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Loot boxes

GambleAware

NSW GOVERNMENT

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Activity introduction

Quick summary

On the surface, loot boxes (digital lucky dips) seem like a fun and easy way for video game players to win important in-game items. But what are the chances of actually receiving, at random, the item you most desire? And how many loot boxes will you have to purchase on average to attain that item?

In this engaging, creative lesson, students will create their own video game concept, complete with a loot box system. They will then calculate the probability of obtaining all unique items to form a complete set, considering the challenges this random system entails and how the gambling system inherent could lead to unexpected losses.

Learning intentions

Students will:

- understand what a loot box is, and how they can exist outside of computer games
- understand why loot boxes are a form of gambling.

Syllabus outcomes

- **MAO-WM-01** develops understanding and fluency in mathematics through exploring and connecting mathematical concepts, choosing and applying mathematical techniques to solve problems, and communicating their thinking and reasoning coherently and clearly
- **MA5-PRO-C-01** solves problems involving probabilities in multistage chance experiments and simulations.

The identified Life Skills outcome that relates to this activity is **MALS-PRO-01** applies chance and probability to everyday events.

Capabilities and priorities

Literacy
Numeracy
Information and communication technology (ICT) capability
Critical and creative thinking
Ethical understanding

Topic
Gambling probability

Unit of work
Mathematics Stage 5

Time required
55 minutes

Level of teacher scaffolding
High - students will require strong scaffolding through the explicit instruction on calculating probabilities, but will be able to perform the tasks independently.

Resources required

- Art supplies – coloured pencils and textas
- Calculators – one per student
- Device capable of presenting a video to the class
- Paper – A3 in size
- Whiteboard

Keywords
Gambling, betting, sports, casino, money, wellbeing, gaming.

Teacher worksheet

Teacher preparation

Gambling can be a high-risk activity and is a priority concern for young people. Therefore, before conducting the lesson on gambling, it is recommended that teachers read the Facilitator pack. The pack provides teachers and parents with essential information about gambling harm amongst young people and clarifies the nature of gambling-related behaviours and how to approach sensitive topics.

Learning intentions

Students will:

- understand what a loot box is, and how they can exist outside of computer games
- understand why loot boxes are a form of gambling.

Success criteria

Students can:

- explain the links between loot boxes and gambling
- calculate the probability of a loot box containing a desired item
- calculate how many loot boxes are needed on average to complete a set of items.

Teacher content information - What is a loot box?

Have you ever been to a market or fete and bought something from the lucky dip table? You might have paid 50c to buy an unknown item wrapped in plain, brown paper. After excitedly opening it you may have been thrilled to find a water pistol with which to terrorise your younger siblings, or been disappointed at discovering you just spent your pocket money on a plastic whistle.

Lucky dips aren't quite extinct, but they are very old-fashioned and less common attractions. However, instead of disappearing completely like jumping jacks or conkers, lucky dips have evolved into loot boxes.

If you aren't a gamer (or a parent of one) you may not be aware of loot boxes or what they have to do with gambling. Think of a loot box as a treasure chest inside a computer game. These boxes can be bought with credits earned in the game, but it is significantly faster and easier to use real-world money. The chance factor is due to the contents of the box being random. You will usually have a general idea of what it will contain (for example, a box may hold one super-rare, three rare, or five common items), but you will never know the specifics.

Loot boxes have been around since 2004, and are no strangers to controversy. EA Games have been the target of two class action lawsuits due to their use of loot boxes in their *FIFA games*.[1] The Australian Classification Board has regulated that games containing loot boxes must have a label stating that the game contains 'in-app purchases'.[2]

Loot boxes appear in other forms, designed to target children as young as three, and outside of computer games. Walk into any toy store and you will likely see a range of toys with certain hidden features. For example, a company might produce a set of twelve plush toys, each representing a different kind of mystical animal. The package is cleverly designed to obfuscate exactly which animal you are buying. Inside is also a small pamphlet outlining which toys you need to complete the set, encouraging multiple purchases until you, by chance, collect them all. Another example is the collectibles many supermarkets offer when you spend a certain amount on groceries. Which one you receive is randomly decided, with no way to tell from the outside packaging, but nevertheless children are encouraged to collect the set.

Teaching sequence

20 minutes - Part A: What is a loot box?

20 minutes - Part B: Calculating loot box chances

15 minutes - Part C: How many for a set?

5 minutes - Reflection

[1] *Source:* forbes.com/sites/andrewjsilver/2020/12/10/an-imperfect-storm-has-sports-betting-operators-watching-the-ea-class-action/?sh=4ea9f12ffa22

[2] *Source:* vg247.com/australian-government-rules-games-microtransactions-must-address-packaging

Part A:
What is a loot box?

Work through this resource material in the following sequence:

Step 1

Arrange your students into groups of three, ensuring that each group contains at least one person who knows what loot boxes are. Have those students describe them to the others, and answer any questions they may have.

Step 2

As a class, create a word wall on the board of other terms students associate with loot boxes. This may include gambling, fun, chance, gamesskins, and real money.

Step 3

Settle on a definition of a loot box. Write this up on the board.

Step 4

Watch: What are video game loot boxes and do they encourage gambling? | ABC News.

Step 5

In their groups, ask students to answer the question: do you think loot boxes are a form of gambling?

Step 6

After a few minutes of discussion, invite some students to volunteer the perspectives of the group, and discuss these as a whole class.

Step 7

Consider whether there are any terms students want to add to the word wall, or whether they want to alter their definition of a loot box.

Step 8

Explain to students that for this task they will invent a computer game that uses loot boxes, and calculate how many loot boxes a player would need to purchase (on average) in order to complete a full set of items, such as a suit of armour.

Step 9

Independently, or in small groups, students design a basic concept for a video game.

First, students take a sheet of A3 paper and map out some of their ideas.

Remember that the game has to include some form of a set of collectibles. In our example, we'll be using a suit of medieval armour in a fantasy type game, since that concept and the individual pieces required by the set are easy for everyone to grasp. However, creative students might adapt the set to, for example, a complete outfit for a model (clothes, shoes, hat, accessory), a set of furniture for a room in a house (bed, lamp, desk, wardrobe), or different parts of a spaceship (engines, cargo bay, weapons, shields).

Step 10

Students write a brief description of their game, such as something that might be included on the back of a box or in a magazine advertisement.

It should also detail all the components required to assemble the whole set. Recommend students come up with between five and ten different pieces.

Students also need to set a price for each loot box.

For example:

> *Squadron of Supers* is an online (fictitious) game where you play a superhero. These heroes roam a digital world, fighting baddies and rescuing cats stuck in trees. Your particular character is *Sir Gwent the Adamant*, a superhero whose power comes from a magical suit of medieval armour. You get a standard set of armour for free, but to maximise Sir Gwent's potential he really needs the complete, eight-piece set known as *Righteous Protection*. The problem is, to obtain the complete set you must purchase loot boxes as the *Righteous Protection* items cannot be found elsewhere. Each loot box will contain one randomly chosen item from the set. For example, your first loot box might give you the *Breastplate of Truth*, and in the next you find the *Helm of Vision*, and so on. A single loot box will cost a player $4.99.

Part B: Calculating loot box chances

Step 1

Ask your class: how many loot boxes would you need to get the full set?

They should realise that you will need at least eight - but that's a best case scenario, and highly unlikely!

Step 2

Ask students to calculate what is the chance that you open 8 boxes in a row and immediately get the 8 items you want?

$$\frac{8}{8} \times \frac{7}{8} \times \frac{6}{8} \times \frac{5}{8} \times \frac{4}{8} \times \frac{3}{8} \times \frac{2}{8} \times \frac{1}{8} = 0.00240...$$

Step 3

In reality it will be much more, since you're not guaranteed to get the exact item you want every time.

So, how do we calculate this?

Let's start by thinking about the very first box. Ask students:

- **What are the chances that your first loot box will contain a unique (one that you don't already have) item?** As you don't have any items yet, the probability is 1, or 100%. There is absolutely no doubt it will give you an item you don't already have. We can think of this as 'unique item number one'. It doesn't really matter which item it is, specifically, as both the *Breastplate* and *Helm* would be unique to our collection at this stage.

We can express this with the equation:

$$P(\text{box one containing a new item}) = 1$$

Step 4

Now ask students:

- **How many 'box number ones' do I need to purchase to ensure it will contain a unique item?** In this case the answer is pretty simple: one. Buying just one loot box will get us an item we don't already own.

Step 5

So we've got one item. Fantastic! Now let's consider the second box. Ask students:

- **As there are eight items in total in the set, and you already have one of them, what is the chance of this box containing something new?**

This can be expressed as:

$$P(\text{box two containing a new item}) = 7/8$$

$$(\text{with } P(\text{box two containing an item you already have}) = 1/8)$$

Step 6

Explain to students that the amount of 'box number twos' you'd need to purchase to ensure the 'box number two' will contain an item I do not already have is (on average) equal to the reciprocal of the probability of that box containing a new item.

In other words, you would need to purchase (on average):

$$8/7 \approx 1.1429 \text{ boxes.}$$

Step 7 - Important!

This is not the number of boxes needed altogether! This is just how many 'box number twos' you would need in order to get 'unique item number two'.

Explain to students that in order to secure two of the eight pieces of armour from loot boxes, you would need to purchase (on average)

- 1 x box number one
- 1.1429 x box number two

Combined with the first box then, you would need to buy (on average):

- 1 + 1.1429 = 2.1429 boxes.

This means that if we bought (on average) 2.1429 loot boxes, we'd obtain two unique items out of the set of eight.

Step 8

Pause for a moment and ask students to discuss how they feel about these chances. It looks pretty good from the outset, right? In fact if we round down, it looks like probability is saying that we purchase two loot boxes for two unique items.

However, is that an extra 0.1429 worrying any students? Can anyone see a potential pattern emerging, even at this early stage?

Ask students to predict what they think might happen in terms of how many 'box number eights' they might have to purchase.

Step 9

Let's try one more box before we leap into a spreadsheet to ease our calculations.

Players currently own two unique items, with six from the collection left to collect.

$$P(\text{box three containing a new item}) = 6/8$$

Taking the reciprocal of this tells us that on average we would have to purchase:

$$8/6 = 1.333 \text{ boxes.}$$

Adding the numbers for each box together gives us:

$$1 + 1.1429 + 1.333 = 3.4762 \text{ boxes.}$$

Purchasing 3.4762 boxes (on average) will reward a player with three unique items.

Not quite three unique items from three loot boxes, is it? Obtaining this full set of armour might be trickier than at first thought...

Part C:
How many for a set?

Step 1

Independently, students calculate how many loot boxes on average a player of their video game will need to purchase in order to achieve a full set of unique items.

Provisions for learning support:

- You may wish to share the following table with students to support them with their calculations, based on the example above.

Box number	Calculation	Number of boxes to be purchased to receive a unique item
Box number one	8/8	1
Box number two	8/7	1.1429
Box number three	8/6	1.333
Box number four	8/5	
Box number five	8/4	
Box number six	8/3	
Box number seven	8/2	
Box number eight	8/1	
-	-	Total:

Part C: How many for a set?

- Alternatively, if the above task is too difficult, encourage students to create a game with a full set of only five items, remembering that the calculations will change based on the total number of items in the set.

Box number	Calculation	Number of boxes to be purchased to receive a unique item
Box number one	5/5	
Box number two	5/4	
Box number three	5/3	
Box number four	5/2	
Box number five	5/1	
-	-	Total:

Provisions for extending students:

- Encourage students to create a game where a full set is in excess of 10 items.
- Some loot boxes contain not one but three or more items. Does this change the probability of receiving a unique item? For better or worse?
- Some loot boxes have different rarities of items. For example, the *Common Boots of Walking* might have a 70% chance of appearing, the *Rare Boots of Striding* Might have a 20% chance of appearing, and the *Ultra Rare Winged Boots of Flight* might have only a 10% chance of appearing. Can students design a system that predicts a player's chance of assembling a full set of ultra-rare items?
  Note: This is a thought experiment to challenge students only! The maths starts to get complicated… like third-year uni complicated… but students will enjoy puzzling over the challenge!
- There are 363 skins in the video game Overwatch - how many boxes do you think you should open to get them all?

Step 2

Once all students have finished their calculations, invite some students to share their findings.

On average, to assemble a full set of eight unique items, a player will be required to purchase 21.74 (or rounding up to 22) loot boxes.

If students had a higher number of unique items in their set, the number of loot boxes to be purchased will be even higher.

Important! Explain to students the use of the phrase 'on average' throughout this lesson. Probability says that if you purchase 22 loot boxes you *should* assemble a full set of eight items. However, reality doesn't always reflect probability. There will be some players who purchase eight loot boxes and receive eight unique items straight away. And there will be other players who purchase fifty loot boxes and still not assemble a set!

Step 3

Independently, or in their small groups, students write a disclaimer for the box of their video game, explaining the probability of achieving a full set, the cost of purchasing that many loots boxes, and warning players about the potential of spending even more than that if the probability doesn't pay out as expected.

Step 4

Students who finish early could draw some cool box art for their game to go alongside their blurb and disclaimer.

Reflection

Ask students to write a short paragraph reflecting on their approach to loot boxes, knowing the probability of winning the items they desire.

How might they feel when they purchase the average amount of loot boxes and don't complete their set?

What impact might this have on their behaviour? Will they continue to gamble on purchasing loot boxes, or will they realise this might not be a rewarding course of action?

Teacher reflection

Take this opportunity to reflect on your own teaching:

What did you learn about your teaching today?

What worked well?

What didn't work so well?

What would you share?

Where to next?

How are you going to get there?