

4. In a game of *Sixes*, each player's turn involves rolling 6 identical dice. If the player gets a six on fewer than 3 dice, the player does not score points.

Assuming that the dice are fair, find the probability that in one turn a player

(a) (i) gets a six on exactly 3 dice

(ii) gets a six on at least 3 dice

(3)

Ali and four of his friends play *Sixes* together and have one turn each.

Two of the 5 players score points.

Ali claims that this suggests the dice are biased towards rolling a six.

(b) Carry out a suitable test to investigate Ali's claim.

You should

- state your hypotheses clearly
- use a 5% level of significance
- state the p -value for the test

(4)

(a) Let X be no. of 6's obtained in a turn

$$X \sim B\left(6, \frac{1}{6}\right) \quad (1 \text{ mark})$$

$$\begin{aligned} \text{(a)(i)} \quad P(X=3) &= {}^6C_3 \left(\frac{1}{6}\right)^3 \left(1-\frac{1}{6}\right)^{6-3} = 0.05858... \\ &= 0.0536 \text{ 3sf} \quad (1 \text{ mark}) \end{aligned}$$

Can use Calculator

fx-991EX: MENU 7 - Dist / Binomial PD / Variable

fx-CG50: MENU 2 - Stats / DIST / BINOMIAL / Bpd / Var

$$\begin{aligned} \text{(a)(ii)} \quad P(X \geq 3) &= 1 - P(X \leq 2) \text{ for discrete distribution} \\ &= 1 - 0.93771... = 0.062285... \end{aligned}$$

Using Calculator for \rightarrow
Binomial CD or Bcd \rightarrow $= 0.0623 \text{ 3sf} \quad (1 \text{ mark})$

$$\text{(b)} \quad P(\text{player scores points}) = P(X \geq 3) = 0.0623 \text{ from (a)(ii)}$$

Let Y be no. of players who score points

$$Y \sim B(5, p)$$

$$H_0: p = 0.0623$$

$$\text{(Ali and his 4 friends)} \rightarrow (1 \text{ mark}) \quad H_1: p > 0.0623 \quad (1 \text{ mark}) \quad (\text{with bias towards rolling 6})$$

$$\text{Under } H_0, P(Y \geq 2) = 1 - P(Y \leq 1) = 0.0342 \text{ 3sf} \quad (1 \text{ mark})$$

p -value 0.0342 is < 0.05 , so we would expect 2 players to score less than 5% of the time under H_0 . This is unlikely, so we can reject H_0 at 5% sig.

There is evidence to support Ali's claim (1 mark)