

S1 June 2006 Q.7

ii) $X \sim B(n, 0.1)$

10% contain fossils so use the 0.1 column on the tables

the geologist wants $P(X \geq 1) \geq 0.8$

$$1 - P(X \leq 0) \geq 0.8$$

subtract 1 from both sides

$$-P(X \leq 0) \geq -0.2$$

$$P(X \leq 0) \leq 0.2$$

\div by a -ve so the inequality sign is reversed

Now look through the tables to find the first n value where $P(X \leq 0) \leq 0.2$ in the 0.1 column.

eg $n=1$ $P(X \leq 0) = 0.9$ too big

$n=2$ $P(X \leq 0) = 0.81$ too big

\vdots

$n=15$ $P(X \leq 0) = 0.2059$ just too big

$n=16$ $P(X \leq 0) = 0.1853 \leq 0.2$

so we need 16 rocks.

iii) "less than 10%" \Rightarrow use a one-tail test

(A) $H_0: p = 0.1$ 10% contain fossils

$H_1: p < 0.1$ less than 10% contain fossils.

(B) 5% level, $X \sim B(30, 0.1)$

$n=30$ so we can't use the tables (they only go up to $n=20$).

$$P(X=0) = {}^{30}C_0 (0.1)^0 (0.9)^{30}$$

$$= 0.0424 \quad (3s.f.)$$

$$P(X \leq 1) = 0.0424 + {}^{30}C_1 (0.1)^1 (0.9)^{29}$$

$$= 0.1837 > 5\%$$

so $P(X=0)$ is less than 5%, we would reject H_0 but $P(X \leq 1)$ is $> 5\%$ \therefore accept H_0 for all non-zero values

(C) 2 is not in the critical region, \therefore accept H_0 : there is no evidence to suggest that less than 10% of rocks contain fossils.