Practice problems, pp. 24 – 29

The answers for each problem are at the end of this document.

(1)

	red is drawn	**blue is drawn**	**yellow is drawn**	**green is drawn**
bet 1	Breville expresso machine	iPad Air	Dyson cordless vacuum	Sony 55-inch TV
bet 2	Weber gas grill	Dell laptop	Nintendo Switch	Bosch Stainless Dishwasher

Here are someone's preferences for this decision problem:

expresso machine **P** Switch, iPad **P** expresso machine, vacuum **P** tv,
dishwasher **P** grill, laptop **I** tv, vacuum **I** grill, grill **P** laptop, and tv **I** iPad

Make a list of these items from most preferred to least preferred, and assign utility values. Create a decision table with the utility values and use the maximin rule to make a decision.

(2) For this decision problem, can the dominance principle be used to either (*a*) rule out any of the options or (*b*) make a decision?

	red is drawn	**blue is drawn**	**yellow is drawn**	**green is drawn**
bet 1	1	6	3	1
bet 2	4	3	2	2
bet 3	7	6	4	2

(3) For this decision problem, first apply the dominance principle. If the dominance principle doesn't yield a single best option, use the maximin rule to make a decision.

	state 1	state 2	state 3	state 4
bet 1	3	6	5	8
bet 2	1	5	7	9
bet 3	4	2	10	2

(4) For this decision problem, first apply the dominance principle. If the dominance principle doesn't yield a single best option, use the maximin rule to make a decision.

	state 1	state 2	state 3	state 4
option 1	$5	-$2	$4	$4
option 2	$1	$3	-$1	$0
option 3	$2	-$2	-$1	$3
option 4	$5	$2	-$3	$3

(5) For this decision problem, first apply the dominance principle. If the dominance principle doesn't yield a single best option, use the maximin rule to make a decision.

	state 1	state 2	state 3	state 4
option 1	5	-3	-2	2
option 2	2	1	-3	-1
option 3	-5	2	3	3
option 4	-3	-1	0	4

(6) Create a regret table for this decision problem. Then, use the minimax regret rule to make a choice.

	state 1	**state 2**	**state 3**
option 1	20	2	5
option 2	2	35	4
option 3	4	1	15
option 4	1	6	3

(7) For this decision problem, what option do we choose when we are using the maximin strategy? Create a regret table and determine what option we choose using the minimax regret rule.

	state 1	**state 2**	**state 3**
option 1	5	5	0
option 2	4	15	2
option 3	3	6	12
option 4	1	8	8

answers

(1)

	red is drawn	blue is drawn	yellow is drawn	green is drawn
bet 1	(2)	3	4	3
bet 2	4	3	(1)	5

The lowest valued outcomes for each option are circled. (That is, the lowest value in each row.) Of these two outcomes, the one associated with bet 1 is higher, and so according to the maximin rule, we select bet 1.

(2) First, if we compare bet 1 and bet 2, we find that neither option dominates the other.

	red is drawn	blue is drawn	yellow is drawn	green is drawn
bet 1	1	6	3	1
bet 2	4	3	2	2
bet 3	7	6	4	2

When we compare bet 1 and bet 3, we find that, for every state, bet 3 is as good or better than bet 1. Therefore, bet 3 dominates bet 1.

	red is drawn	blue is drawn	yellow is drawn	green is drawn
bet 1	1	6	3	1
bet 2	4	3	2	2
bet 3	7	6	4	2

When we compare, bet 2 and bet 3, we find that, for every state, bet 3 is as good or better than bet 2. Therefore, bet 3 dominates bet 2.

	red is drawn	blue is drawn	yellow is drawn	green is drawn
bet 1	1	6	3	1
bet 2	4	3	2	2
bet 3	7	6	4	2

Since bet 3 dominates both of the other options, the dominance principle tells us to choose it.

(3) None of the options dominate any of the others in this decision problem. According to the maximin rule, we choose bet 1. (The lowest valued outcome for each option are circled. The highest of these minimums goes with bet 1, and so according to the maximin rule, we select bet 1.)

	state 1	state 2	state 3	state 4
bet 1	(3)	6	5	8
bet 2	(1)	5	7	9
bet 3	4	(2)	10	(2)

(4) Option 1 dominates option 3, and so option 3 is eliminated. (No other options dominate any others, and so that's all that we can do with the dominance principle.) Of the remaining options, option 2 has the highest minimum, and so following the maximin rule, we select it.

	state 1	state 2	state 3	state 4
option 1	$5	(-$2)	$4	$4
option 2	$1	$3	(-$1)	$0
~~option 3~~	~~$2~~	~~$2~~	~~$1~~	~~$3~~
option 4	$5	$2	(-$3)	$3

(5) No option dominates any of the others in this decision problem.

	state 1	state 2	state 3	state 4
option 1	5	(-3)	-2	2
option 2	2	1	(-3)	-1
option 3	(-5)	2	3	3
option 4	(-3)	-1	0	4

Options 1, 2, and 4 all have -3 as the minimum. Using the lexical maximin rule to break the tie, we eliminate option 3 and find the next lowest valued outcome for options 1, 2, and 4.

	state 1	state 2	state 3	state 4
option 1	5	(-3)	(-2)	2
option 2	2	1	(-3)	(-1)
~~option 3~~	~~(-5)~~	~~2~~	~~3~~	~~3~~
option 4	(-3)	(-1)	0	4

Again, we have a tie for the highest minimum valued outcomes—now, between option 2 and option 4.

So, we eliminate option 1, and compare the next lowest for options 2 and 4.

	state 1	state 2	state 3	state 4
~~option 1~~	~~5~~	~~3~~	~~2~~	~~2~~
option 2	2	1	-3	-1
~~option 3~~	~~-5~~	~~2~~	~~3~~	~~3~~
option 4	-3	-1	0	4

Between those two and the outcomes still being considered, the lowest for option 2 is 1, and the lowest for option 4 is 0. So, we select option 2—after all the eliminations, it has the highest minimum.

(6) This is the decision table, with each state's maximum value in bold. The difference between MAX (for each state) and the value of the outcome are in parentheses—e.g., 20 – 20 = 0, 20 – 2 = 18, 20 – 4 = 16, etc.

	state 1	state 2	state 3
option 1	**20** (0)	2 (33)	5 (10)
option 2	2 (18)	**35** (0)	4 (11)
option 3	4 (16)	1 (34)	**15** (0)
option 4	1 (19)	6 (29)	3 (12)

This is the regret table with the maximum regret value for each option listed to the right.

	state 1	**state 2**	**state 3**	*maximums*
option 1	0	33	10	33
option 2	18	0	11	18*
option 3	16	34	0	34
option 4	19	29	12	29

Using the minimax regret rule, we choose option 2.

(When we use the minimax regret rule, we are *minimizing* the amount of regret that we will experience. So, we select an option based on the lowest of the maximum regrets associated with each option.)

(7) Using the maximin rule, we choose option 3.

	state 1	**state 2**	**state 3**
option 1	5	5	(0)
option 2	4	15	(2)
option 3	(3)	6	12
option 4	(1)	8	8

To create the regret table, we do these calculations with the information in the decision table:

	state 1	**state 2**	**state 3**
option 1	5 – 5 = 0	15 – 5 = 10	12 – 0 = 12
option 2	5 – 4 = 1	15 – 15 = 0	12 – 2 = 10
option 3	5 – 3 = 2	15 – 6 = 9	12 – 12 = 0
option 4	5 – 1 = 4	15 – 8 = 7	12 – 8 = 4

Now, we can create this regret table. The maximum regret value for each option is listed to the right.

	state 1	**state 2**	**state 3**	*maximums*
option 1	0	10	12	12
option 2	1	0	10	10
option 3	2	9	0	9
option 4	4	7	4	7

Following the minimax regret rule, we choose option 4.

This is a decision problem where the option chosen is not the one that gives us a chance at the highest payoff (or even the second highest payoff). Nonetheless, option 4 minimizes the "what could have been" scenarios.