$\mathbb{P}(P(Y) \in D \mid Y \in S(p_i))$

$= \mathbb{P}(\quad \mid Y \in S(p_i))$

$$T(p_i) = \bigcup_{p \in p_i} S(p)$$

$\mathbb{P}(\quad \mid Y \in T(p_i))$

Given $p_i \leq p_i'$:

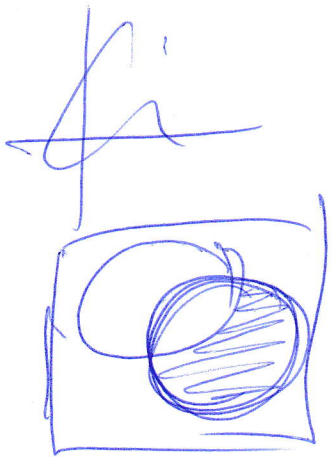
$T(p_k)$ is an increasing set

i.e.: $Y^{-1}(\{p \leq p\})$

In particular, thus is an increasing set say $P^{-1}(D)$

$\mathbb{P}(P(Y) \in D \mid Y \in P^{-1}(D) \mid Y \in T(p_i))$

$= \dfrac{\mathbb{P}(Y \in P^{-1}(D) \cap T(p_i))}{\mathbb{P}(Y \in T(p_i))}$



$\dfrac{\mathbb{P}(Y \in P^{-1}(D) \cap T(p_i'))}{\mathbb{P}(Y \in T(p_i'))}$