Public Policy Modeling - Homework 2.

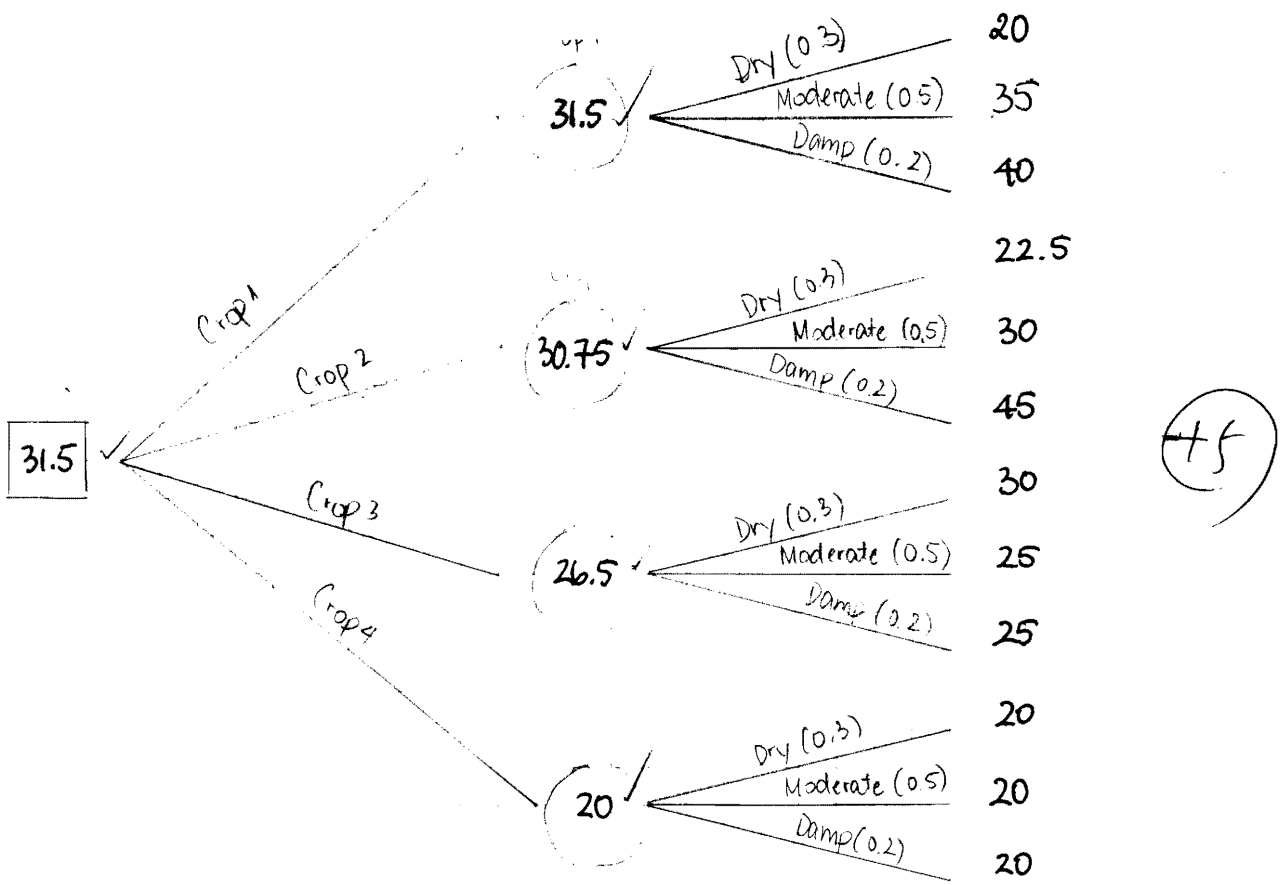
Question 1. 100 + 15 = 115 Great answers

(1.1) Construct payoff table

Alternatives	States of nature: Dry	Moderate	Damp
Crop 1	20	35	40
Crop 2	22.5	30	45
Crop 3	30	25	25
Crop 4	20	20	20
Prior probability	0.3	0.5	0.2

(unit in thousand dollars).

(1.2) Draw decision tree



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Question 2

(2.1) Using Hurwicz criterion : $\alpha = 0.1 \rightarrow \alpha \times \text{Max}_i + (1-\alpha)\,\text{Min}_i$

Crop 1: $0.1 \times \text{Max}(20, 35, 40) + (1-0.1)\,\text{Min}(20, 35, 40) = 22$
Crop 2: $0.1 \times \text{Max}(22.5, 30, 45) + (1-0.1)\,\text{Min}(22.5, 30, 45) = 24.75$
Crop 3: $0.1 \times \text{Max}(30, 25, 25) + (1-0.1)\,\text{Min}(30, 25, 25) = 25.5$
Crop 4: $0.1 \times \text{Max}(20, 20, 20) + (1-0.1)\,\text{Min}(20, 20, 20) = 20$.

→ Crop 3 has the largest weighted sum → Choose crop 3

(2.2) Using Maximin criterion

Crop 1 : Min (20, 35, 40) = 20 /
Crop 2 : Min (22.5, 30, 45) = 22.5 /
Crop 3 : Min (30, 25, 25) = 25 /
Crop 4 : Min (20, 20, 20) = 20 /

→ Crop 3 has the "largest" of the "minimum payoff" → choose crop 3.

(2.3) Using Savage criterion

④ Regret table:

Regret (crop1 | dry) = Max (20, 22.5, 30, 20) − 20 = 10 ✓
Regret (crop 2 | dry) = Max (20, 22.5, 30, 20) − 22.5 = 7.5 /
Regret (crop 3 | dry) = max (20, 22.5, 30, 20) − 30 = 0 /
Regret (crop 4 | dry) = max (20, 22.5, 30, 20) − 20 = 10 /

I love these expressions!

Regret (crop 1 | moderate) = max (35, 30, 25, 20) − 35 = 0 /
Regret (crop 2 | moderate) = max (35, 30, 25, 20) − 30 = 5 /
Regret (crop 3 | moderate) = max (35, 30, 25, 20) − 25 = 10 /
Regret (crop 4 | moderate) = max (35, 30, 25, 20) − 20 = 15 /

Regret (crop 1 | damp) = max (40, 45, 25, 20) − 40 = 5 /
Regret (crop 2 | damp) = max (40, 45, 25, 20) − 45 = 0 /
Regret (crop 3 | damp) = max (40, 45, 25, 20) − 25 = 20 /
Regret (crop 4 | damp) = max (40, 45, 25, 20) − 20 = 25 /

→ Regret table

alternatives	Dry	Moderate	Damp
Crop 1	10	0	5
Crop 2	7.5	5	0
Crop 3	0	10	20
Crop 4	10	15	25.

✓

(thousand dollars)

④ Decide using savage criterion.

Maximum regret of Crop 1 : max (10, 0, 5) = 10 /
Crop 2 : max (7.5, 5, 0) = 7.5 /
Crop 3 : max (0, 10, 20) = 20 /
Crop 4 : max (10, 15, 25) = 25 /

→ Crop 2 has the smallest maximum regret → choose crop 2. /

Question 3:

(3.1) Decide using EMV.

EMV (Crop 1) = 0.3 (20) + 0.5 (35) + 0.2 (40) = 31.5 /
EMV (Crop 2) = 0.3 (22.5) + 0.5 (30) + 0.2 (45) = 30.75 /
EMV (Crop 3) = 0.3 (30) + 0.5 (25) + 0.2 (25) = 26.5 /
EMV (Crop 4) = 0.3 (20) + 0.5 (20) + 0.2 (20) = 20 /

→ Crop 1 has the highest EMV → choose crop 1. /

(3.2) Using EOL

EOL (crop 1) = 0.3 (10) + 0.5 (0) + 0.2 (5) = 4 ✓
EOL (crop 2) = 0.3 (7.5) + 0.5 (5) + 0.2 (0) = 4.75 ✓
EOL (crop 3) = 0.3 (0) + 0.5 (10) + 0.2 (20) = 9. ✓
EOL (crop 4) = 0.3 (10) + 0.5 (15) + 0.2 (25) = 15.5 ✓

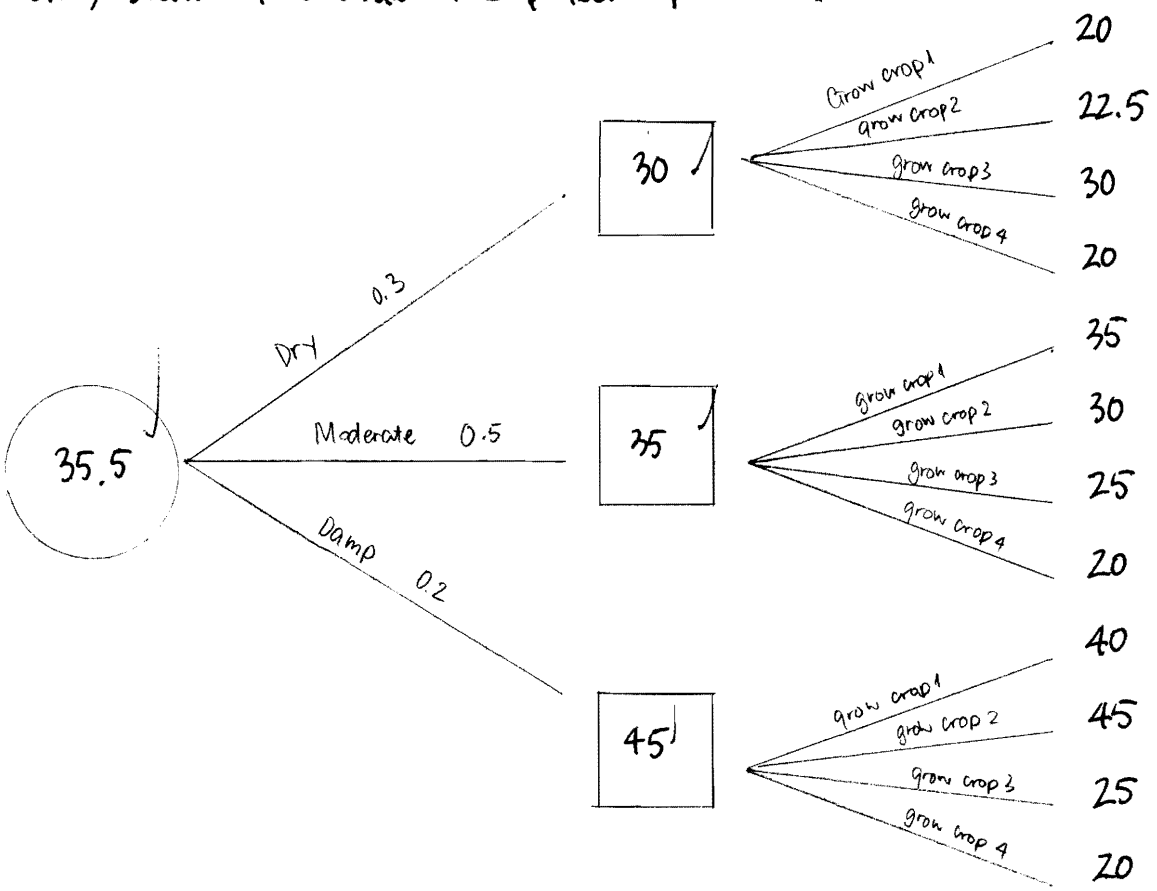
→ Crop 1 has the smallest EOL → choose crop 1. ✓

Question 4

(4.1) Expected monetary value under / with perfect information.

EMV = 0.3 × Max (20, 22.5, 30, 20) + 0.5 × Max (35, 30, 25, 20) + 0.2 × Max (40, 45, 25, 20
= 0.3 (30) + 0.5 (35) + 0.2 (45)
= 35.5 ✓

(4.2) Decision tree under the perfect information.



Question 5.

P(green | dry) = 0.05
P(green | moderate) = 0.7
P(green | damp) = 1

P(red | dry) = 0.95
P(red | moderate) = 0.3
P(red | damp) = 0.

(5.1) Six joint probabilities.

P(green & dry) = P(green | dry) . P(dry) = 0.05 × 0.3 = 0.015 ✓
P(green & moderate) = P(green | moderate) . P(moderate) = 0.7 × 0.5 = 0.35
P(green & damp) = P(green | damp) . P(damp) = 1 × 0.2 = 0.2 ✓

$P(\text{red} \& \text{dry}) = P(\text{red}|\text{dry}) \cdot P(\text{dry}) = 0.95 \times 0.3 = 0.285$ ✓

$P(\text{red} \& \text{moderate}) = P(\text{red}|\text{moderate}) \cdot P(\text{moderate}) = 0.3 \times 0.5 = 0.15$ ✓

$P(\text{red} \& \text{damp}) = 0$ ✓

(5.2) Marginal probability.

$P(\text{green}) = P(\text{green} \& \text{dry}) + P(\text{green} \& \text{moderate}) + P(\text{green} \& \text{damp})$
$= 0.015 + 0.35 + 0.2$
$= 0.565$ ✓

$P(\text{red}) = P(\text{red} \& \text{dry}) + P(\text{red} \& \text{moderate}) + P(\text{red} \& \text{damp})$
$= 0.285 + 0.15 + 0$
$= 0.435$ ✓

(5.3) Six postercor probaboclity.

$P(\text{dry}|\text{green}) = \frac{P(\text{dry} \& \text{green})}{P(\text{green})} = \frac{0.015}{0.565} = 0.027$ ✓

$P(\text{dry}|\text{red}) = \frac{P(\text{dry} \& \text{red})}{P(\text{red})} = \frac{0.285}{0.435} = 0655.$ ✓

$P(\text{moderate}|\text{green}) = \frac{P(\text{moderate} \& \text{green})}{P(\text{Green})} = \frac{0.35}{0.565} = 0.619$ ✓

$P(\text{moderate}|\text{red}) = \frac{P(\text{moderate} \& \text{red})}{P(\text{red})} = \frac{0.15}{0.435} = 0.345$ ✓

$P(\text{damp}|\text{green}) = \frac{P(\text{damp} \& \text{green})}{P(\text{green})} = \frac{0.2}{0.565} = .0.354$ ✓

$P(\text{damp}|\text{red}) = 0.$ ✓

(5.4) Expected monetary value of eight cases.

EMV of crop 1 given green $= 0.027(20) + 0.619(35) + 0.354(40) = 36.37$ ✓
red $= 0.655(20) + 0.345(35) + 0.(40) = 25.18$ ✓

EMV of crop 2 given green $= 0.027(22.5) + 0.619(30) + 0.354(45) = 35.11$ ✓
red $= 0.655(22.5) + 0.345(30) + 0(45) = 25.09$ ✓

EMV of crop 3 given green $= 0.027(30) + 0.619(25) + 0.354(25) = 25.14$ ✓
red $= 0.655(30) + 0.345(25) + 0(25) = 28.28$ ✓

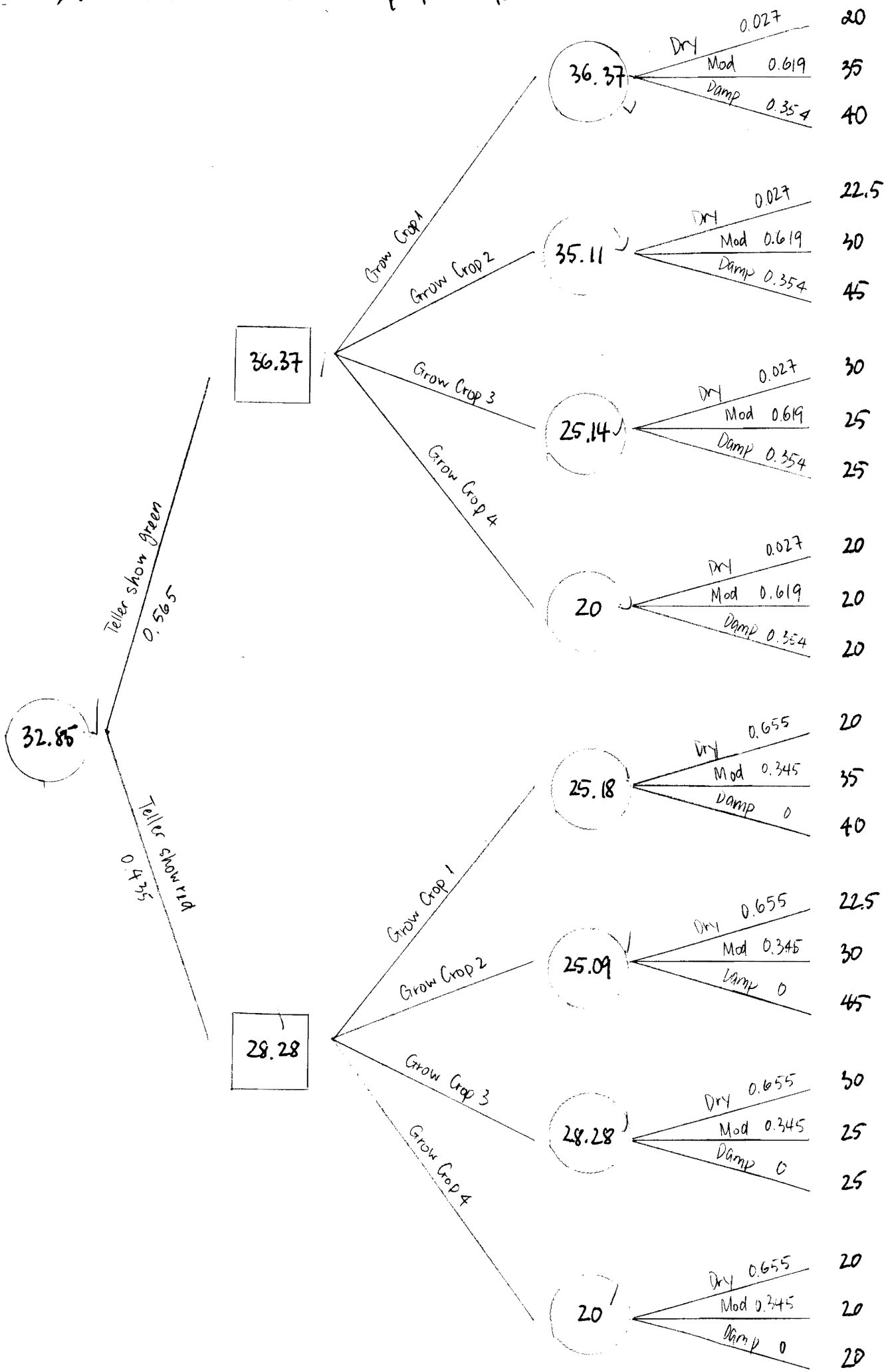
EMV of crop 4 given green $= 0.027(20) + 0.619(20) + 0.354(20) = 20$ ✓
red $= 0.655(20) + 0.345(20) + 0(20) = 20$ ✓

(5.5) Expected value with this imperfect information.

EMV $= 0.565 \times \max(36.37, 35.11, 25.14, 20) + 0.435 \times \max(25.18, 25.09, 28.20)$
$= 0.565 \times (36.37) + 0.435(28.28)$ ✓
$= 32.85$ ✓

Great!

(5.6) Draw decision tree under imperfect information.



(5.7) EVII = Expected value with imperfect information − EMV
= 32.85 − 31.5
= 1.35 ✓ But Thousand?

→ EVII is larger than the cost of Weather Teller → buy Weather Teller. ✓

Bonus question

EVPI = Expected value with perfect information − EMV
= 35.5 − 31.5
= 4 (thousand dollars)

EVPI set the maximum value for information which means that any information that cost more than EVPI is not worth buying.

If Weather Teller's price is 2.000 USD → still smaller than 4.000 → I would probably advise Dwight to buy.

good reasoning.

+10