STEP II, 2005, Q13 EC

Q13 Few candidates made significant progress with this question. Responses generally began with an explanation as to why $p = e^{-\lambda}(1+\lambda)$, but generally did not include any serious attempt to show that Y is a binomial variate.

(i) It was expected that candidates would get as far as

$$q \approx 1 - (1+\lambda)[1 - \lambda + \lambda^2/2)]$$

when λ is small. However, as in *Q8*, candidates seemed to be unfamiliar with the concept of approximating a function by use of its power series expansion and so there were few satisfactory solutions here.

(ii) Similarly, few candidates got beyond

$$P(Y = n) = p^n > 1 - \lambda \Rightarrow e^{-n\lambda}(1+\lambda)^n > 1 - \lambda$$

to write something like

$$-n\lambda + n\lambda - n\lambda^2/2 > -\lambda - \lambda^2/2 + O(\lambda^3)$$

and so go on to establish the required result.

(iii) Some responses began (correctly) with

$$P(Y > 1|Y > 0) = P(Y > 1)/P(Y > 0) = (1 - q^n - npq^{n-1})/(1 - q^n)$$

but again, most candidates lacked the technical expertise needed for further progress.