Practice problems, sections 2-4 & 2-5

The answers are in the second half of this document.

1. Which option do we choose if we are using the maximin rule? Why? Which option do we choose if we are using the maximax rule? Why?

	state 1	state 2	state 3
option 1	-5	0	12
option 2	8	6	1

Use the decision problem in (1) for questions 1 - 5.

2. Calculate the *a*-index for both options when $a = .7$. With this value for *a*, which option do we choose when we are following the optimism-pessimism rule?

3. Calculate the *a*-index for both options when $a = .3$. With this value for *a*, which option do we choose when we are following the optimism-pessimism rule?

4. Calculate the *a*-index for both options when $a = 1$. With this value for *a*, which option do we choose when we are following the optimism-pessimism rule? This value for *a* reduces the optimism-pessimism rule to which other rule? Why?

5. Calculate the *a*-index for both options when $a = 0$. With this value for *a*, which option do we choose when we are following the optimism-pessimism rule? This value for *a* reduces the optimism-pessimism rule to which other rule? Why?

6. What option do we choose in this decision problem if we are following the maximin rule? Which option do we choose if we are following the maximax rule?

	state 1	state 2	state 3	state 4	state 5	state 6	state 7	state 8	state 9
act 1	10	9	9	9	9	9	9	9	0
act 2	10	9	0	0	0	0	0	0	9

Use the decision problem in (6) for questions 7 - 10.

7. Create a regret table for the decision problem in question (6). Which option do we choose if we are following the minimax regret rule?

8. Calculate the *a*-index for both options when $a = .7$. With this value for *a,* which option do we choose when we are following the optimism-pessimism rule?

9. Calculate the *a*-index for both options when $a = .3$. With this value for *a,* which option do we choose when we are following the optimism-pessimism rule?

10. Use the principle of insufficient reason to determine the best option.

11. Use the principle of insufficient reason to determine the best option in this decision problem.

	state 1	state 2	state 3	state 4
act 1	$5	-$4	-$10	$20
act 2	$4	-$6	-$6	$14
act 3	$3	-$2	-$1	$12

12. Use the principle of insufficient reason to determine the best option in this decision problem.

	state 1	**state 2**	**state 3**	**state 4**
act 1	20	6	-10	-3
act 2	30	5	-15	-2
act 3	9	10	-6	-1

answers

1.

	state 1	state 2	state 3
option 1	-5	0	12
option 2	8	6	1

If we are using the maximin rule, then we choose option 2. The minimum value associated with option 1 is -5, and the minimum value associated with option 2 is 1. The maximin rule requires us to choose the option with the highest minimum value, which is 1.

If we are using the maximax rule, then we choose option 1. To apply this rule, we just have to located the highest valued outcome, which is 12, and choose the option associated with it.

2. If a = .7, then we calculate the a-index for each option as follows.

option 1, a-index = (.7)(12) + (.3)(-5) = 8.4 + (-1.5) = **6.9**

option 2, a-index = (.7)(8) + (.3)(1) = 5.6 + 0.3 = 5.9

Since option 1 has the higher a-index, the optimism-pessimism rule tells us to choose it.

3. If a = .3, then we calculate the a-index for each option as follows.

option 1, a-index = (.3)(12) + (.7)(-5) = 3.6 + (-3.5) = 0.1

option 2, a-index = (.3)(8) + (.7)(1) = 2.4 + 0.7 = **3.1**

Since option 2 has the higher a-index, the optimism-pessimism rule tells us to choose it.

4. If a = 1.0, then we calculate the a-index for each option as follows.

option 1, a-index = (1)(12) + (0)(-5) = 12 + 0 = **12**

option 2, a-index = (1)(8) + (0)(1) = 8 + 0 = 8

Since option 1 has the higher *a*-index, the optimism-pessimism rule tells us to choose it.

With this value for *a*, all of the weighting (100%) is placed on the highest valued outcome for each option (and the lowest valued outcome receives zero weight). Hence, the optimism-pessimism rule just becomes the maximax rule.

5. If *a* = 0, then we calculate the *a*-index for each option as follows.

option 1, *a*-index = (0)(12) + (1)(-5) = 0 + (-5.0) = -5.0

option 2, *a*-index = (0)(8) + (1)(1) = 0 + 1 = **1.0**

Since option 2 has the higher *a*-index, the optimism-pessimism rule tells us to choose it.

With this value for *a*, all of the weighting (100%) is placed on the lowest valued outcome for each option (and the highest valued outcome receives zero weight). Hence, when we select the option with the higher *a*-index, the optimism-pessimism rule just becomes the maximin rule.

6.

	state 1	**state 2**	**state 3**	**state 4**	**state 5**	**state 6**	**state 7**	**state 8**	**state 9**
act 1	10	9	9	9	9	9	9	9	0
act 2	10	9	0	0	0	0	0	0	9

To use the maximin rule, we proceed as follows. The minimum valued outcome is 0 for both options. The next highest minimum is 9 for both options. And the next (and last) highest minimum is 10, again for both. Hence, both options are equally good according to the maximin rule.

To use the maximax rule, we proceed as follows. The highest valued outcome for both options is 10 (which is, therefore, the highest valued outcome in the decision problem). Hence, both options are equally good according to the maximax rule.

7. To create the regret table, we do these calculations:

	state 1	**state 2**	**state 3**	**state 4**	**state 5**	**state 6**	**state 7**	**state 8**	**state 9**
act 1	10 -10 = 0	9 – 9 = 0	9 – 9 = 0	9 – 9 = 0	9 – 9 = 0	9 – 9 = 0	9 – 9 = 0	9 – 9 = 0	9 – 0 = 9
act 2	10 – 10 = 0	9 – 9 = 0	9 – 0 = 9	9 – 0 = 9	9 – 0 = 9	9 – 0 = 9	9 – 0 = 9	9 – 0 = 9	9 – 9 = 0

And this is the regret table:

	state 1	**state 2**	**state 3**	**state 4**	**state 5**	**state 6**	**state 7**	**state 8**	**state 9**
act 1	0	0	0	0	0	0	0	0	9
act 2	0	0	9	9	9	9	9	9	0

The maximum regret for act 1 is 9, and the maximum regret for act 2 is 9. Since both maximum regrets are the same, both options are equally good according to the minimax regret rule. (Remember that, for the maximin regret rule, we select the option with the lowest maximum regret.)

8. If $a = .7$, we calculate the a-index for each option this way:

act 1, *a*-index = (.7)(10) + (.3)(0) = 7 + 0 = 7.0

act 2, *a*-index = (.7)(10) + (.3)(0) = 7 + 0 = 7.0

Since both options have the same *a*-index, both options are equally good according to the optimism-pessimism rule.

9. 8. If $a = .3$, we calculate the a-index for each option this way:

act 1, *a*-index = (.3)(10) + (.7)(0) = 3 + 0 = 3.0

act 2, *a*-index = (.3)(10) + (.7)(0) = 3 + 0 = 3.0

Since both options have the same *a*-index, both options are equally good according to the optimism-pessimism rule.

10. To use the principle of insufficient reason, we can do this set of calculations:

act 1 = 10 + 9 + 9 + 9 + 9 + 9 + 9 + 9 + 0 = 73/9 = **8.1**

act 2 = 10 + 9 + 0 + 0 + 0 + 0 + 0 + 0 + 9 = 28/9 = 3.1

Or, since dividing by 9 (because there are 9 states) only makes the values smaller without changing which is larger and which is smaller, we can leave that step out.

act 1 = 10 + 9 + 9 + 9 + 9 + 9 + 9 + 9 + 0 = **73**

act 2 = 10 + 9 + 0 + 0 + 0 + 0 + 0 + 0 + 9 = 28

In any case, act 1 has the higher value, and so, according to this principle, we should choose it.

11. To use the principle of insufficient reason, we do this set of calculations:

act 1 = $5 + (-$4) + (-$10) + $20 = 11/4 = $2.75

act 2 = $4 + (-$6) + (-$6) + $14 = 6/4 = $1.50

act 3 = $3 + -$2 + (-$1) + $12 = 12/4 = **$3.00**

Act 3 has the highest value, and so, according to this principle, we should choose it.

12. To use the principle of insufficient reason, we do this set of calculations:

act 1 = 20 + 6 + (-10) + (-3) = 13/4 = 3.25

act 2 = 30 + 5 + (-15) + (-2) = 18/4 = **4.5**

act 3 = 9 + 10 + (-6) + (-1) = 12/4 = 3

Act 2 has the highest value, and so, according to this principle, we should choose it.

Note: Dividing by 9 (in problem 10) is equivalent to multiplying by .11 (i.e., 1/9). And dividing by 4 (in problems 11 and 12) is equivalent to multiplying by .25 (i.e., 1/4).