

STEP II, 2006, Q14

- 14 Sketch the graph of $y = \frac{1}{x \ln x}$ for $x > 0$, $x \neq 1$. You may assume that $x \ln x \rightarrow 0$ as $x \rightarrow 0$.

The continuous random variable X has probability density function

$$f(x) = \begin{cases} \frac{\lambda}{x \ln x} & \text{for } a \leq x \leq b, \\ 0 & \text{otherwise,} \end{cases}$$

where a , b and λ are suitably chosen constants.

- (i) In the case $a = 1/4$ and $b = 1/2$, find λ .
- (ii) In the case $\lambda = 1$ and $a > 1$, show that $b = a^e$.
- (iii) In the case $\lambda = 1$ and $a = e$, show that $P(e^{3/2} \leq X \leq e^2) \approx \frac{31}{108}$.
- (iv) In the case $\lambda = 1$ and $a = e^{1/2}$, find $P(e^{3/2} \leq X \leq e^2)$.



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