CSE 5525 Artificial Intelligence II

Quiz #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 $P(+\text{toothache})$?

2) What is $P(\text{Catch})$?

3) What is $P(+\text{cavity}| + \text{catch})$?

4) What is $P(+\text{cavity}| + \text{toothache } \textit{or} + \text{catch})$?

5) Is the random variable Catch *conditionally independent* of Toothache, given Cavity? (Hint: $P(+\text{catch}| + \text{toothache}, +\text{cavity}) = P(+\text{catch}| + \text{cavity})$?)

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: $P(X, Y) = P(X)P(Y)$).