

# Machine Learning Homework 1

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# 1. Joint Distribution of Death Sentence, Victim Race, and Murderer Race

Each outcome corresponds to a murder trial.

Let  $D = 1$  if the murderer gets the death sentence and 0 otherwise.

Let  $M = 1$  if the murderer is white and 0 otherwise.

Let  $V = 1$  if the victim is white and 0 otherwise.

Let  $p(M = 1) = .5$ .

Let  $p(V = 1 | M = 1) = .8$ .

Let  $p(V = 1 | M = 0) = .2$ .

Let  $p(D = 1 | M = 1, V = 1) = .6$ .

Let  $p(D = 1 | M = 1, V = 0) = .4$ .

Let  $p(D = 1 | M = 0, V = 1) = .6$ .

Let  $p(D = 1 | M = 0, V = 0) = .4$ .

These probabilities define the joint distribution of  $(M, V, D)$

(a) Who is more likely to get the death sentence?

That is, what are  $p(D = 1 | M = 1)$  and  $p(D = 1 | M = 0)$  ?

(b) Find the joint distribution of  $(M, D)$  (give the two-way table).

(c) Are  $M$  and  $D$  independent ?

(d) Find the joint distribution of  $(M, D)$  given  $V = 1$  (give the two-way table).

(e) Given  $V = 1$ , are  $M$  and  $D$  independent?

(f) Find the joint distribution of  $(M, D)$  given  $V = 0$  (give the two-way table).

(g) Given  $V = 0$ , are  $M$  and  $D$  independent?

(h) Are  $M$  and  $V$  independent?

(i) Are  $D$  and  $V$  independent?

(j) How is  $D$  related to  $M$  and  $V$ ?

If correct for some population, what do these probabilities  
say about the impact of race on whether or not a murder is sentenced to death?