$$\mathbb{P}\left(p_i \le \frac{\alpha r}{m^*} \,,\, R_i = r-1 \right)$$

$$= \mathbb{E}\left[\mathbb{E}\left[\mathbb{1}\left(p_i \le \frac{\alpha r}{m^*} \,,\, R_i = r-1 \right) \mid m^* \right] \right]$$

Given m^*, $\left\{ p_i \le \frac{\alpha r}{m^*} \right\}$ and $\{R_i = r-1\}$ are independent

as the first $m_i^* \ge p_i / \alpha r$ gives information about p_j $j \neq i$

m_i^*

Take $m^* = \max_i m_i^*$

$$\frac{\alpha r}{m^*} \le \frac{\alpha r}{m_i^*} \quad \text{i.e.} \quad m^* \ge$$