PS7

Graded

Student

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Total Points

92 / 100 pts

Question 1

7.1 Marginalization and conditioning from a joint distribution — **25** / 25 pts

1.1 (a) — **6** / 6 pts

✔ **+ 6 pts** Correct

1.2 (b) — **6** / 6 pts

✔ **+ 6 pts** Correct

1.3 (c) — **6** / 6 pts

✔ **+ 6 pts** Correct

1.4 (d) — **7** / 7 pts

✔ **+ 7 pts** Correct

Question 2

7.2 Good news, bad news from doctor — **17** / 25 pts

✔ **+ 25 pts** Correct

✔ **− 4 pts** Missing discussion about results. Is it good news or bad?

✔ **− 4 pts** Discussion about the news misses the point on false positive tests

Question 3

7.3 Normalization calculations — **25** / 25 pts

✔ **+ 25 pts** Correct

Question 4

7.4 Athenian taxis, or uncertain observations **25** / 25 pts

4.1 **(a)** **10** / 10 pts

✔ **+ 10 pts** Correct

4.2 **(b)** **15** / 15 pts

✔ **+ 15 pts** Correct

Question assigned to the following page: 1.3

6. $P(\text{Toothache} \mid \text{Cavity}) = \frac{P(\text{Toothache} \wedge \text{Cavity})}{P(\text{Cavity})}$

$= \frac{0.108 + 0.012}{0.2} = \frac{0.12}{0.2} = 0.6$

So, $\underline{P}(\text{Toothache} \mid \text{Cavity}) = \langle 0.6, 1 - 0.6 \rangle = \langle 0.6, 0.4 \rangle$.

Question assigned to the following page: 1.4

d. $P(\text{Cavity} \mid \text{Toothache} \vee \text{Catch}) = \frac{P(\text{Cavity} \wedge (\text{Toothache} \vee \text{Catch}))}{P(\text{Toothache} \vee \text{Catch})}$

$= \frac{0.108 + 0.012 + 0.072}{0.108 + 0.012 + 0.016 + 0.064 + 0.072 + 0.144} = \frac{0.292}{0.4416} = 0.4615$

So, $\underline{P}(\text{Cavity} \mid \text{Toothache} \vee \text{Catch}) = \langle 0.4615, 1 - 0.4615 \rangle$

$= \langle 0.4615, 0.5385 \rangle.$

Question assigned to the following page: 4.1

4a. $P(LB|B) = P(\neg LB|\neg B) = 0.75$

$P(B|LB) \propto P(LB|B)P(B) \propto 0.75P(B)$

$P(\neg B|LB) \propto P(LB|\neg B)P(\neg B) \propto 0.25P(\neg B)$

So, you can't find the information to calculate the most likely taxi color since some probabilities are missing.

Question assigned to the following page: 1.1

12.

	Toothache		¬Toothache	
	Catch	¬Catch	Catch	¬Catch
Cavity	0.108	0.012	0.072	0.008
¬Cavity	0.016	0.064	0.144	0.576

Question assigned to the following page: 1.1

a. $P(\text{Toothache}) = 0.108 + 0.012 + 0.016 + 0.064 = 0.2$

So, $\underline{P}(\text{Toothache}) = \langle 0.2, 1 - 0.2 \rangle = \langle 0.2, 0.8 \rangle$.

Question assigned to the following page: 2

2. $P(D) = \frac{1}{10000} = 0.0001$ (Rare Disease)

$P(\neg D) = 1 - P(D) = 1 - 0.0001 = 0.9999$

$P(T|D) = 0.99$ (Test is positive when I have the disease.)

$P(\neg T|D) = 1 - P(T|D) = 1 - 0.99 = 0.01$

$P(\neg T|\neg D) = 0.99$ (Test is negative when I have no disease.)

$P(T|\neg D) = 1 - P(\neg T|\neg D) = 1 - 0.99 = 0.01$

$$P(D|T) = \frac{P(T|D)P(D)}{P(T)} = \frac{P(T|D)P(D)}{P(T|D)P(D) + P(T|\neg D)P(\neg D)}$$

$$= \frac{0.99(0.0001)}{0.99(0.0001) + 0.01(0.9999)}$$

$$= \frac{0.000099}{0.010089} = 0.009804$$

Question assigned to the following page: 4.2

b. $P(\neg B) = 0.9$ (The taxi is green.)
$P(B) = 1 - P(\neg B) = 1 - 0.9 = 0.1$

$P(B \mid \angle B) \propto 0.75\,(0.1) \propto 0.075$
$P(\neg B \mid \angle B) \propto 0.25\,(0.9) \propto 0.225$

$P(B \mid \angle B) = \frac{0.075}{0.075 + 0.225} = 0.25$
$P(\neg B \mid \angle B) = \frac{0.225}{0.075 + 0.225} = 0.75$

$\underline{P}(B \mid \angle B) = \langle 0.25, 0.75 \rangle$

Therefore, the taxi is green even though the taxi looks blue since $P(\neg B \mid \angle B) > P(B \mid \angle B)$.

Question assigned to the following page: 1.2

b. $P(\text{Cavity}) = 0.108 + 0.012 + 0.072 + 0.008 = 0.2$

So, $\underline{P}(\text{Cavity}) = \langle 0.2, 1 - 0.2 \rangle = \langle 0.2, 0.8 \rangle$.

Question assigned to the following page: 3

3. $P(s|\neg m) = 0.7$ $\quad P(m) = \frac{1}{50000}$

$P(s|\neg m) = 0.05$ $\quad P(\neg m) = 1 - P(m) = 1 - \frac{1}{50000} = \frac{49999}{50000}$

$P(m|s) = \alpha P(s|m) P(m) = 0.7\left(\frac{1}{50000}\right) = 0.000014$

$P(\neg m|s) = \alpha P(s|\neg m) P(\neg m) = 0.05\left(\frac{49999}{50000}\right) = 0.049999$

$P(m|s) = \frac{0.000014}{0.000014 + 0.049999} = 0.00028$

$P(\neg m|s) = \frac{0.049999}{0.000014 + 0.049999} = 0.99972$

$\underline{P}(M,S) = \langle 0.00028, 0.99972 \rangle.$