Public Policy Modeling
Homework #2

100 − 5 = 95
great P

Question 1 Payoff table

Q.1.1 Solve the question a. Construct payoff table

(units in million dollars)

Decision Alternatives	States of Nature		
	Winning season	Losing season	Tired season
Hold campaign	3	-2	1
No campaign	0	0	0
Prior Probability	0.6	0.3	0.1

✓

Qustion 2. Decision-making under uncertainty (Assume no probability)

Q 2.1. Decision with Savage criation. Report the regret table.

Regret (Hold campaign | winning) = Max (3, 0) − 3 = 0
Regret (No campaign | winning) = Max (3, 0) − 0 = 3
Regret (Hold campaign | Losing) = Max (−2, 0) − (−2) = 2
Regret (No campaign | Losing) = Max (−2, 0) − 0 = 0
Regret (Hold campaign | Tired) = Max (1, 0) − 1 = 0
Regret (No campaign | Tired) = Max (1, 0) − 0 = 1

✓

Regret table.

Alternatives	State of Nature		
	Winning season	Losing season	Tired season
Hold Campaign	0	2	0
No campaign	3	0	1

✓

Hold camaign : Max (0, 2, 0) = 2
No campaign : Max (3, 0, 1) = 3

✓

Therefore I choose Hold campaign because it gives smaller regret of 2 million dollars.

Question 2.2. Decision making with Laplace criation

I will choose Laplace criation, because I am not sure that even probability of having winning season is highest 0.6, → Uncertainty
also here is possibility to lose 2 million dollars. → Maximin
This creation used equal probability for each state of nature. Not logical

-2

Question 2.3. Make a decision with criation in Q 2.2.

Laplace creation, we assume that each season have same probabity.

Hold campaign: $\frac{1}{3}(3) + \frac{1}{3}\cdot(-2) + \frac{1}{3}(1) = 1 + (-\frac{2}{3}) + \frac{1}{3}$

$= \frac{3\cdot(1)+(-2)+1}{3} = \frac{3-2+1}{3} = \frac{2}{3} = 0.66$

No campaign: $\frac{1}{3}(0) + \frac{1}{3}(0) + \frac{1}{3}(0) = 0+0+0 = 0$

Therefore I will choose the alternative with maximum expected profit, which is 0.66 mill. Hold campaign. ✓

Question 2.4. Decision making with Hurwicz criation.

Assume that I have $\alpha = 0.3$ $\quad 1-\alpha = 1-0.3 = 0.7$

As this creation considers only maximum and minimum

Hold campaign will give: $0.3\cdot \text{Max}(3,-2,1) + 0.7\cdot \text{Min}(3,-2,1)$

$= 0.3\cdot(3) + 0.7(-2)$

$= 0.9 + (-1.4)$

$= -0.5$

No campaign will give: $0.3\cdot \text{Max}(0,0,0) + 0.7\cdot \text{Min}(0,0,0)$

$= 0.3\cdot(0) + 0.7(0)$

$= 0+0$

$= 0$

Therefore I will choose No campaign, because it has higher value than negative (-0.5)

Question 3. Decision making under risk.

Q.3.1. Making decision using EMV

Hold campaign: $0.6\times(3) + 0.3(-2) + 0.1(1) = 1.8 - 0.6 + 0.1 = 1.3$ ✓

No campaign: $0.6\cdot(0) + 0.3(0) + 0.1(1) = 0+0+0 = 0$ ✓

Therefore I will choose Hold campaign Max(1.3, 0) = 1.3
it gives larger payoff of 1.3 million dollars ✓

Q. 3.2 Making a decision using EOL

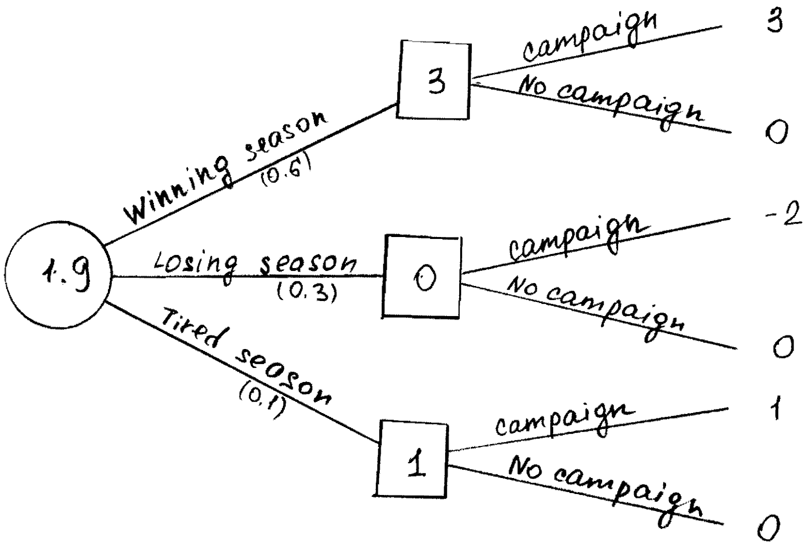
Hold campaign: $0.6 \cdot (0) + 0.3 \cdot (2) + 0.1 (0) = 0 + 0.6 + 0 = 0.6$ ✓

No campaign: $0.6 \cdot (3) + 0.3 \cdot (0) + 0.1 (1) = 1.8 + 0 + 0.1 = 1.9$ ✓

Therefore, I will choose hold campaign, because it has smaller expected opportunity loss of 0.6 million dollars. ✓

Question 4. Expected value of perfect information

Q. 4.1. Decision tree under the perfect information



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Q. 4.2. Expected value of perfect information - calculation.

Expected value under the perfect information

$Max(3,0) \cdot (0.6) + Max(-2,0)(0.3) + Max(1,0)(0.1) = 1.8 + (-0.6) + 0.1 = 1.9$

Expected value of perfect information

$EVPI = 1.9 - 1.3 = 0.6$ ✓

Question 5. Expected value of imperfect information.

William predictions as additional information:

$P(Up \mid Winning) = 0.75$

$P(Down \mid Winning) = 1 - 0.75 = 0.25$

$P(Down \mid Losing) = 0.75$

$P(Up \mid Losing) = 1 - 0.75 = 0.25$

$P(Up \mid Tired) = 0.5$

$P(Down \mid Tired) = 0.5$

Question 5.1 Identifying two decision variables

First decision variable for Athletic Department is to buy the additional information from William or not to buy this information,

Secon decision variable for Athletic Department is to Hold campaign or not to hold campaign.

Question 5.2. Identifying environment variables

In this decision situation environment variables which we can not control or decide are having winning season, having losing season or tired season. ?

-3

Question 5.3. Calculate joint probabilities.

P(Up & winning) = P(Up/winning) × P(winning) = 0.75 × 0.6 = 0.45

P(Down & winning) = P(Down/winning) × P(winning) = 0.25 × 0.6 = 0.15

P(Up & Losing) = P(Up/Losing) × P(Losing) = 0.25 × 0.3 = 0.075

P(Down & Losing) = P(Down/Losing) · P(Losing) = 0.75 × 0.3 = 0.225

P(Up & Tired) = P(Up/Tired) × P(Tired) = 0.5 × 0.1 = 0.05

P(Down & Tired) = P(Down/Tired) × P(Tired = 0.5 × 0.1 = 0.05

Question 5.4. Calculate marjinal probabilities

P(Up) = P(Up & winning) + P(Up & Losing) + P(Up & Tired) = 0.45 + 0.075 + 0.05 = 0.575

P(Down) = P(Down & winning) + P(Down & Losing) + P(Down & Tired) = 0.15 + 0.225 + 0.05 = 0.425

Question 5.5. Calculate posterior probabilities

$$P(Winning/Up) = \frac{P(Winning \& Up)}{P(Up)} = \frac{0.45}{0.575} = 0.78$$

$$P(Losing/Up) = \frac{P(Losing \& Up)}{P(Up)} = \frac{0.075}{0.575} = 0.13$$

$$P(Tired/Up) = \frac{P(Tired \& Up)}{P(Up)} = \frac{0.05}{0.575} = 0.09$$

Cont. Q. 5.5

$$P(\text{winning}/\text{Down}) = \frac{P(\text{Winning} \,\&\, \text{Down})}{P(\text{Down})} = \frac{0.15}{0.425} = 0.35$$

$$P(\text{Losing}/\text{Down}) = \frac{P(\text{Losing} \,\&\, \text{Down})}{P(\text{Down})} = \frac{0.225}{0.425} = 0.53$$

$$P(\text{Tired}/\text{Down}) = \frac{P(\text{Tired} \,\&\, \text{Down})}{P(\text{Down})} = \frac{0.05}{0.425} = 0.12$$

Question 5.6 Expected value of four cases.

$EV(\text{Hold campaign}/\text{up}) = P(\text{winning}/\text{Up})\cdot(3) + P(\text{Losing}/\text{up})\cdot(-2) + P(\text{Tired}/\text{up})\cdot(1) =$
$= (0.78)\cdot(3) + (0.13)(-2) + (0.09)\cdot(1) = 2.174$

$EV(\text{No campaign}/\text{up}) = P(\text{winning}/\text{Up})\cdot(0) + P(\text{Losing}/\text{Up})\cdot(0) + P(\text{Tired}/\text{up})\cdot(0) =$
$= (0.78)\cdot(0) + (0.13)\cdot(0) + (0.09)(0) = 0$

$EV(\text{Hold campaign}/\text{Down}) = P(\text{winning}/\text{Down})\cdot(3) + P(\text{Losing}/\text{Down})\cdot(-2) + P(\text{Tired}/\text{Down})(1)$
$= (0.35)\cdot 3 + (0.53)\cdot(-2) + (0.12)(1) = 0.117$

$EV(\text{No campaign}/\text{Down}) = P(\text{winning}/\text{Down})\cdot(0) + P(\text{Losing}/\text{Down})\cdot(0) + P(\text{Tired}/\text{Dow})\cdot(0)$
$= (0.35)(0) + (0.53)\cdot(0) + (0.12)\cdot(0) = 0$

Question 5.7 Calculate this value with this imperfect information

$EV(\text{with imperfect information}) = [P(\text{up})\cdot \text{Max}(2.174, 0)] + [P(\text{Down})\cdot \text{Max}(0.117\ 0)]$

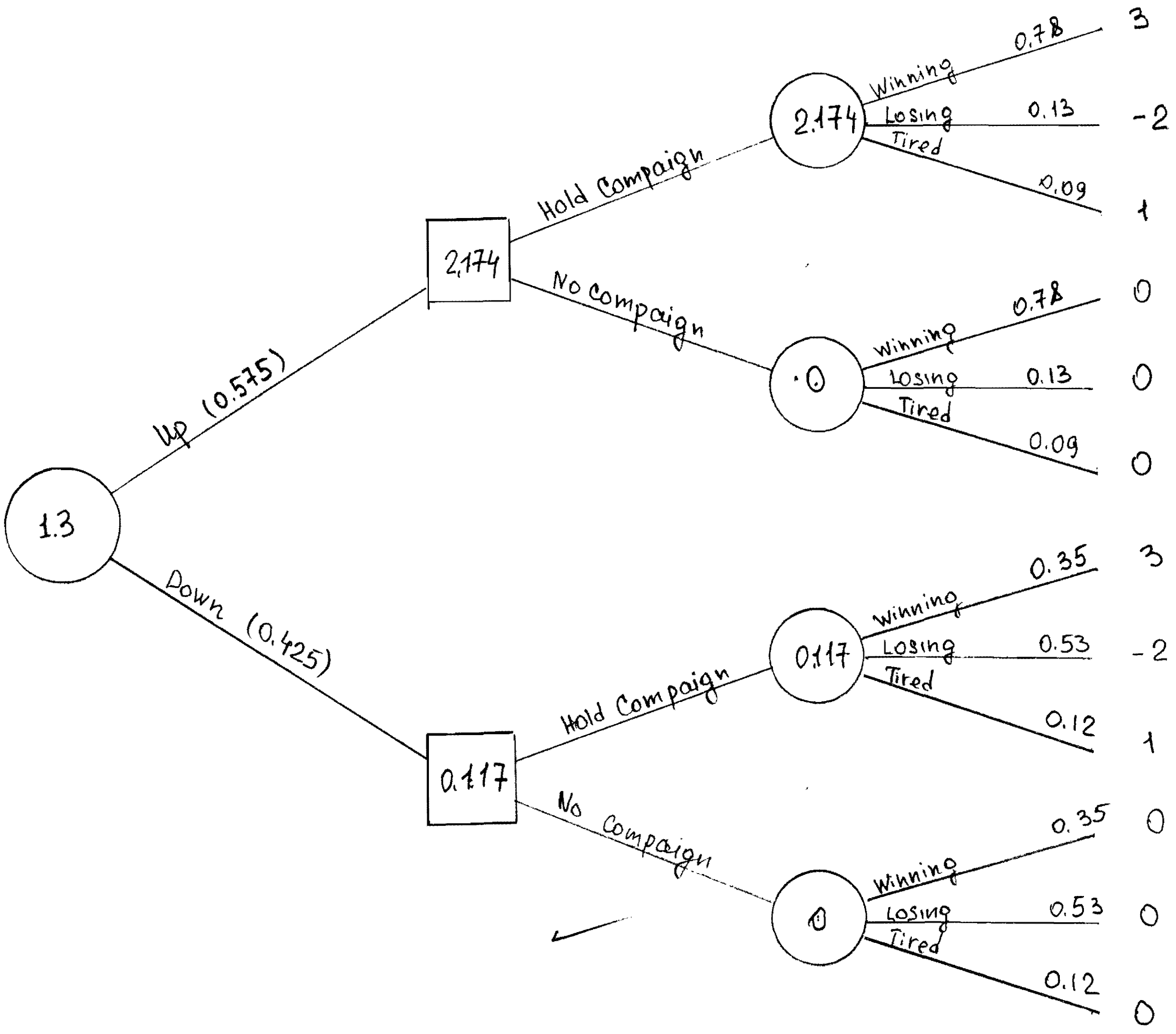
$= 0.575\cdot 2.174 + 0.425\cdot 0.117 = 1.3$

Question 5.8 Calculate expected value of sample information

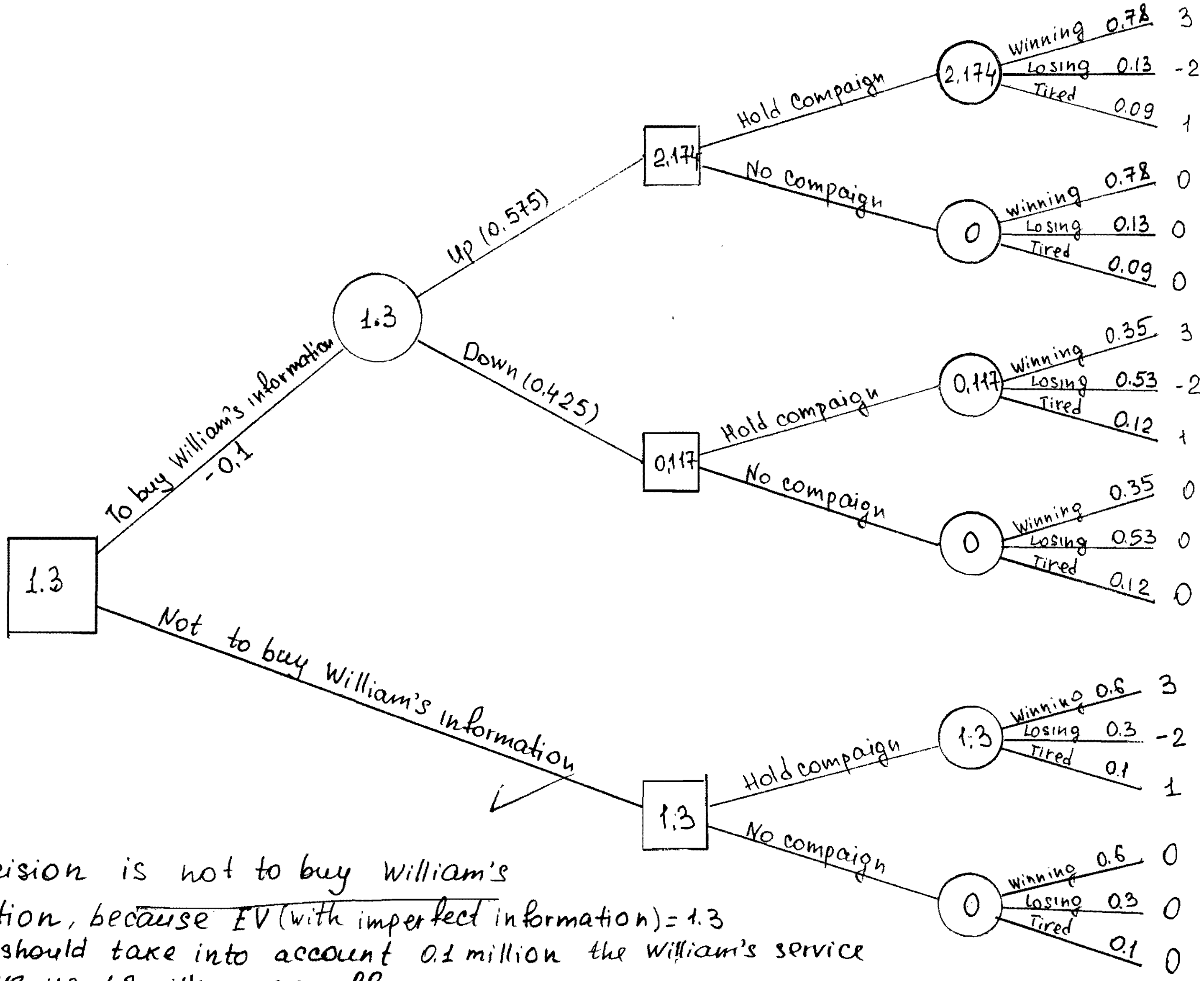
$EVSI = EV(\text{With imperfect information}) - EMV(\text{with no information})$

$= 1.3 - 1.3 = 0$

Question 5.9 Decision tree under the imperfect information



5.10. Decision tree with buying William's hunch incorporated.



Last decision is not to buy William's information, because EV (with imperfect information) = 1.3 also we should take into account 0.1 million the William's service it will give us 1.2 million payoff.
Therefore Not to buy William's information gives higher payoff of 1.3 million dollars.