B)(a)

at a time t, packet sizes

$$a=2, \quad b=4, \quad c=6 \text{ or } d=8$$

Probability P_a P_b P_c P_d

for Case (i)

$$P_a = P_b = P_c = P_d = 0.25$$

$$\Rightarrow E[X] = \tfrac{1}{4} \times 2 + \tfrac{1}{4} \times 4 + \tfrac{1}{4} \times 6 + \tfrac{1}{4} \times 8$$

$$= \frac{20}{4} = 5 \text{ bits}$$

Variance, $var(X) = E[X^2] - (E(X))^2$

$$= \tfrac{1}{4}(2^2 + 4^2 + 6^2 + 8^2) - (5)^2$$

$$= \frac{120}{4} - 25 = 5$$

for Case(ii), Similarly,

∴ $P_a = P_d = 0$ $P_b = P_c = 0.5$

$$\Rightarrow E(X) = \tfrac{1}{2}(4+6) = 5$$

$$Var(X) = \frac{4^2 + 6^2}{2} - 25 = 1$$

for Case(iii), ∴ $P_a = P_d = 0.5$ $P_b = P_c = 0$

$$E(X) = \tfrac{1}{2}(2+8) = 5$$

$$Var(X) = \tfrac{1}{2}(8^2 + 2^2) - 25 = 9$$

for Case iv, $P_a = P_b = P_c = 0$ $P_d = 1$

$\Rightarrow E(X) = 8$ $var(X) = 0$