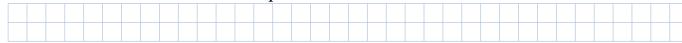## 3.10 Lesson 10 Tree diagrams with Double Grim dice

Consider the random experiment :

Each players picks two dice of the same color. The one that rolls the highest total wins.

We will work out **theoretical probabilities** of winning using sample space diagrams and tree diagrams.

1. We roll 2 blue dice. What are the possible totals of the two dice?

2. Use sample space diagram to work out the probability of each possible total outcome.

Blue die 2

Blue die 1

$P(\text{Total} = \ldots\ldots) =$

$P(\text{Total} = \ldots\ldots) =$

$P(\text{Total} = \ldots\ldots) =$

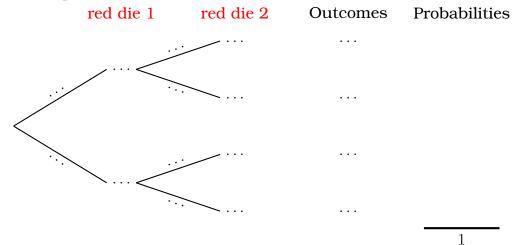3. Do you think it matters whether we "roll one dice and then the other" or "roll them both at once"?

4. Use the tree diagram to work out the probabilities of possible outcomes.
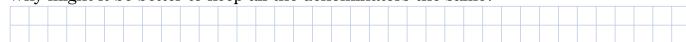
blue die 1   blue die 2   Outcomes   Probabilities

2

2 2

7 7

7

2 2

7 7

1

5. We roll two red Grim dice and add the scores. Use the tree diagram to work out the possibles outcomes and the probabilities of each outcome.

<div align="center">

red die 1   **red die 2**   Outcomes   Probabilities

</div>
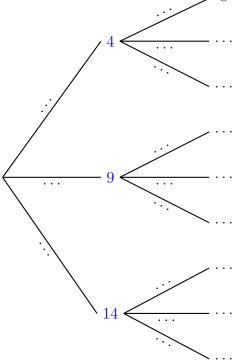

$$\overline{}$$
$$1$$

6. Why might it be better to keep all the denominators the same?

7. Use the tree diagram to work out the probabilities of two blue dice beating two red dice.

Outcome 1   Outcome 2   Winner   Probabilities
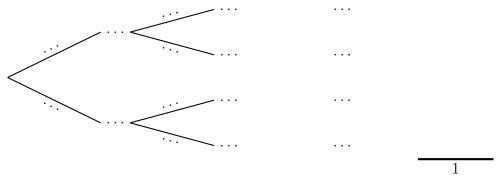
total blue dice   total red dice

8   Red wins

4

9

14

8. Which do you think is better - a pair of blue dice, or a pair of red dice?[1]

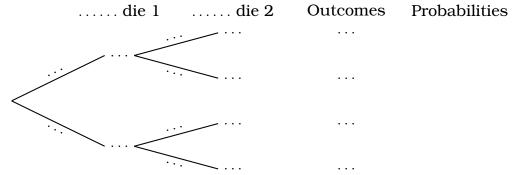[1]In a previous lesson we found that single red dice beats blue dice with a chance of $\frac{7}{12}$.

9. Pick double dice pair of your choice. Work out the probabilities of the total score outputs, then the probabilities of one pair winning. *Pick different pair from your classmates.*
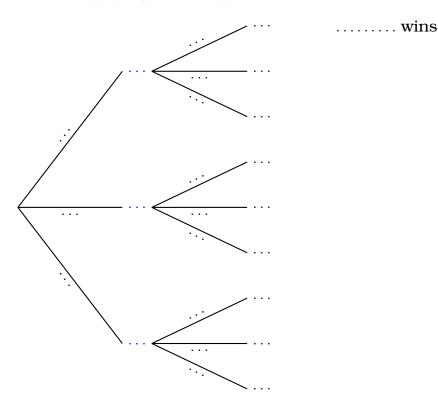
   I chose to study double . . . . dice and double . . . . dice.

	. . . . . die 1	. . . . . die 2	Outcomes	Probabilities

   . . . . . . die 1   . . . . . . die 2   Outcomes   Probabilities

   Outcome 1 total   Outcome 2 total

   double dice 1   double dice 2

   Winner   Probabilities

   . . . . wins

10. The following table shows the probabilities for each double dice to beat another double dice from a different color.

    Using the table, draw a diagram showing which double dice colours wins over another.

    An arrow from Blue to Red would indicate that Blue beats Red.

    Compare it to the diagram we had for a single die.

beats	The double dice ...				
a .... double dice		Red	Blue	Olive	Yellow	Magenta
Red		$\frac{85}{144}$	$\frac{625}{1296}$		
Blue			$\frac{85}{144}$	$\frac{5}{9}$	
Olive				$\frac{56}{81}$	$\frac{7}{12}$
Yellow	$\frac{7}{12}$				$\frac{16}{27}$
Magenta	$\frac{56}{81}$	$\frac{5}{9}$			

BLUE

BLUE

RED   OLIVE

RED   OLIVE

MAGENTA   YELLOW   MAGENTA   YELLOW

SINGLE DIE GAME   **DOUBLE DICE GAME**

Why can one join Double Red and Double Olive with a line instead of an arrow?

Can you devise a strategy to beat a player that just picked his double dice?

What about 2 other players when rolling single dice?

(if player B and player C picked single red and single yellow, I would pick)