FOUR ACES

Aims:
To explore a student's concept of '*likely*' and '*unlikely*' in the context of a hand of four cards drawn at random from a normal playing deck.

To also demonstrate just how unreliable we humans can be at estimating the chance of an event occurring and that we are instead better off with a system of assigning numerical probabilities etc.

I normally use this activity as a plenary after having first discussed basic probability. It normally leads on to a more substantial activity in which I ask the students to design '*fairground*' type games which are *ever-so-slightly* biased in favour of the fairground attendant.

- Begin by asking the class how likely it is that a hand of four cards dealt at random will comprise all 4 aces?

  Answers will likely include: $\frac{4}{52}$, $\frac{1}{4}$, "not very likely" etc.

- Students are now asked to **imagine** a game in which they must pay £1 to play against the teacher.

  The game involves the teacher shuffling a pack of cards and dealing 4 cards at random to the student. The student wins if all 4 aces are dealt.

  Simple!

  Now ask if anyone would be willing to play if all they received upon winning is their £1 back, plus £1 from the teacher.

  "No way!" "That's not fair!" "There's no chance of winning!"

- Now ask how many would consider risking their £1, if, upon winning, they received their £1 back, plus £10 from the teacher!
  (I normally get a couple of *takers* at this point!)

- Now for the important part. Ask each student to decide, individually, upon the **minimum amount** the teacher would have to put up against the student's £1 before they would be willing to risk their £1.

Ask them to write down their answer so that no one else can see it. Serious answers only though!

When ready, collate the answers from the class in increasing amounts of money. I normally tabulate the numbers willing to play the game for various amounts of winnings; e.g. £10, £100, £1000 etc.

At each step, I normally state that, for example;

> "*I would happily play the game if I had to pay £10000 if you get all 4 aces…*" etc.

This usually generates quite a bit of interest and discussion.

- On revealing that the '*break even*' point is actually £270 725, because the **probability** of obtaining 4 aces is '*1 chance in 270725*' or $\frac{1}{270725}$, the class are (hopefully!) surprised and amazed!