

## STEP II, 2001, Q12

- 12** The national lottery of Ruritania is based on the positive integers from 1 to  $N$ , where  $N$  is very large and fixed. Tickets cost £1 each. For each ticket purchased, the punter (i.e. the purchaser) chooses a number from 1 to  $N$ . The winning number is chosen at random, and the jackpot is shared equally amongst those punters who chose the winning number.

A syndicate decides to buy  $N$  tickets, choosing every number once to be sure of winning a share of the jackpot. The total number of tickets purchased in this draw is  $3.8N$  and the jackpot is £ $W$ . Assuming that the non-syndicate punters choose their numbers independently and at random, find the most probable number of winning tickets and show that the expected net loss of the syndicate is approximately

$$N - \frac{5(1 - e^{-2.8})}{14} W .$$



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