Ann is in charge of a **Lucky Dip** to raise money for charities.

Each barrel contains an equal number of red, green, white and black balls.

The balls are buried in sawdust so that you cannot see them before you pick one out.

To play the game, you give Ann your 25¢, then you pick one ball from each barrel.

You win $5 if all three balls are the same color.

1. Calculate the probability that you will win the $5 if you play once.

   \[
   16 \times 4 = 64 \quad \frac{4}{64} = \frac{1}{16}
   \]

2. Do you think that the **Lucky Dip** will raise money for the local charities?

   **No**

   Show your calculations.

   \[0.25 \times 16 = 4\]

   16 turns = $4 gained

   $5 prize

   $1 lost.
3. Ann wants to change the game so as to increase the amount of money it makes for the charities. Describe two different kinds of change that she could make to the Lucky Dip and find how much is likely to be raised for the charities after each change. Show all your calculations.

Change one

75¢ a chance, get 3 balls the same color, win $0.5. Calculations

\[ 16.4 = 64 \quad \frac{4}{16} = \frac{1}{16} \quad 0.75 \times 16 = 12 \]. In 16 turns, it will raise $12 but one person will win causing a decrease in $5. Basically in 64 turns the game will raise $36. Using ratios, you raise \( \frac{11.5}{18.75} \) every time someone takes a turn.

Change two

Have an extra barrel. 75¢ a chance. Get 4 balls, win $5. Calculations

All same colors \( 4 \times \frac{1}{4} \times \frac{1}{4} \times \frac{1}{4} \times \frac{1}{4} \). In 64 turns it will raise \$4.80, but one person will win causing a decrease of \$5 to \$48 - \$5 = \$43. So they could drop the price down to persuade more people to play. So at 254 it would be $16 - 5 = $11 win.
Charity Fair

LUCKY DIP
25¢ A CHANCE
3 balls the same color
WIN $5

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1. Calculate the probability that you will win the $5 if you play once.

   \[
   \frac{1}{4} \times \frac{1}{4} \times \frac{1}{4} = \frac{1}{64}
   \]

2. Do you think that the **Lucky Dip** will raise money for the local charities?

   \[\text{yes}\]

   Show your calculations.

   \[64 \times 25 = 1600 \]

   \[1600 - 5 = 11\]
3. Ann wants to change the game so as to increase the amount of money it makes for the charities.

Describe two different kinds of change that she could make to the Lucky Dip and find how much is likely to be raised for the charities after each change. Show all your calculations.

Change one

Put 2 more colors in the bins

\[
\frac{1}{6} \times \frac{1}{6} \times \frac{1}{6} = \frac{1}{216} \\
216 \times 0.25 = 54 \\
54 - 5 = 49 \\
49 - 11 = 38
\]

Change two

Add another bin so you need 4 balls of the same color

\[
\frac{1}{6} \times \frac{1}{6} \times \frac{1}{6} \times \frac{1}{6} = \frac{1}{256} \\
256 \times 0.25 = 64 \\
64 - 5 = 59 \\
59 - 11 = 48
\]
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1. Calculate the probability that you will win the $5 if you play once.

\[ \frac{4}{4} \times \frac{1}{4} = \frac{1}{4} \times \frac{1}{4} = \frac{1}{16} \]

2. Do you think that the Lucky Dip will raise money for the local charities?

No

Show your calculations.

You play 16x and pay 25¢ each time

16x25¢ = $4 by probability you win once

out of 16x and you win $5 thus you

loose $1
3. Ann wants to change the game so as to increase the amount of money it makes for the charities.

Describe two different kinds of change that she could make to the Lucky Dip and find how much is likely to be raised for the charities after each change.
Show all your calculations.

Change one

Increase the number of barrels,

If Ann increases the number of barrels by 1

probability of winning decreases and she will earn more money because for the person to win they have

\[
\frac{2}{4}, \frac{2}{4} \times \frac{1}{16} = \frac{1}{64}
\]

\[\text{to spend $16.} \quad \text{earn $11}\]

Change two

Increase the number of colors

probability changes to \(\frac{1}{5}\) for each barrel

probability you win decrease \(\frac{1}{5} \times \frac{1}{5} \times \frac{1}{5} = \frac{1}{125}\)

\[25 \times \frac{1}{125} = \$0.25 \text{ so earn $1.25}\]
Charity Fair

LUCKY DIP
25c A CHANCE
3 balls the same color
WIN $5

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1. Calculate the probability that you will win the $5 if you play once.
   
   \[ \frac{16}{64} = \frac{1}{4} = \frac{4}{16} \]

2. Do you think that the Lucky Dip will raise money for the local charities?
   
   No

Show your calculations.

Since 0.25 \cdot 20 = 5

And \( \frac{20}{16} = \frac{5}{4} = 1.25 \) is more than 1

So before she can get $5, the $5 is already gone because someone already won it due to the fact that 50% of the money has more than 100% chance.
3. Ann wants to change the game so as to increase the amount of money it makes for the charities.

Describe two different kinds of change that she could make to the **Lucky Dip** and find how much is likely to be raised for the charities after each change.
Show all your calculations.

Change one

Since before save up to $5, player has more than 100% and before $4 player has exactly 100%. So $3 is a good price yet not 100% win chance for the player to have before spending $5.

Change two

If she increase cost for one chance, the player will pay her $5 before the player’s chance of winning raise to 100%.
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You win $5 if all three balls are the same color.

1. Calculate the probability that you will win the $5 if you play once.

   \[
   \frac{1}{4} \cdot \frac{1}{4} \cdot \frac{1}{4} = \frac{1}{6}
   \]

   1st barrel  2nd barrel  3rd barrel

2. Do you think that the **Lucky Dip** will raise money for the local charities?

   \[\text{No}\]

Show your calculations.

Prize ratio = \[\frac{5}{0.25} = 20\]

Chance of winning = \[\frac{1}{16}\]

\[20 \cdot \frac{1}{16} = 1.25 > 1\]

Ann loses money
3. Ann wants to change the game so as to increase the amount of money it makes for the charities.

Describe two different kinds of change that she could make to the **Lucky Dip** and find how much is likely to be raised for the charities after each change. Show all your calculations.

**N = # of people playing**

Change one

Increase the amount of money to play to $1. Now the price ratio is 5:1; chance of winning is \( \frac{1}{16} \). Multiply them to get \( \frac{5}{16} \), which is less than 1. Therefore, Ann will make more money. If \( n \) people come to play, \( n \) is large, Ann's income will be \( 1 \cdot n \). Price money = \( \frac{1}{16} \cdot n \cdot 5 = \frac{5}{16} n \). Money to charity = \( 1n - \frac{5}{16}n = \frac{11}{16}n \).

Change two

\( N = \# \) of people playing

Decrease the chance of winning to \( \frac{1}{64} \) by making the player pick two balls of the same color out of the last barrel instead of one ball (all balls must be same color). Ann's income: \( 0.25 \cdot N \)

Players' income: \( \frac{1}{64} \cdot N \cdot 5 \)

\( 0.25N - \frac{5}{64}N = \frac{11}{64}N \). Money to charity: \( \frac{11}{64}N \).