The issue that started the math study of probability

Chevalier de Mere Problem de Meer was a famous gambler in mid 1600's, who became got rich on die-throw scam

Original deal: Throw a die 4 times,
bet that the value 6 will occur at least once.

He had become hugely rich, this must be right.
Customers figured out they were being scammed and stopped playing.

de Mere's analysis

Original Scam (6) one die

	1 throw	4 throws
Prob:	$\frac{1}{6}$	$4\times\frac{1}{6} = \frac{2}{3}$

New deal: Throw 2 dice 24 times, look for (6,6)
Bet (6,6) occurs at least once

de Mere thought he would win 2/3 of the time, but lost almost everything. He hired Blaise Pascal tp figure out whiy. Pascal worked with Pierre de Fermat. They solved the issue and started modern Probability analysis

de Mere's analysis

Replacement Scam (6,6) two dice

	1 throw	4 throws
Prob:	$\frac{1}{36}$	$24\times\frac{1}{36} = \frac{2}{3}$

- The single throw probability value P is correct, both cases.
- Finding probability for one win in N throws is not simple – not as easy as de Mere's suggestion.

To calculate, find the probability for loss on the first throw. To lose a third time in a row, we must first lose the preceding 2 rolls in succession. To loose 6 times in a row means we had to lose 5 times in succession and finally loose the final throw. Since the events are independent, the probability for this cascade of losses is the value when the Probability of each single loss is multiplied together.

Original scam

The probability of losing all 4 times is $(5/6)^4 = 0.482$
The probability for winning at least once is $1 - 0.482 = 0.518$

Original scam had ... probability of 51.8% to win.
de Mere fooled himself – thought he won 2/3 of the time.

Pascal-Fermat analysis

Original Scam (6) one die

at least once in	**1 throw**	**N throws**
P(win)	$\frac{1}{6}$	$1-\left(\frac{5}{6}\right)^N$
P(lose)	$\frac{5}{6}$	$\left(\frac{5}{6}\right)^N$

New scam

Probability of losing 24 times in a row is $(35/36)^{24} = 0.5086$.
P(win) = 1 – 0.5086 = 0.491 only 2.7% below Scam1

This was enough to wipe out de Mere 's wealth.

Pascal-Fermat analysis

Replacement Scam (6,6) 2 dice

at least once in	**1 throw**	**N throws**
P(win)	$\frac{1}{36}$	$1-\left(\frac{35}{36}\right)^N$
P(lose)	$\frac{35}{36}$	$\left(\frac{35}{36}\right)^N$