

## STEP II, 2005, Q12 MS

*Q12* It is important to adopt an effective notation. Thus, for example, let  $\alpha \sim$  heads,  $\beta \sim$  tails,  $T \sim$  true,  $F \sim$  false.

(i) Use of the multiplication and addition laws of probability leads immediately to  $P(\alpha) = ap + bq$ . The coin is given to be fair so that  $P(\alpha) = 1/2$ . Hence  $2(ap + bq) = 1$ .

(ii) Write  $G = ap + bq$ , then,

$$P(\alpha) = P(\alpha TF) / [P(\alpha TF) + P(\beta FT)] = [G(1 - G)/2] / [G(1 - G)/2 + (1 - G)G/2] = 1/2,$$

independently of the value of  $G$ .

(iii) Here, it is given that  $G = 1/2$ . Although the argument below has some similarities with the previous working, there are important differences in the fine detail. Thus now,

$$P(\alpha) = P(\alpha TT) / [P(\alpha TT) + P(\beta FF)] = [G^2/2] / [G^2/2 + (1 - G)^2/2] = 1/2.$$



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