

STEP II, 2000, Q12

- 12** *Tabulated values of $\Phi(\cdot)$, the cumulative distribution function of a standard normal variable, should not be used in this question.*

Henry the commuter lives in Cambridge and his working day starts at his office in London at 0900. He catches the 0715 train to King's Cross with probability p , or the 0720 to Liverpool Street with probability $1 - p$. Measured in minutes, journey times for the first train are $N(55, 25)$ and for the second are $N(65, 16)$. Journey times from King's Cross and Liverpool Street to his office are $N(30, 144)$ and $N(25, 9)$, respectively. Show that Henry is more likely to be late for work if he catches the first train.

Henry makes M journeys, where M is large. Writing A for $1 - \Phi(20/13)$ and B for $1 - \Phi(2)$, find, in terms of A , B , M and p , the expected number, L , of times that Henry will be late and show that for all possible values of p ,

$$BM \leq L \leq AM.$$

Henry noted that in $3/5$ of the occasions when he was late, he had caught the King's Cross train. Obtain an estimate of p in terms of A and B .

[A random variable is said to be $N(\mu, \sigma^2)$ if it has a normal distribution with mean μ and variance σ^2 .]



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