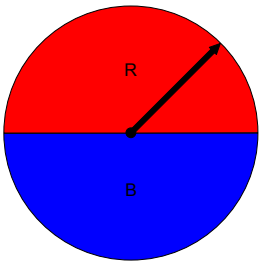
Problem of the Week
Problem A and Solution
Spinner

Problem

A spinner is a math tool that can be used to demonstrate the probability of a particular outcome. For example if you design a spinner that has a background divided into two equal parts: red and blue, there is a 50% probability of landing on red and a 50% probability of landing on blue.



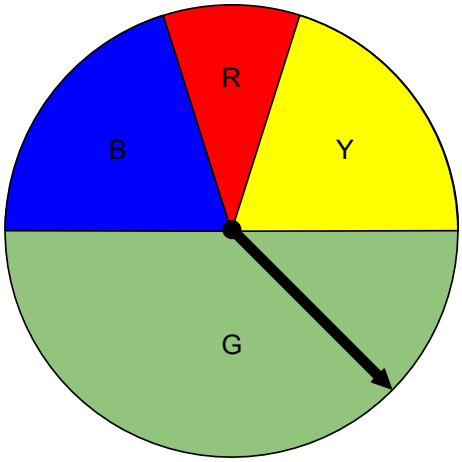
Design a spinner to match the following requirements:

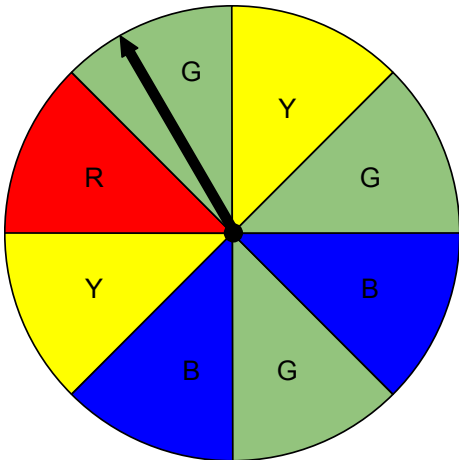
1) The probability of landing on **blue** is greater than landing on **red**.
2) The probability of landing on **yellow** is the same as landing on **blue**.
3) You are more likely to land on **green** than any other colour.

Is it possible to create a different spinner using the same clues?
If it is possible design another spinner.

Solution

There are many correct solutions to this problem. Here are two designs that satisfy the requirements.





The spinner on the left has four sections. The green section takes up half of the spinner's area. The other three sections fill the other half of the spinner, so each of those sections must be less than half of the spinnner's area. This means that the probability of landing on green is higher than any other colour. The yellow and blue areas are the same size. This means that the probability of landing on yellow is equal to the probability of landing on blue. The red section is smaller than any of the other areas of the spinner, so the probability of landing on red is less than the probability of landing on blue. This means all of the requirements have been met.

The spinner on the right has been divided into eight equal sections. The sections are filled with the following distribution of colours:

- 1 section of red
- 2 sections of yellow
- 2 sections of blue
- 3 sections of green

Since the sections are the same size, where there are more sections of a colour on the spinner the probability of landing on that colour is higher. So, there is a greater probability of landing on green than any other colour. The probability of landing on yellow is equal to the probability of landing on blue. The probability of landing on blue is greater than the probability of landing on red. This means all of the requirements have been met.

Teacher's Notes

Many people misunderstand probability. Describing an outcome as having a 50%, 75%, or even 99% probability of occurring does not provide any guarantees, especially in the short term. This is simply an outcome we expect to observe over the long term.

For example, with our 50/50 spinner, there is 100% guarantee that the pointer does not land on one of the colours on each spin. So even though we expect the spinner to land on red half of the time and blue the other half of the time, we cannot know the outcome of any particular spin.

We can make better guesses about the outcome of many spins. For example, if we spin four times, we would guess that two times we would land on blue and two times we would land on red. However, there are actually 16 possible outcomes:

RRRR RRRB RRBR RRBB RBRR RBRB RBBR RBBB
BRRR BRRB BRBR BRBB BBRR BBRB BBBR BBBB

all of which are equally likely sequences, and only 6 of the 16 outcomes have the spinner landing on red twice and blue twice. So more than half the time we actually expect that we will not get an equal number of spins landing on red and landing on blue.

Over a larger number of spins, we do expect to see approximately as many red spins as blue spins. However, it would still be possible to get all red or all blue outcomes. The chance is very small, but all things being equal, we expect that

$$2 \text{ out of } 2^{100} \text{ or } 2 \text{ out of } 1267650600228229401496703205376 \text{ times}$$

the spinner would land on the same colour for each of the 100 spins.