Document Generation

$$\frac{P(R=1|Q,D)}{P(R=0|Q,D)} \propto \frac{P(Q,D|R=1)}{P(Q,D|R=0)}$$

$$= \frac{P(D|Q,R=1)}{P(D|Q,R=0)} \boxed{\frac{P(Q|R=1)}{P(Q|R=0)}} \qquad \Longleftarrow \textbf{\textcolor{red}{Ignored for ranking D}}$$

$$\propto \frac{P(D|Q,R=1)}{P(D|Q,R=0)} \qquad \longleftarrow \textbf{Model of \textcolor{red}{relevant} docs for Q}$$

$$\qquad\qquad\qquad\qquad \longleftarrow \textbf{Model of \textcolor{red}{non-relevant} docs for Q}$$

Assume independent attributes $A_1 \ldots A_k$ ....(why?)

Let $D = d_1 \ldots d_k$, where $d_k \in \{0,1\}$ is the value of attribute A_k (Similarly $Q = q_1 \ldots q_k$)

$$\frac{P(R=1|Q,D)}{P(R=0|Q,D)} \propto \prod_{i=1}^{k} \frac{P(A_i=d_i|Q,R=1)}{P(A_i=d_i|Q,R=0)}$$

$$= \prod_{i=1,d_i=1}^{k} \frac{P(A_i=1|Q,R=1)}{P(A_i=1|Q,R=0)} \prod_{i=1,d_i=0}^{k} \frac{P(A_i=0|Q,R=1)}{P(A_i=0|Q,R=0)}$$

$$\propto \prod_{i=1,d_i=1}^{k} \frac{P(A_i=1|Q,R=1)P(A_i=0|Q,R=0)}{P(A_i=1|Q,R=0)P(A_i=0|Q,R=1)}$$

$$\approx \prod_{i=1,d_i=q_i=1}^{k} \frac{P(A_i=1|Q,R=1)P(A_i=0|Q,R=0)}{P(A_i=1|Q,R=0)P(A_i=0|Q,R=1)}$$

$$\boxed{\prod_{i=1}^{k} \frac{P(A_i=0|Q,R=1)}{P(A_i=0|Q,R=0)}} \qquad \Longleftarrow \textcolor{red}{\text{Ignored for ranking D}}$$

$$\overline{\prod_{i=1,d_i=1}^{k} \frac{P(A_i=0|Q,R=1)}{P(A_i=0|Q,R=0)}}$$

$$(Assume \ P(A_i=1|Q,R=1) = P(A_i=1|Q,R=0), if \ q_i=0)$$