We want $E[X]$.

$$E[X] = E\left[\sum_{i=1}^{n-1} \sum_{j=i+1}^{n} X_{ij}\right]$$

$$= \sum_{i=1}^{n-1} \sum_{j=i+1}^{n} E[X_{ij}]$$

$$= \sum_{i=1}^{n-1} \sum_{j=i+1}^{n} \frac{1}{2}$$

$$= \binom{n}{2} \frac{1}{2}$$

$$= \frac{n(n-1)}{2} \cdot \frac{1}{2}$$

$$= \frac{n(n-1)}{4}$$

Expected number of inversions is $n(n-1)/4$

4. $p(A) = 0.32$ $\quad c(A) = 00$
$p(B) = 0.25$ $\quad c(B) = 10$
$p(C) = 0.2$ $\quad c(C) = 110$
$p(D) = 0.18$ $\quad c(D) = 01$
$p(E) = 0.05$ $\quad c(E) = 111$

Average code length $= 0.32(2) + 0.25(2) + 0.2(3) + 0.18(2) + 0.05(3)$
$= 2.25$