

Name: _____

Student ID: _____

Problem 1

(15 pts) Draw a truth table and use it to identify whether the following argument is valid: $r \& (s \vee t), r \& \sim s$, therefore t .

Problem 2

(15 pts) [The actual midterm will ask one of the questions from the following list, and you will have to write a few sentences answering it.]

List of possible questions:

- Why does Hume think we can never have a deductive proof of the uniformity of nature?
- Why does Hume think an inductive argument for the uniformity of nature can never be convincing?
- What does it mean for an argument to be inductively strong, and how is this related to epistemic probability?
- What does it mean for an argument to be deductively valid, and how can truth tables be used to identify it?

Problem 3

For these questions, either calculate the desired probability, or state that not enough information is present.

- (a) (5 pts) If $Pr(x) = .3$ and $Pr(x \vee y) = .7$, then what is $Pr(y \& \sim x)$? _____
- (b) (5 pts) If $Pr(z \& v) = .3$ and $Pr(z) = .6$, then what is $Pr(v)$? _____
- (c) (5 pts) If $Pr(\sim d) = .4$ and $Pr(d \vee e) = .8$, then what is $Pr(e \& \sim d)$? _____
- (d) (5 pts) If $Pr(f \& g) = .2$ and $Pr(f \vee g) = .6$, then what is $Pr(f)$? _____
- (e) (5 pts) If $Pr(h) = .4$ and $Pr(l) = .3$ and $Pr(h \vee l) = .6$, then what is $Pr(h \& l)$? _____
- (5 pts) Are h and l probabilistically independent? _____
- (f) (5 pts) If $Pr(n \& q) = .25$ and $Pr(n) = .5$ and $Pr(q) = .5$, then what is $Pr(n \vee q)$? _____
- (5 pts) Are n and q probabilistically independent? _____
- (g) (5 pts) If $Pr(u) = .4$ and $Pr(w) = .6$ and $Pr(u \vee \sim w) = .7$, then what is $Pr(u \& w)$? _____
- (5 pts) Are u and w probabilistically independent? _____

Problem 4

Fill in the probabilities of this truth table (5 pts each) using the following information:

- $Pr(x) = .4$
- $Pr(y \mid x) = 1/4$
- $Pr(y \mid \sim x) = 1/2$
- $Pr(z \mid (x \& y)) = 1/2$
- $Pr(z \mid (x \& \sim y)) = 1/3$
- $Pr(z \mid (\sim x \& y)) = 2/3$
- $Pr(z \mid (\sim x \& \sim y)) = 1/3$

x	y	z	Pr
T	T	T	_____
T	T	F	_____
T	F	T	_____
T	F	F	_____
F	T	T	_____
F	T	F	_____
F	F	T	_____
F	F	F	_____

Problem 5

A fair six-sided die is rolled. Calculate the expected value of each of these gambles:

- (a) (5 pts) +6 if the result is 2 or less, nothing otherwise. _____
- (b) (5 pts) +12 if the result is exactly 6, -3 if the result is exactly 1, nothing otherwise. _____
- (c) (5 pts) +3 if the result is odd, -3 if the result is even. _____
- (d) (5 pts) +9 if the result is 3 or 5, -3 if the result is even, nothing otherwise. _____

Problem 6

- (a) (10 pts) Sam is deciding whether to cook eggs from the refrigerator for breakfast or eat cereal instead. Cooking the eggs gives +10 utility if they're still fresh, but an unknown lower value if they've gone bad. Eating cereal gives +1 utility for sure. If Sam thinks there's a 40% chance the eggs are still fresh, but chooses cereal anyway, how bad must Sam's utility be for cooking eggs that have gone bad?
- (b) (10 pts) Morgan is deciding whether to walk to class (+9 if sunny, -3 if raining) or ride the campus shuttle (+3 regardless of weather). Morgan checks the weather app, which indicates a chance of rain, and decides to take the shuttle. How likely must Morgan think it is to rain for this decision to be rational?

Problem 7

A forensic investigator is analyzing whether a suspect is guilty of theft (g). Currently, she assigns $Pr(g) = .2$. The investigator collects fingerprint evidence. She might find the suspect's fingerprints at the scene (p) — there is a high chance of finding such prints if the suspect is guilty ($Pr(p \mid g) = 3/4$) but also a chance of finding their prints for innocent reasons ($Pr(p \mid \sim g) = 1/4$). The investigator might also find surveillance footage of someone matching the suspect's description (v ; $Pr(v \mid g) = 1/2$), although the footage could match someone else by coincidence ($Pr(v \mid \sim g) = 1/8$).

- (a) (10 pts) What is $Pr(g \mid p)$? _____
- (b) (10 pts) What is $Pr(g \mid v)$? _____
- (c) (20 pts) If p and v are independent conditional on g and on $\sim g$, then what is $Pr(g \mid p \& v)$? _____