap, manufacture and sell instant film cameras. Customer surveys suggest that the companies' market shares can be modelled using a Markov chain with the following initial probability vector S_0 and transition matrix P.

$$S_0 = [0.67 \;\; 0.33] \qquad P = \begin{bmatrix} 0.6 & 0.4 \\ 0.5 & 0.5 \end{bmatrix}$$

Assume that the first element in the initial probability vector pertains to Instax. Explain the significance of

a) the elements in the initial probability vector

b) each element of the transition matrix

c) each element of the product of S_0P.

11. A marketing research firm has tracked restaurants who use Platform-to-Consumer Food Delivery in a city. Each year, on average,
    - UberEats keeps 60% of its restaurant users in the city, but loses 15% to SkipTheDishes and 25% to DoorDash
    - SkipTheDishes keeps 65% of its users, but loses 25% to UberEats and 10% to DoorDash
    - DoorDash keeps 70% of its users, but loses 20% to SkipTheDishes and 10% to UberEats

    Currently, UberEats has 60% of the market, DoorDash has 25% while SkipTheDishes has 15%. Assume that the market continues to be split between the three companies,

    a) What is the initial probability vector?

    b) What is the transition matrix?

    c) Determine the market share of each company after one, two and three years.

d) Determine the long-range market share of each company.

e) What assumption must you make to answer part d)?