The previous step follows because given a random variable (say) Y_i from distribution $F(Y_i)$, we know that $F(Y_i)$ is a $[0,1]$ uniform random variable.

We also know that for any x, $F(x) \in [0,1]$.
Rename $F(x)$ as y, which gives us

$$P(D \geq d) = P\left\{ \max_{0 \leq y \leq 1} \left| \sum_i \frac{1(U_i \leq y)}{n} - y \right| \geq d \right\}$$

$$= P(E \geq d)$$

Q3 For covariance matrix of multinomial, refer to lecture slides on multinomial distribution.

Q4)

a) Let $Y = \min \{X_i\}_{i=1}^{n}$ where

$X_i \sim \text{Bernoulli}(p)$.

$$P(Y=1) = \prod_{i=1}^{n} P(X_i = 1) = p^n$$

$$P(Y=0) = 1 - P(Y=1) = 1 - p^n$$

So Y is a Bernoulli random variable with parameter p^n.