Calculating Probability

Probability 3

Chapter 8, 364 - 371

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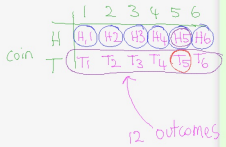
Using Grids

- Grids can be used to visualise sample space

Example:

1. Use a grid to illustrate the sample space for tossing a coin and rolling a die simultaneously. From this grid determine the probability of:
   a) tossing a head
   b) getting a tail & a 5
   c) getting a tail or a 5



a) $\frac{6}{12} = \frac{1}{2}$

b) $\frac{1}{12}$

c) $\frac{7}{12}$

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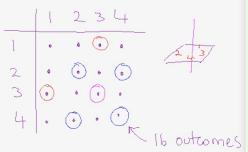
Example to Try

2. Two square spinners, each with 1, 2, 3 and 4 on their edges, are twirled simultaneously. Draw a grid of the possible outcomes.



Use your grid to determine the probability of getting:

a) a 3 with each spinner $\frac{1}{16}$ $\frac{1}{4} \times \frac{1}{4} = \frac{1}{16}$

b) a 3 and a 1 $\frac{2}{16}$

c) an even result for each spinner. $\frac{4}{16}$

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Compound Events

- If A and B are two events, where the outcome of one of them does not affect the other, then:

$$P(A \text{ and } B) = P(A) \times P(B)$$

- We call A and B independent events.

Example:

3. A 8-sided dice and a 20-sided dice are tossed together. Determine the probability of getting two 5's. (without using a grid)

$P(5 \text{ on 8 sided die}) \times P(5 \text{ on 20 sided die})$

$\frac{1}{8} \times \frac{1}{20} = \frac{1}{160}$

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Examples to Try

4. At a mountain village in New Guinea it rains on average 6 days a week. Determine the probability that it rains on:

   a) any one day $\frac{6}{7}$

   b) two successive days $\frac{6}{7} \times \frac{6}{7} = \frac{36}{49}$

   c) three successive days $\frac{6}{7} \times \frac{6}{7} \times \frac{6}{7} = \frac{216}{343}$ ✓ ✓

5. A coin is tossed 3 times. Determine the probability of getting the following sequences of results:

   a) head, then head, then head $\frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = \frac{1}{8}$

   b) tail, then head, then tail $\frac{1}{8}$

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Dependent Events

- Dependent events occur when the 2nd event is affected by the first.
- The most common example is taking 2 objects from a container without replacing the first.
- If A and B are dependent events then:

$$P(A \text{ and } B) = P(A) \times P(B \text{ given that A has occured})$$

Example to Try

6. A box contains 4 red and 2 yellow tickets. Two tickets are randomly selected, one by one from the box, *without* replacement. Find the probability that:
   a) both are red
   b) the first is red and the second is yellow.

a) P(1st ticket red) = $\frac{4}{6}$ 1 red taken
P(2nd ticket red) = $\frac{3}{5}$ 1 ticket taken
P(R,R) = $\frac{4}{6}^{2} \times \frac{3}{5} = \frac{2}{5} = \frac{12}{30}$

b) P(R then Y) = $\frac{4}{6} \times \frac{2}{5} = \frac{4}{15}$

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Example to Try

7. A hat contains tickets with numbers 1, 2, 3, ….., 19, 20 printed on them. If three tickets are drawn from the hat, without replacement, determine the probability that all are prime numbers.

2, 3, 5, 7, 11, 13, 17, 19 = 8 primes

P(3 primes) = P(1st prime) × P(2nd) × P(3rd prime)

= $\frac{8}{20} \times \frac{7}{19} \times \frac{6}{18}$

= $\frac{14}{285}$

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Using Tree Diagrams

- Tree diagrams can clearly show the sample space ____. The probabilities are written on the branches (usually as fractions (don't to simplify) but occasionally as decimals). (Copy the Q format).
- The probability of any outcome is obtained by multiplying along the branch.
- If there are more than 1 branch to give the outcome you need, the individual probabilities are added.

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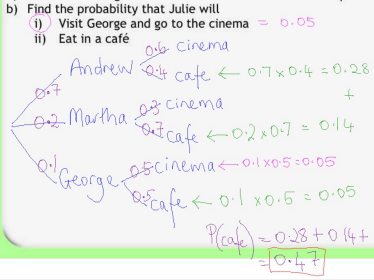
Example to Try

8. Julie is deciding whether to visit Andrew, Martha or George. The probability that she will visit Andrew is 0.7 and the probability that she will visit Martha is 0.2.
Julie will take her friend either to the cinema or to eat in a café. If Julie visits Andrew, the probability that they will go to the cinema is 0.6 but if she visits Martha it is 0.3. If she visits George it is equally likely that they will go to a cinema or a café.

a) Draw a tree diagram for this situation and fill in all the probabilities.
b) Find the probability that Julie will
   i) Visit George and go to the cinema = 0.05
   ii) Eat in a café



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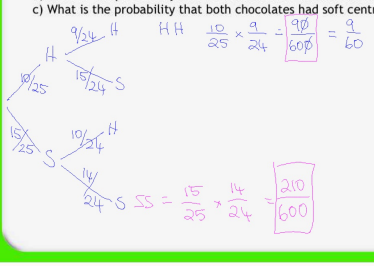
Example to Try

9. Petra selects a chocolate at random from a box containing 10 hard-centred and 15 soft-centred chocolates. She bites it to see if is hard centered or not. She then selects another chocolate at random from the box and checks it. (she eats both chocolates).
Let H represent "a hard-centered chocolate" and S represent "a soft-centered chocolate".
   a) Draw a tree diagram to illustrate this sampling process.
   b) What is the probability that both chocolates had hard centres?
   c) What is the probability that both chocolates had soft centres?



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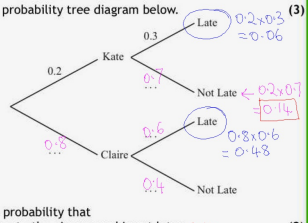
Example to Try

10. Claire and Kate both wish to go to the cinema but one of them has to stay at home to baby-sit.
The probability that Kate goes to the cinema is 0.2. If Kate does not go Claire goes.
If Kate goes to the cinema the probability that she is late home is 0.3.
If Claire goes to the cinema the probability that she is late home is 0.6.

(a) Complete the probability tree diagram below. (3)



(b) Calculate the probability that
   (i) Kate goes to the cinema and is not late; 0.14 (2)
   (ii) the person who goes to the cinema arrives home late. (3)
0.06 + 0.48 = 0.54

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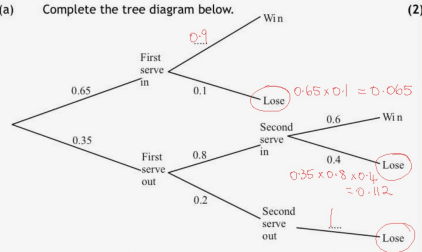
Example to Try

11. When Andy plays tennis, 65% of his first serves go into the correct area of the court. If the first serve goes into the correct area, his chance of winning the point is 90%. If his first serve does not go into the correct area, Andy is allowed a second serve and, of these, 80% go into the correct area.
If the second serve goes into the correct area, his chance of winning the point is 60%. If neither serve goes into the correct area, Andy loses the point.

(a) Complete the tree diagram below. **(2)**



(b) Find the probability that Andy loses the point. **(4)**

0.065 + 0.112 + 0.07 = 0.247

0.35 x 0.2 x 1 = 0.07

Homework

Ex 8N, p365: Q2 and 5
Ex 8O, p368: Q1
Ex 8P, p370: Q1 and 5