

CSE 5525 Artificial Intelligence II

Homework #5: Probability

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1 Joint and Conditional Distributions

Consider three random variables Toothache, Cavity and Catch. The joint probabilities that each random variable takes on the respective values is given below:

	+toothache		-toothache	
	+catch	-catch	+catch	-catch
+cavity	0.108	0.012	0.072	0.008
-cavity	0.016	0.064	0.144	0.576

Questions:

- 1) What is $P(+toothache)$?
- 2) What is $P(Catch)$?
- 3) What is $P(+cavity | +catch)$?
- 4) What is $P(+cavity | +toothache \text{ or } +catch)$?
- 5) Is the random variable Catch *conditionally independent* of Toothache, given Cavity?
(Hint: $P(+catch | +toothache, +cavity) = P(+catch | +cavity)$?)

2 Conditional Independence

For random variables X, Y, Z , show that the following three statements are equivalent:

- (i) $P(X|Y, Z) = P(X|Z)$
- (ii) $P(Y|X, Z) = P(Y|Z)$
- (iii) $P(X, Y|Z) = P(X|Z)P(Y|Z)$

Equivalence of the first two statements show that conditional independence is symmetric (X and Y are conditionally independent given Z , and the order of X and Y doesn't matter). The third statement is analogous to the definition of *unconditional* independence: $P(X, Y) = P(X)P(Y)$.