Claim $\sum_{i=1}^{m} \mathbb{1}[R_i = r-1] = 1$.

i.e. on p_j, $j \neq i$

Using $m_i = h_i(\alpha)$

Question: what is $\mathbb{E}\left[\frac{1}{h(\alpha)}\right]$???

$$m_0 \le h(\alpha) \Rightarrow \frac{1}{h(\alpha)} \le \frac{1}{m_0}$$

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w.p. $1-\alpha$, $m_0 \le h(\alpha)$.

$h(\alpha) \le m$

i.e. $\frac{1}{h(\alpha)} \le \frac{1}{m_0}$ $\Rightarrow$ $\cancel{\frac{1}{h(\alpha)} \ge \frac{1}{m}}$

So
$$\mathbb{E}\left[\frac{1}{h(\alpha)}\right] = \mathbb{E}\left[\frac{1}{h(\alpha)} \mathbb{1}[m_0 \le h(\alpha)]\right] + \mathbb{E}\left[\underbrace{\frac{1}{h(\alpha)} \mathbb{1}[m_0 > h(\alpha)]}\right]$$

$\frac{1}{h(\alpha)} \le 1$

& $\mathbb{P}(m_0 > h(\alpha)) \le \alpha$

$$\le \mathbb{E}\left[\frac{1}{m_0} \mathbb{1}[m_0 \le h(\alpha)]\right] + \alpha$$

if $m_0 \le 20$ then $\alpha m_0 \le 1$

so this controls the FDR