

1 a

$$\begin{aligned}
 & \mathbb{E}[\mathbf{X}] \\
 &= \mathbb{E}\left[\sum_i \mathbf{X}_i\right] \\
 &= \sum_i \mathbb{E}[\mathbf{X}_i] \\
 &= n\mathbb{E}[\mathbf{X}_i] \\
 &= n\frac{1}{p}
 \end{aligned}$$

$$\begin{aligned}
 & \text{Var}(\mathbf{X}) \\
 &= \text{Var}\left(\sum_i \mathbf{X}_i\right) \\
 &= \sum_i \text{Var}(\mathbf{X}_i) \\
 &= n\text{Var}(\mathbf{X}_i) \\
 &= n\frac{1-p}{p^2}
 \end{aligned}$$

2 b

$$\Pr[|\mathbf{X} - \mathbb{E}[\mathbf{X}]| \geq \epsilon] \leq \frac{\text{Var}(\mathbf{X})}{\epsilon^2}$$

$$\Pr\left[\left|\mathbf{X} - \frac{n}{p}\right| \geq \epsilon\right] \leq \frac{n\frac{1-p}{p^2}}{\epsilon^2}$$

$$\Pr\left[\left|\mathbf{X} - \frac{n}{p}\right| \geq \epsilon\right] \leq \frac{n\frac{1-p}{p^2}}{\epsilon^2}$$

$$\Pr\left[\mathbf{X} \geq \left(1 + \left(n\frac{1-p}{p^2}\right)\right)\frac{n}{p}\right] \leq \frac{1}{\left(n\frac{1-p}{p^2}\right)\frac{n}{p}}$$

$$\Pr\left[\mathbf{X} \geq \left(\frac{p^2 + n - np}{p^2}\right)\mathbb{E}[\mathbf{X}]\right] \leq \frac{p^3}{n^3 - n^2p}$$

$$c =$$