

## **STEP II, 2012, Q13**

- 13 In this question, you may assume that  $\int_0^{\infty} e^{-x^2/2} dx = \sqrt{\frac{1}{2}\pi}$ .

The number of supermarkets situated in any given region can be modelled by a Poisson random variable, where the mean is  $k$  times the area of the given region. Find the probability that there are no supermarkets within a circle of radius  $y$ .

The random variable  $Y$  denotes the distance between a randomly chosen point in the region and the nearest supermarket. Write down  $P(Y < y)$  and hence show that the probability density function of  $Y$  is  $2\pi y k e^{-\pi k y^2}$  for  $y \geq 0$ .

Find  $E(Y)$  and show that  $\text{Var}(Y) = \frac{4 - \pi}{4\pi k}$ .



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