World of Markets

Introduction

Stock markets are often considered a complex and alien concept that conjure up images of trading floors full of adrenalin-fuelled buyers and sellers. In fact, we regularly hear the names of global brands, such as Apple or Amazon, but have little understanding of how these companies are given a monetary value or have claimed their reputations as leaders in their fields. Markets can actually be described using common mathematical principles. This workshop will build on students' understanding of statistics, with the aim of demonstrating to them the random nature of stock markets in today's world. In particular, this workshop will introduce students to the theory of random walks by drawing on the concepts of standard deviation and normal distribution.

Aim of Workshop

The aim of the workshop is to build on students' prior learning of statistics in order to introduce them to the workings behind the global stock markets. A real market environment will also be created using well-known brands to spark their interest in the topic.

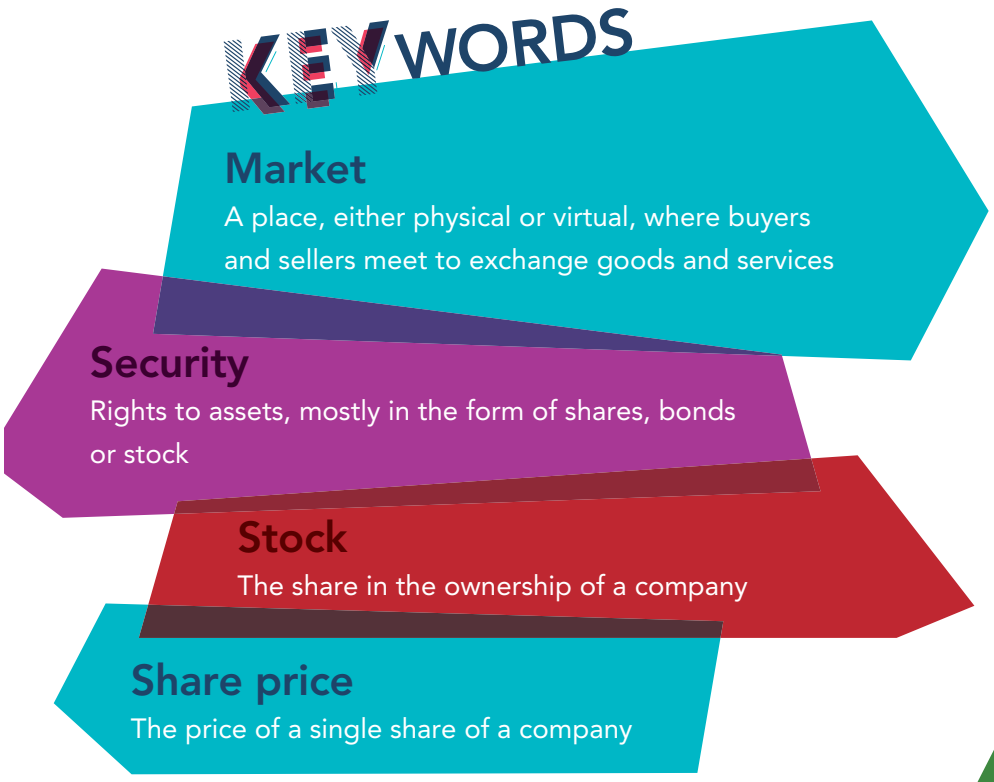
Learning Outcomes

By the end of this workshop, students will be able to:

- Explain how a stock market works
- Model a random walk
- Describe, in their own words, what is meant by the normal distribution

Materials and Resources

Coins, activity sheets, open space to demonstrate the random walk



World of Markets: Workshop Outline

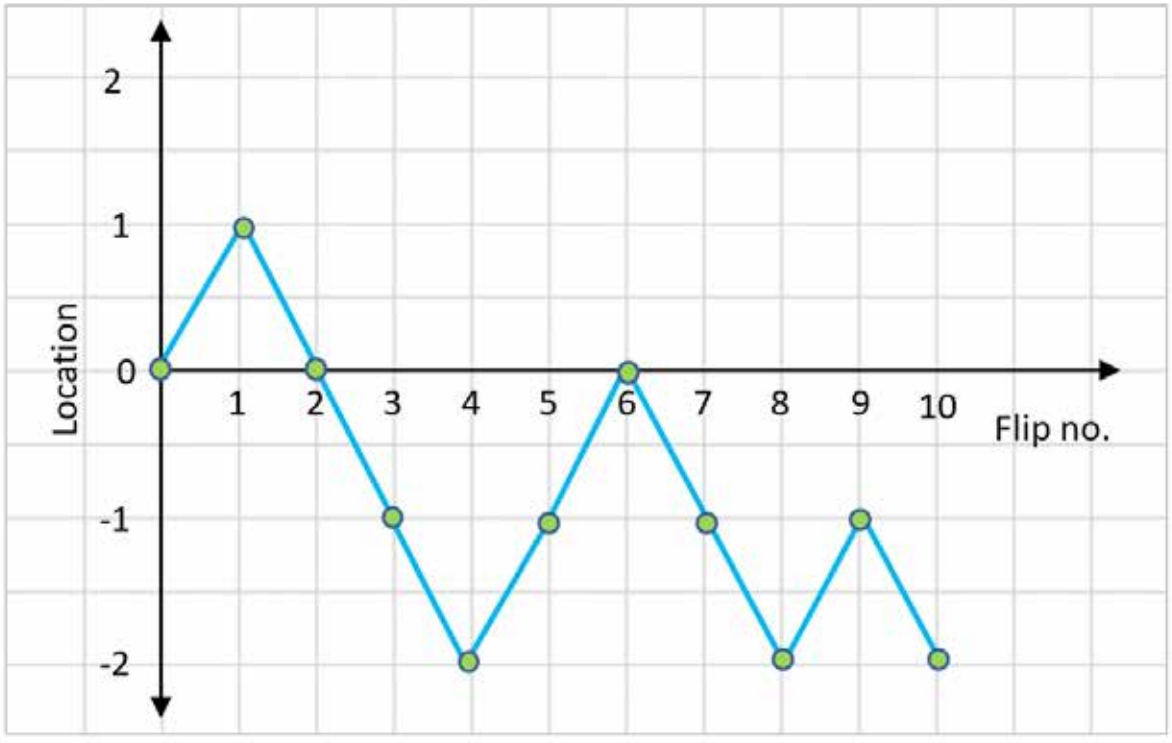
Suggested Time (Total mins)	Activity	Description
5 mins (00:05)	Introduction to stock markets	· Ask students to discuss what comes to mind when they think of a market · Discuss the ideas as a class before introducing the concept of a market (see **Key Words**)
5 mins (00:10)	Securities and Stocks	· Ask students if they can think of any examples of markets (see **Appendix – Note 1**) · Explain what is meant by securities and introduce the idea of a market where securities are traded (see **Key Words**) · Discuss the concept of stock and share price (See **Key Words**).
15 mins (00:25)	Activity 1 Flip Trip	· Hand out the activity sheet and a coin to each pair of students and explain the task · **Activity Sheet 1:** In pairs, students flip a coin 10 times and graph the current total (see **Appendix – Note 2**)
5 mins (00:30)	Random Walk and Stochastic Process	· Explain stochastic processes (see **Appendix – Note 3**) · Give the example of random walk and refer back to Activity 1 (see **Appendix – Note 3**)
10 mins (00:40)	Normal Distribution	· Mention that random walks follow a standard normal distribution and recap the characteristics of a normal distribution · You may wish to revise mean and variance and link this to standard normal distribution
10 mins (00:50)	Class Activity Random Walk	· Optional: Students model a random walk (see **Appendix – Note 4**)
5 mins (00:55)	Conclusion	· Refer to the share price of some well-known brands to show how share prices change (Link this to a random walk)

Note 1: Different Types of Markets

Physical market	Place where goods are physically bought and sold
Virtual market	Place were goods are bought and sold electronically, such as Amazon
Securities market	A financial market where bonds, stocks, shares and other securities are traded

Note 2: Sample Solution for Activity 1

Flip Number		1	2	3	4	5	6	7	8	9	10
H/T	-	H	T	T	T	H	H	T	T	H	T
Value	-	+1	-1	-1	-1	+1	+1	-1	-1	+1	-1
Location	0	+1	0	-1	-2	-1	0	-1	-2	-1	-2



Note 3: Stochastic Processes and Random Walk

A stochastic process is a way of describing successive random events that are associated with a variable such as time. Even if the initial starting point is known, there are often several directions in which the process may evolve. In Activity 1, for example, there was a 50:50 chance of getting heads or tails with each flip of the coin, yet the actual outcomes for each person was not the same. So, whilst we can define certain characteristics for a process, such as probabilities or starting points, we cannot predict what will actually happen and, thus, it is random.

Similarly, the future share prices of a company cannot be determined as it depends on supply and demand. If more people hope to sell a stock than buy it, then there would be a greater supply than demand and thus the price would fall. However, this cannot be predicted and is therefore considered a stochastic process.

A random walk is an example of a stochastic process that consists of a sequence of steps (such as movements in share prices) determined completely by chance. In Activity 1, for example, we started at the origin and moved +1 if the coin landed on heads and -1 if the coin landed on tails. We cannot predict where we will end up after the 10th throw as our movement is determined by chance.

However, we are more likely to end up closer to the origin than at +10 or -10. For larger samples, such as 100 coin tosses, the outcomes will begin to model a standard distribution.

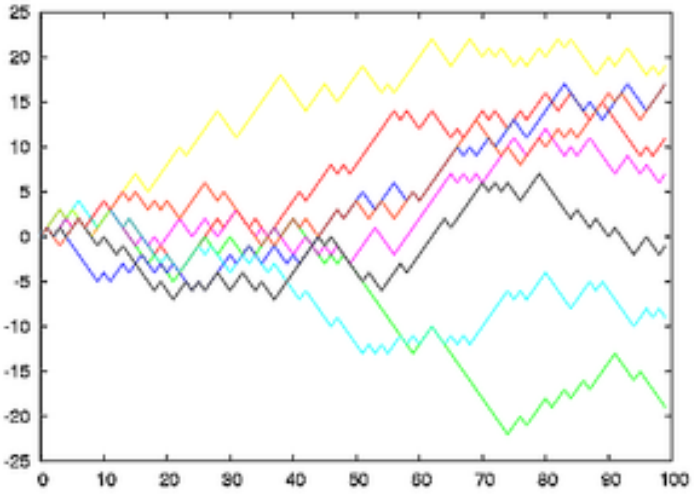


Figure 1 shows a series of random walks, each of which started at the origin.

Note 4: Random Walk Simulation

Step 1: For the random walk simulation, ask students to line up along a central line. This represents the location 0 (Note: you may want to do this outside or in a large room).

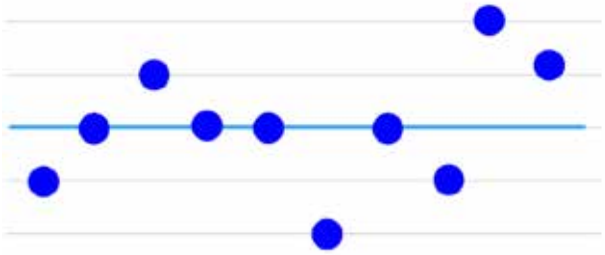
Step 2: Now ask students a series of 5 to 10 binary questions, whereby there are only two possible answers. One answer will correspond to stepping forward one step (+1) and the other will correspond to stepping backward one step (-1). For example, do you have brown hair? Do you prefer summer or winter?

Step 3: Ask students to stay in their final position (e.g. -2) but to move down towards the wall and group together (see diagram below)

The result of the random walk should follow a normal distribution, with most students centred around 0.

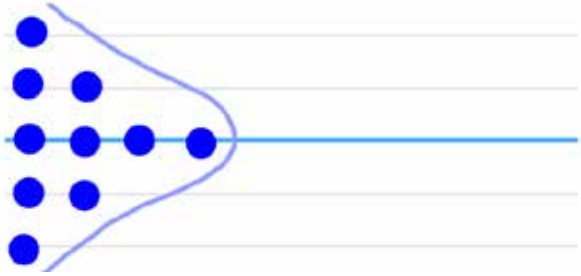
Random Walk Simulation

Step 1



Step 2

Step 3



Result

Sources and Additional Resources

https://www.thebalance.com/securities-definition-and-effect-on-the-u-s-economy-3305961 (securities)

https://momath.org/wp-content/uploads/2016/11/Random-Walk-lesson-9.12.15.pdf (random walk)

http://www.randomservices.org/random/ (additional resources)

World of markets: Activity 1

Q1. Flip the coins a total of 10 times and record the events in the table below as follows:

- H/T: Fill in "H" for heads and "T" for tails.
- Value: If you flip heads you will step forward one step (+1) and if you flip tails you will step backward one step (-1).
- Location: You will start at position 0 as seen in the table below. You then add the value from each flip to your previous location to find your new location (e.g. if you land on heads first, followed by another heads, your location is now +2)

Flip Number		1	2	3	4	5	6	7	8	9	10
H/T	-										
Value (+1 or -1)	-										
Location	0										

Q2. Graph your location results on the graph paper. Compare this with others in the class.