20-07_jdm.pdf

This box is for the examiner only.

Question:	1	2	3	4	5	6	Total
Points:	2	8	17	8	9	16	60
Score:							

Questions

1. (2 points) Linda is thirty-one years old, single, outspoken, and very smart. She majored in philosophy. As a student, she was deeply concerned with issues of discrimination and social justice, and she participated in antinuclear demonstrations. Rank the following descriptions in order of the probability (likelihood) that they describe Linda:

   a) Linda is a bank teller who is active in the feminist movement.

   b) Linda is active in the feminist movement.

   c) Linda is a bank teller.

2. (8 points) Daniel Kahneman sees human thinking in two forms that he calls System 1 and System 2. Describe these forms of thinking and give examples of decisions which are predominately taken with System 1 and 2 thinking, respectively.

Please turn over!

3. Bazerman and Moore (2009) discuss several heuristics that explain the biased decision making of individuals.

   (a) (8 points) Discuss the general advantages and the disadvantages of using heuristics in the decision making process.

(b) (9 points) Bazerman and Moore (2009) mention that individuals sometimes rely their decision making on the *Availability Heuristic* which yields the so-called *Ease of Recall* and the *Retrievability* bias. Explain these biases.

4. The following statements are all incorrect. For each statement, state briefly what parts of the statement are false and incorrect, respectively.

   (a) (2 points) Huber, Model, and Städter (2019) execute a series of laboratory experiments with students. In particular, they play a public goods game with and without ostracism both, with individuals and teams. They find that teams exclude more in early periods but earn earn more in treatments with ostracism.

   (b) (2 points) The rational model of decision making sets forth a logical sequence of steps to be followed in every decision situation. The rational models are based on the believe that under a given set of circumstances human behavior is logical and therefore predictable. That is the reason why they are always superior to heuristics or more intuitive methods to come to a decision and hence, should always be used if possible.

   (c) (2 points) Profiling analyses aspects of an individual's personality, behavior, interests and habits to make predictions or decisions about them. In particular, profiling' means any form of automated processing of personal data, for marketing purpose only. Overall, profiling and automated decision making can be very useful for organisations in the marketing sector.

   (d) (2 points) *Dark data* is data which organizations cannot use analytically because it is not stored somewhere.

5. Given the following payoff table.

	z_1	z_2	z_3	z_4	z_5
a_1	1	2	3	4	3
a_2	4	3	2	1	4
a_3	4	5	0	5	6
a_4	1	5	1	5	6
a_5	2	2	2	1	3
a_6	3	4	0	5	3

(a) (4 points) State which alternatives can be excluded because they are dominated by other alternatives.

(b) (5 points) Suppose your preference scheme is as follows:

$$g_1 = \frac{1}{2}; \quad g_2 = 1; \quad g_3 = 2; \quad g_4 = 1; \quad g_5 = 1.$$

Find the order of preference based on the aggregated expected utility.

6. (16 points) **[Bayes Theorem: Elderly Fall and Death]**

Suppose you analyze the causes of death of elderly persons (over 80 years of age) over the course of a year. Let's assume that the base rate of someone elderly dying, $P(Die)$, is 10%, and that the base rate for elderly people falling, $P(Fall)$, is 5%. Moreover, you know that from all elderly people, 7% of those that die had a fall, i.e., $P(Fall|Die) = 0.07$.

(a) Calculate the probability that an elderly person will die from a fall, i.e., $P(Die|Fall)$.

(b) Calculate the probability that an elderly person falls and dies in the given period, i.e., $P(Die \cap Fall)$.

(c) Calculate the probability that an elderly person falls and doesn't in the given period, i.e., $P(Die \cap \neg Fall)$.

(d) Calculate the probability that an elderly person does neither fall nor die in the given period, i.e., $P(\neg Die \cap \neg Fall)$.

References

Bazerman, Max H and Don A. Moore. 2009. Judgement in Managerial Decision Making. John Wiley & Sons, 7th ed.

Huber, Stephan, Jochen Model, and Silvio Städter. 2019. "Ostracism in Alliances of Teams and Individuals: Voting, Exclusion, Contribution, and Earnings." Tech. rep.

20-11_jdm.pdf

This box is for the examiner only.

Question:	1	2	3	4	5	6	Total
Points:	15	4	15	10	6	10	60
Score:							

Questions

1. [**Common Biases in Decision Making**] Bazerman and Moore (2009) discuss several heuristics that explain the biased decision making of individuals.

   (a) (5 points) One bias emanating from the confirmation heuristic is called *'conjunctive- and disjunctive-events bias'*. Explain what this bias is all about.

(b) (5 points) Bazerman and Moore (2009) mention that individuals sometimes make estimates for values based on so-called *Anchoring*. Explain what *Anchoring* is and how it can be used in bargaining situations.

(c) (5 points) Bazerman and Moore (2009) also emphasize that we often fall into the *Confirmation trap*. Describe briefly what that trap is all about.

2. (4 points) [**Conjunctive- and Disjunctive-Events Bias**] Which of the following instances appears most likely? Which appears second most likely?

   a) Drawing a red marble from a bag containing 50 percent red marbles and 50 percent white marbles.

   b) Drawing a red marble seven times in succession, with replacement (i.e., a selected marble is put back into the bag before the next marble is selected), from a bag containing 90 percent red marbles and 10 percent white marbles.

   c) Drawing at least one red marble in seven tries, with replacement, from a bag containing 10 percent red marbles and 90 percent white marbles.

3. [**Decision Making Under Uncertainty**] Given the following payoff table.

	z_1	z_2	z_3	z_4	z_5
a_1	3	3	3	3	3
a_2	5	4	3	2	1
a_3	2	2	6	6	7
a_4	1	5	1	5	6
a_5	2	2	2	1	3

   (a) (3 points) State which alternatives can be excluded because they are dominated by other alternatives. (Hint: exclude dominated alternative in the calculations of the following questions.)

   (b) (6 points) Calculate the preferred alternative, a_i, given the *Laplace criterion*.

(c) (3 points) What is the best alternative given the *Maximax criterion*.

(d) (3 points) What is the best alternative given the *Minimax criterion*.

4. (10 points) **[Bayes Theorem: COVID-17 and Death]**

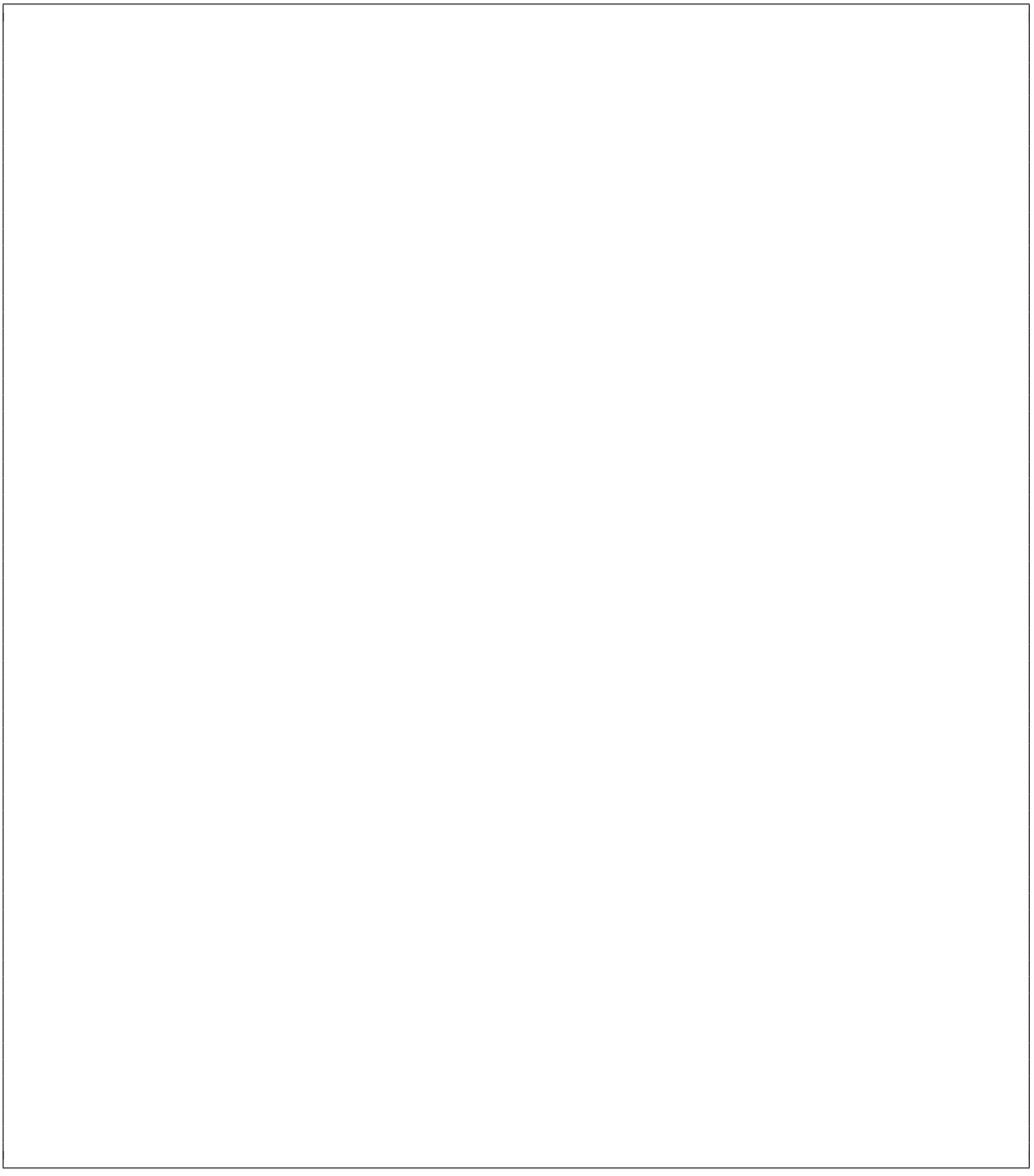
Suppose you analyze the causes of death of people over the course of a year in times of COVID-17 a.k.a. *the Corona disease*. Let's assume that the base rate of someone dying before Corona, $P(Die)$, was 1%, and that the base rate for having COVID-17, $P(Corona)$, is 5%. Moreover, suppose you know that from all people, 4% of those that die have COVID-17, i.e., $P(Corona|Die) = 0.04$.

(a) Calculate the probability that a person will die from COVID-17, i.e., $P(Die|Corona)$.

(b) Calculate the probability that a person is infected with COVID-17 and dies in the given period, i.e., $P(Die \cap Corona)$.

5. (6 points) **[Automated Decision Making]** Explain what *automated decision making* means and give examples for such decisions.

6. (10 points) **[Characteristics of Decisions]** Discuss in detail how decisions can be characterized and categorized.



References

Bazerman, Max H and Don A. Moore. 2009. Judgement in Managerial Decision Making. John Wiley & Sons, 7th ed.

Huber, Stephan, Jochen Model, and Silvio Städter. 2019. "Ostracism in Alliances of Teams and Individuals: Voting, Exclusion, Contribution, and Earnings." Tech. rep.

21-07_jdm_mock.pdf

This box is for the examiner only.

Question:	1	2	3	4	5	6	Total
Points:	15	9	4	6	10	12	56
Score:							

Selection of Old Exam Questions in Judgement and Decision Making

©Prof. Dr. Stephan Huber (stephan.huber@hs-fresenius.de)

1. [**Decision Making Under Uncertainty**] Given the following payoff table.

	z_1	z_2	z_3	z_4	z_5
a_1	3	3	3	3	3
a_2	5	4	3	2	1
a_3	2	2	6	6	7
a_4	1	5	1	5	6
a_5	2	2	2	1	3

   (a) (3 points) State which alternatives can be excluded because they are dominated by other alternatives. (Hint: exclude dominated alternative in the calculations of the following questions.)

   (b) (6 points) Calculate the preferred alternative, a_i, given the *Laplace criterion*.

   (c) (3 points) What is the best alternative given the *Maximax criterion*.

   (d) (3 points) What is the best alternative given the *Minimax criterion*.

2. [**Decision Making Under Certainty**] Given the following payoff table.

	z_1	z_2	z_3	z_4	z_5
a_1	1	2	3	4	3
a_2	4	3	2	1	4
a_3	4	5	0	5	6
a_4	1	5	1	5	6
a_5	2	2	2	1	3
a_6	3	4	0	5	3

   (a) (4 points) State which alternatives can be excluded because they are dominated by other alternatives.

   (b) (5 points) Suppose your preference scheme is as follows:

$$g_1 = \frac{1}{2}; \quad g_2 = 1; \quad g_3 = 2; \quad g_4 = 1; \quad g_5 = 1.$$

Find the order of preference based on the aggregated expected utility.

3. (4 points) [**Automated Decision Making**] Explain what *automated decision making* means and give examples for such decisions.

4. [**Various**] The following statements are all incorrect. For each statement, state briefly what parts of the statement are false and incorrect, respectively.

   (a) (2 points) The rational model of decision making sets forth a logical sequence of steps to be followed in every decision situation. The rational models are based on the believe that under a given set of circumstances human behavior is logical and therefore predictable. That is the reason why they are always superior to heuristics or more intuitive methods to come to a decision and hence, should always be used if possible.

   (b) (2 points) Profiling analyses aspects of an individual's personality, behavior, interests and habits to make predictions or decisions about them. In particular, profiling' means any form of automated processing of personal data, for marketing purpose only. Overall, profiling and automated decision making can be very useful for organisations in the marketing sector.

   (c) (2 points) *Dark data* is data which organizations cannot use analytically because it is not stored somewhere.

5. (10 points) [**Bayes Theorem: COVID-17 and Death**]

   Suppose you analyze the causes of death of people over the course of a year in times of COVID-17 a.k.a. *the Corona disease*. Let's assume that the base rate of someone dying before Corona, $P(Die)$, was 1%, and that the base rate for having COVID-17, $P(Corona)$, is 5%. Moreover, suppose you know that from all people, 4% of those that die have COVID-17, i.e., $P(Corona|Die) = 0.04$.

   (a) Calculate the probability that a person will die from COVID-17, i.e., $P(Die|Corona)$.

   (b) Calculate the probability that a person is infected with COVID-17 and dies in the given period, i.e., $P(Die \cap Corona)$.

6. (12 points) [**Bayes Theorem: Elderly Fall and Death**]

   Suppose you analyze the causes of death of elderly persons (over 80 years of age) over the course of a year. Let's assume that the base rate of someone elderly dying, $P(Die)$, is 10%, and that the base rate for elderly people falling, $P(Fall)$, is 5%. Moreover, you know that from all elderly people, 7% of those that die had a fall, i.e., $P(Fall|Die) = 0.07$.

   (a) Calculate the probability that an elderly person will die from a fall, i.e., $P(Die|Fall)$.

   (b) Calculate the probability that an elderly person falls and dies in the given period, i.e., $P(Die \cap Fall)$.

(c) Calculate the probability that an elderly person falls and doesn't in the given period, i.e., $P(Die \cap \neg Fall)$.

(d) Calculate the probability that an elderly person does neither fall nor die in the given period, i.e., $P(\neg Die \cap \neg Fall)$.

Solution:

$$P(Die|Fall) = \frac{P(Fall|Die) \cdot P(Die)}{P(Fall)} = \frac{0.07 \cdot 0.10}{0.05} = 0.14$$

References

21-07_jdm.pdf

This box is for the examiner only.

Question:	1	2	3	Total
Points:	9	6	5	20
Score:				

Questions (Prof. Dr. Stephan Huber)

1. [**Decision Making Under Uncertainty**] Given the following payoff table.

	z_1	z_2	z_3	z_4
a_1	1	2	3	4
a_2	5	6	7	8
a_3	8	7	6	5
a_4	2	2	2	2
a_5	3	4	4	3
a_6	6	6	6	6

   (a) (3 points) State which alternatives can be excluded because they are dominated by other alternatives. (Hint: exclude dominated alternatives in the calculations of the following questions.)

   (b) (2 points) Calculate the preferred alternative, a_i, given the *Laplace criterion*.

   (c) (2 points) What is the best alternative given the *Maximax criterion*.

   (d) (2 points) What is the best alternative given the *Minimax criterion*.

2. [**Decision Making Under Certainty**] Given the following payoff table.

	z_1	z_2	z_3	z_4
a_1	1	2	3	4
a_2	6	3	2	0
a_3	2	2	2	2

   (a) (2 points) State which alternatives can be excluded because they are dominated by other alternatives. (Hint: exclude dominated alternatives in the calculations of the following questions.)

   (b) (4 points) Suppose your preference scheme is as follows:

$$g_1 = \frac{1}{2}; \quad g_2 = 1; \quad g_3 = 2; \quad g_4 = 1.$$

   Find the order of preference based on the aggregated expected utility.

3. (5 points) [**Profiling**] Explain briefly what *profiling* means. Discuss why *profiling* is an essential part of `www.amazon.com`'s business success. Compare `www.amazon.com`'s *profiling* to that of a small local bookstore. Why can `www.amazon.com` use *profiling* so much more powerfully?

21-11_jdm_solution.pdf

This box is for the examiner only.

Question:	1	2	3	Total
Points:	8	8	4	20
Score:				

Questions (Prof. Dr. Stephan Huber)

1. [**Decision Making Under Uncertainty**] Given the following payoff table.

	z_1	z_2	z_3	z_4
a_1	1	2	3	9
a_2	5	6	7	8
a_3	1	7	1	5
a_4	2	2	2	2
a_5	4	4	4	7

   (a) (2 points) State which alternatives can be excluded because they are dominated by other alternatives. (Hint: exclude dominated alternatives in the calculations of the following questions.)

   Solution: Alternative 4 and 5 are dominated and can be excluded

   (b) (2 points) Using the *Laplace criterion*, calculate the preferred alternative(s), a_i.

   Solution: Alternative 2 and 3: $= 6.5$

   (c) (2 points) Using the *Maximax criterion*, calculate the best alternative(s), a_i.

   Solution: Alternative 2 and 3 give the best possible outcome, i.e., 8. Alternative 6 only gives 6. Thus, indifferent between 2 and 3.

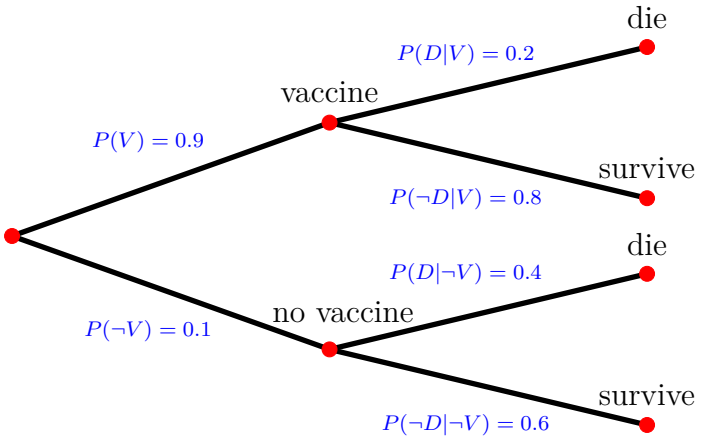
   (d) (2 points) What is the best alternative given the *Minimax criterion*.

   Solution: Alternative 2 gives 5 at worst and hence is best.

2. [**Bayes Theorem**]

   You read on *Facebook* that in the year 2021 about over 80% of people that died were vaccinated. You are shocked by this high probability that a dead person was vaccinated, $P(V|D)$. You decide to check this fact. Reading the study on which the Facebook post is referring to, you find out that the study only refers to people above the age of 90. Moreover, you find the following *Tree Diargram*. It allows to check the fact as it describes

the vaccination rates and the conditional probabilities of people to die given the fact they were vaccinated or not. In particular, D denotes the event of *die* and $\neg D$ denotes *not die*, i.e., survive; V denotes the event of *vaccinated* and $\neg V$ *not vaccinated*.



(a) (2 points) Calculate the overall probability to die, $P(D)$

(b) (4 points) Calculate the probability that a person that has died was vaccinated, $P(V|D)$.

(c) (2 points) Your calculations shows that the fact used in the statement on *Facebook* is indeed true. Discuss whether this number should have an impact to get vaccinated or not.

Solution:

(a)

$$P(D) = 0.9 \cdot 0.2 + 0.1 \cdot 0.4 = 0.22$$

(b)

$$P(V \mid D) = \frac{P(D \mid V)P(V)}{P(D)} = \frac{0.2 \cdot 0.9}{0.22} = \frac{0.036}{0.22} \approx 0.8181$$

(c)

3. **[Various]** The following statements are all incorrect. For each statement, discuss why the statement is not perfectly true.

(a) (2 points) The rational model of decision making sets forth a logical sequence of steps to be followed in every decision situation. The rational models are based on the believe that under a given set of circumstances human behavior is logical and therefore predictable. That is the reason why they are always superior to heuristics or more intuitive methods to come to a decision and hence, should always be used if possible.

(b) (2 points) Profiling analyses aspects of an individual's personality, behavior, interests and habits to make predictions or decisions about them. In particular, profiling' means any form of automated processing of personal data, for marketing purpose only. Overall, profiling and automated decision making can be very useful for organisations in the marketing sector.

22-01_jdm.pdf

This box is for the examiner only.

Question:	1	2	3	Total
Points:	9	9	12	30
Score:				

1. **[Decision Making Under Uncertainty]**

	z_1	z_2	z_3
a_1	0	3	8
a_2	5	7	8
a_3	1	10	1
a_4	2	2	2
a_5	2	3	7

Above you see a payoff table where high numbers indicate high disutility, ranging from 0 (no disutility) to 10 (high disutility).

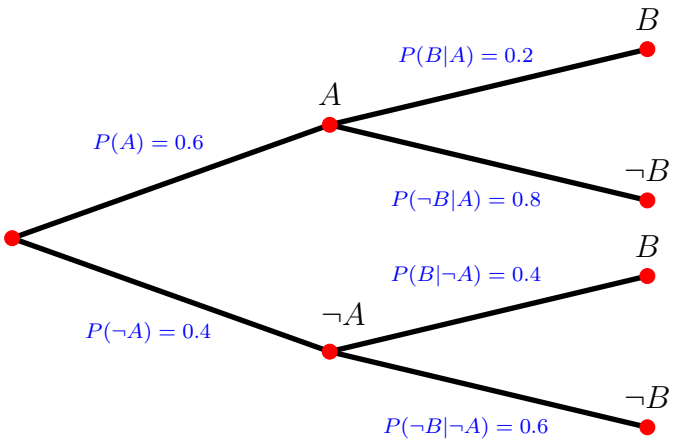
(a) (2 points) Using this payoff table, indicate which alternatives can be excluded because they are dominated by other alternatives. (Hint: Exclude dominated alternatives in the calculations of the following questions).

(b) (3 points) Using the *Laplace criterion*, calculate the preferred alternative(s), a_i.

(c) (2 points) Using the *Maximax criterion*, calculate the best alternative(s), a_i.

(d) (2 points) Using the *Minimax criterion*, calculate the best alternative(s), a_i.

2. (9 points) **[Bayes Theorem]**



Using the *tree diagram* above,

(a) fill out all missing probabilities of table below and

	A	$\neg A$	sum
B	$P(A \cap B) = ?$	$P(\neg A \cap B) = ?$	$P(B) = ?$
$\neg B$	$P(A \cap \neg B) = ?$	$P(\neg A \cap \neg B) = ?$	$P(\neg B) = ?$
	$P(A) = 0.6$	$P(\neg A) = 0.4$	1

(b) calculate the probability $P(A|B)$ and $P(A|\neg B)$.

3. **[Various]** The following statements are all incorrect. For each statement, discuss why the statement is not perfectly true.

   (a) (2 points) The rational model of decision making sets forth a logical sequence of steps to be followed in every decision situation. The rational models are based on the believe that under a given set of circumstances human behavior is logical and therefore predictable. That is the reason why they are always superior to heuristics or more intuitive methods to come to a decision and hence, should always be used if possible.

   (b) (2 points) Profiling analyses aspects of an individual's personality, behavior, interests and habits to make predictions or decisions about them. In particular, profiling' means any form of automated processing of personal data, for marketing purpose only. Overall, profiling and automated decision making can be very useful for organisations in the marketing sector.

   (c) (2 points) Behavioral economics have shown that most individuals do not act perfectly rational. Thus, economic theory that assumes rational individuals is useless.

   (d) (2 points) *Dark data* is data which organizations cannot use analytically because it is not stored somewhere.

   (e) (2 points) Automated decision-making is when the process of making a decision is supported by the use of machines like a Computer.

   (f) (2 points) Profiling analyzes aspects of an individual's personality, behavior, interests and habits to make predictions or decisions about them. In particular, profiling' means any form of automated processing of personal data consisting of the use of personal data to evaluate certain personal aspects relating to a natural person, in particular to analyze or predict aspects concerning that natural person's performance at work, economic situation, health, personal preferences, interests, reliability, behavior, location or movements. While profiling can help to make more consistent decisions, it is rather time consuming as it usually is based on the fact that big datasets needed to be analyzed.

End of exam

22-01_jdm_solution.pdf

This box is for the examiner only.

Question:	1	2	3	Total
Points:	9	9	12	30
Score:				

1. **[Decision Making Under Uncertainty]**

	z_1	z_2	z_3
a_1	0	3	8
a_2	5	7	8
a_3	1	10	1
a_4	2	2	2
a_5	2	3	7

Above you see a payoff table where high numbers indicate high disutility, ranging from 0 (no disutility) to 10 (high disutility).

(a) (2 points) Using this payoff table, indicate which alternatives can be excluded because they are dominated by other alternatives. (Hint: Exclude dominated alternatives in the calculations of the following questions).

Solution: Alternative 2 is dominated by 4. Alternative 5 is dominated by 4.

(b) (3 points) Using the *Laplace criterion*, calculate the preferred alternative(s), a_i.

Solution: Alternative $1 \approx 3.6$; Alternative $3 = 4$; Alternative $4 = 2$.
Thus, alternative 4 is best.

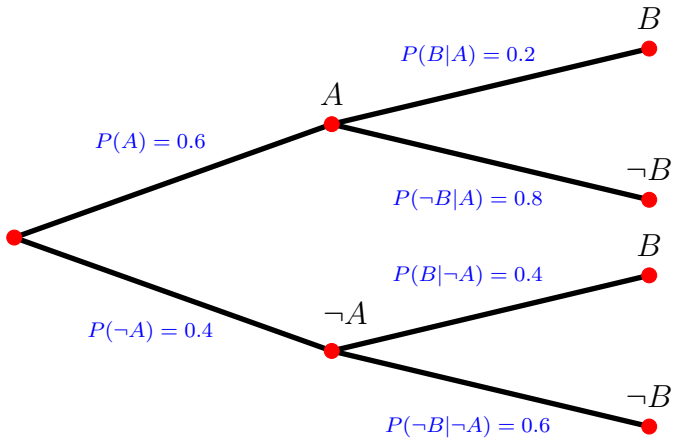
(c) (2 points) Using the *Maximax criterion*, calculate the best alternative(s), a_i.

Solution: Alternative 1 give the best possible outcome, i.e., 0.

(d) (2 points) Using the *Minimax criterion*, calculate the best alternative(s), a_i.

Solution: Alternative 4 is best.

2. (9 points) **[Bayes Theorem]**



Using the *tree diagram* above,

(a) fill out all missing probabilities of table below and

	A	$\neg A$	sum
B	$P(A \cap B) = ?$	$P(\neg A \cap B) = ?$	$P(B) = ?$
$\neg B$	$P(A \cap \neg B) = ?$	$P(\neg A \cap \neg B) = ?$	$P(\neg B) = ?$
	$P(A) = 0.6$	$P(\neg A) = 0.4$	1

(b) calculate the probability $P(A|B)$ and $P(A|\neg B)$.

Solution:

	A	$\neg A$	sum
B	$P(A \cap B) = 0.12$	$P(\neg A \cap B) = 0.16$	$P(B) = 0.28$
$\neg B$	$P(A \cap \neg B) = 0.48$	$P(\neg A \cap \neg B) = 0.24$	$P(\neg B) = 0.72$
	$P(A) = 0.6$	$P(\neg A) = 0.4$	1

$P(A \cap B) = 0.6 \cdot 0.2 = 0.12$
$P(\neg A \cap B) = 0.4 \cdot 0.4 = 0.16$
$P(B) = 0.28$
$P(A|B) = \frac{0.12}{0.28} \approx 0.42857$
$P(A|\neg B) = \frac{0.48}{0.72} \approx 0.6666$

3. **[Various]** The following statements are all incorrect. For each statement, discuss why the statement is not perfectly true.

(a) (2 points) The rational model of decision making sets forth a logical sequence of steps to be followed in every decision situation. The rational models are based on the believe that under a given set of circumstances human behavior is logical and therefore predictable. That is the reason why they are always superior to heuristics or more intuitive methods to come to a decision and hence, should always be used if possible.

Solution: Rational models are not always *superior* because things like time may play a role and hence it should not always used.

(b) (2 points) Profiling analyses aspects of an individual's personality, behavior, interests and habits to make predictions or decisions about them. In particular, profiling' means any form of automated processing of personal data, for marketing purpose only. Overall, profiling and automated decision making can be very useful for organisations in the marketing sector.

Solution: The purpose for *marketing purpose only* is too narrow.

(c) (2 points) Behavioral economics have shown that most individuals do not act perfectly rational. Thus, economic theory that assumes rational individuals is useless.

Solution: No, theory with rational individuals is not useless. It may still be the best approximation to human behavior in an abstract sense because assuming irrational behavior would mean we barely can explain anything. Everything would be a random walk. However, theory can improve by considering common mistakes in individuals decision making.

(d) (2 points) *Dark data* is data which organizations cannot use analytically because it is not stored somewhere.

Solution: Dark data is stored but not used (analytically).

(e) (2 points) Automated decision-making is when the process of making a decision is supported by the use of machines like a Computer.

Solution: Automated decision-making literally means the decision is taken without any human interference.

(f) (2 points) Profiling analyzes aspects of an individual's personality, behavior, interests and habits to make predictions or decisions about them. In particular, profiling' means any form of automated processing of personal data consisting of the use of personal data to evaluate certain personal aspects relating to a natural person, in particular to analyze or predict aspects concerning that natural person's performance at work, economic situation, health, personal preferences, interests, reliability, behavior, location or movements. While profiling can help to make more consistent decisions, it is rather time consuming as it usually is based on the fact that big datasets needed to be analyzed.

Solution: No, it don't have to be time consuming very often descisions are made very quickly and *automated*.

End of exam

22-04_jdm.pdf

This box is for the examiner only.

Question:	1	2	3	4	5	Total
Points:	8	5	7	6	4	30
Score:						

1. **[Decision Making Under Uncertainty]** Below, you see a payoff table where high numbers indicate high utility, ranging from 0 (no utility) to 10 (high utility).

	z_1	z_2	z_3	z_4
a_1	0	0	8	5
a_2	3	6	8	4
a_3	1	10	8	3
a_4	2	2	2	2
a_5	5	7	8	4
a_6	5	0	8	4

   (a) (3 points) Using this payoff table, indicate which alternatives can be excluded because they are dominated by other alternatives. (Hint: Exclude dominated alternatives in the calculations of the following questions.)
   (b) (3 points) Using the *Laplace criterion*, calculate the preferred alternative(s), a_i.
   (c) (1 point) Using the *Maximax criterion*, calculate the best alternative(s), a_i.
   (d) (1 point) Using the *Minimax criterion*, calculate the best alternative(s), a_i.

2. (5 points) **[Game Theory]** Define what we mean by a *Nash equilibrium*. Discuss if the *normal form* of the following game has a *Nash equilibrium*.

		Player 2: P	Player 2: V
Player 1	P	$4, 4$	$2, 6$
	V	$7, 1$	$3, 3$

3. (7 points) **[Automated Decision Making]** Explain what *automated decision making* means and give examples for such decisions.

4. (6 points) **[Heuristics]** Discuss the general advantages and the disadvantages of using heuristics in the decision making process.

5. (4 points) **[Conjunctive- and Disjunctive-Events Bias]** Which of the following instances appears most likely? Which appears second most likely?

   a) Drawing a red marble from a bag containing 50 percent red marbles and 50 percent white marbles.

   b) Drawing a red marble seven times in succession, with replacement (i.e., a selected marble is put back into the bag before the next marble is selected), from a bag containing 90 percent red marbles and 10 percent white marbles.

   c) Drawing at least one red marble in seven tries, with replacement, from a bag containing 10 percent red marbles and 90 percent white marbles.

End of exam

22-04_jdm_solution.pdf

This box is for the examiner only.

Question:	1	2	3	4	5	Total
Points:	8	5	7	6	4	30
Score:						

1. **[Decision Making Under Uncertainty]** Below, you see a payoff table where high numbers indicate high utility, ranging from 0 (no utility) to 10 (high utility).

	z_1	z_2	z_3	z_4
a_1	0	0	8	5
a_2	3	6	8	4
a_3	1	10	8	3
a_4	2	2	2	2
a_5	5	7	8	4
a_6	5	0	8	4

(a) (3 points) Using this payoff table, indicate which alternatives can be excluded because they are dominated by other alternatives. (Hint: Exclude dominated alternatives in the calculations of the following questions.)

Solution: Alternative 2, 4, and 6 are dominated by 5.

(b) (3 points) Using the *Laplace criterion*, calculate the preferred alternative(s), a_i.

Solution: Alternative 1 ≈ 3.25; Alternative 3 $= 5.75$; Alternative 5 $= 6$.
Thus, alternative 5 is best, followed by 3 and 1.

(c) (1 point) Using the *Maximax criterion*, calculate the best alternative(s), a_i.

Solution: Alternative 3 give the best possible outcome, i.e., 10.

(d) (1 point) Using the *Minimax criterion*, calculate the best alternative(s), a_i.

Solution: Alternative 5 is best as it gives at least 4.

2. (5 points) **[Game Theory]** Define what we mean by a *Nash equilibrium*. Discuss if the *normal form* of the following game has a *Nash equilibrium*.

		Player 2: P	Player 2: V
Player 1	P	$4, 4$	$2, 6$
	V	$7, 1$	$3, 3$

Solution: The Nash equilibrium is a concept of game theory where the optimal outcome of a game is one where no player has an incentive to deviate from his chosen strategy after

considering an opponent's choice.

In the game above the point where both play V with (3,3) is a Nash-Equilibrium Nash equilibrium.

3. (7 points) **[Automated Decision Making]** Explain what *automated decision making* means and give examples for such decisions.
4. (6 points) **[Heuristics]** Discuss the general advantages and the disadvantages of using heuristics in the decision making process.
5. (4 points) **[Conjunctive- and Disjunctive-Events Bias]** Which of the following instances appears most likely? Which appears second most likely?
   a) Drawing a red marble from a bag containing 50 percent red marbles and 50 percent white marbles.
   b) Drawing a red marble seven times in succession, with replacement (i.e., a selected marble is put back into the bag before the next marble is selected), from a bag containing 90 percent red marbles and 10 percent white marbles.
   c) Drawing at least one red marble in seven tries, with replacement, from a bag containing 10 percent red marbles and 90 percent white marbles.

Solution: a) 50%, b) .4782 %, c) .5217 %
Thus c) is most likely followed by a) and b)

End of exam

22-07_jdm.pdf

This box is for the examiner only.

Question:	1	2	3	4	5	6	Total
Points:	30	15	24	5	10	6	90
Score:							

Questions from Don L. Kirk

1. **[Behavioral Decision Making]**

   (a) (5 points) Describe how system 1 and system 2 thinking will occur in business? What are the conditions which make the use of one system more likely than the use of the other?

   (b) (5 points) Describe how bounded rationality works in business. What aspects are bounded in our judgement and how are they bounded.

   (c) (5 points) Why, according to research, do people tend to be overconfident in estimating outcomes? How can this affect a business decision and describe a mechanism for tackling overconfidence.

   (d) (5 points) Discuss some of the reasons why managers continue to use unstructured employment interviews despite the abundant evidence that they are not useful for predicting future job performance.

   (e) (5 points) When meeting separately with each side to a negotiation, what two things can mediators to increase the chances of agreement? Why do they work?

   (f) (5 points) Explain the paradox that a manager faces, when choosing between changing course of action and escalating commitment to it.

2. **[Behavioral Strategic Management]**

   (a) (5 points) Organizations often use teams to make a variety of decisions. However, teams differ in effectiveness. Some teams quickly make excellent decisions, while others are synonymous with slow and ineffective decision making. Given our discussion on information processing constraints, why do you think organizations use teams? What makes teams effective or ineffective at decision making? How would the type of decision addressed influence the effectiveness of a team?

   (b) (5 points) Premortem is a managerial tool in which a manager or decision-making team begins by imagining that a project or strategy under consideration has failed. The team then works backward to determine what could potentially cause the project or strategy to fail. Why do you think this tool works?

   (c) (5 points) Observers often revile red tape or bureaucracy for slowing decision making in companies. However, almost all organizations use preset routines and procedures—in other words, some form of bureaucracy—to make any number of routine decisions. Why? How does the use of routines and procedures relate to our discussion of cognitive limitations during decision making?

Please go on to the next page...

Questions from Stephan Huber

3. **[Decision Making Under Uncertainty]** Below, you see a payoff table where high numbers indicate high dis-utility, ranging from 1 (high utility) to 10 (low utility). z_i denote different states of nature and a_j denote different alternative actions.

	z_1	z_2	z_3	z_4
a_1	1	2	3	4
a_2	4	3	2	1
a_3	3	3	3	3
a_4	2	1	2	3
a_5	2	2	2	4

   (a) (4 points) Using this payoff table, indicate which alternatives can be excluded because they are dominated by other alternatives. (Hint: Exclude dominated alternatives in the calculations of the following questions.)

   (b) (3 points) Using the *Laplace criterion*, calculate the preferred alternative(s), a_i.

   (c) (2 points) Using the *Maximax criterion*, calculate the best alternative(s), a_i.

   (d) (2 points) Using the *Minimax criterion*, calculate the best alternative(s), a_i.

   (e) (9 points) Using *Körth's Maximin-Rule*, calculate the best alternative(s), a_i. Explain in detail the procedure to calculate the solution.

	z_1	z_2	z_3	z_4	Φ
a_1	1	8/9	7/8	6/9	6/9
a_2	6/9	7/9	1	1	6/9
a_4	8/9	1	8/8	7/9	7/9

   (f) (4 points) Suppose the probability of occurrence are given as follows:

   $$p_1 = 0.5; \quad p_2 = 0.5; \quad p_3 = 0; \quad p_4 = 0.$$

   Find the order of preference based on the aggregated expected utility **and consider all five alternatives**.

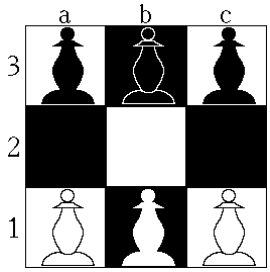
4. (5 points) **[Nash equilibrium]** Define what we mean by a *Nash equilibrium*. Can you find one or multiple Nash equilibria in the normal form of the following game?

		Player 2	
		P	V
Player 1	P	$4, 2$	$0, 3$
	V	$3, 0$	$1, 1$

5. (10 points) **[Elements of a game]**

   Hexapawn is a simple game with the following rules: As in chess, each pawn may be moved in two different ways: it may be moved one square forward, or it may capture a

pawn one square diagonally ahead of it. A pawn may not be moved forward if there is a pawn in the next square. Unlike chess, the first move of a pawn may not advance it by two spaces. A player loses if they have no legal moves or the other player reaches the end of the board with a pawn. Hexapawn on a 3×3 board like shown below is a solved game; with perfect play: the first player to move will always lose in 3 moves.



(a) Name the elements of this game.

(b) What class of game is *Hexapawn*.

6. (6 points) **[Rational models of decision making]**

Discuss the advantages of rational models of decision making. Also address the fact that some simplifying assumptions on which some rational models of decision making are based are not met in reality. Therefore, are alternative methods of decision making preferable?

End of exam

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This box is for the examiner only.

Question:	1	2	3	4	5	6	Total
Points:	30	15	24	5	10	6	90
Score:							

Questions from Don L. Kirk

1. **[Behavioral Decision Making]**

   (a) (5 points) Describe how system 1 and system 2 thinking will occur in business? What are the conditions which make the use of one system more likely than the use of the other?

   (b) (5 points) Describe how bounded rationality works in business. What aspects are bounded in our judgement and how are they bounded.

   (c) (5 points) Why, according to research, do people tend to be overconfident in estimating outcomes? How can this affect a business decision and describe a mechanism for tackling overconfidence.

   (d) (5 points) Discuss some of the reasons why managers continue to use unstructured employment interviews despite the abundant evidence that they are not useful for predicting future job performance.

   (e) (5 points) When meeting separately with each side to a negotiation, what two things can mediators to increase the chances of agreement? Why do they work?

   (f) (5 points) Explain the paradox that a manager faces, when choosing between changing course of action and escalating commitment to it.

2. **[Behavioral Strategic Management]**

   (a) (5 points) Organizations often use teams to make a variety of decisions. However, teams differ in effectiveness. Some teams quickly make excellent decisions, while others are synonymous with slow and ineffective decision making. Given our discussion on information processing constraints, why do you think organizations use teams? What makes teams effective or ineffective at decision making? How would the type of decision addressed influence the effectiveness of a team?

   (b) (5 points) Premortem is a managerial tool in which a manager or decision-making team begins by imagining that a project or strategy under consideration has failed. The team then works backward to determine what could potentially cause the project or strategy to fail. Why do you think this tool works?

   (c) (5 points) Observers often revile red tape or bureaucracy for slowing decision making in companies. However, almost all organizations use preset routines and procedures—in other words, some form of bureaucracy—to make any number of routine decisions. Why? How does the use of routines and procedures relate to our discussion of cognitive limitations during decision making?

Please go on to the next page…

Questions from Stephan Huber

3. **[Decision Making Under Uncertainty]** Below, you see a payoff table where high numbers indicate high dis-utility, ranging from 1 (high utility) to 10 (low utility). z_i denote different states of nature and a_j denote different alternative actions.

	z_1	z_2	z_3	z_4
a_1	1	2	3	4
a_2	4	3	2	1
a_3	3	3	3	3
a_4	2	1	2	3
a_5	2	2	2	4

(a) (4 points) Using this payoff table, indicate which alternatives can be excluded because they are dominated by other alternatives. (Hint: Exclude dominated alternatives in the calculations of the following questions.)

Solution: Alternative 3 and 5 are dominated by 4.

(b) (3 points) Using the *Laplace criterion*, calculate the preferred alternative(s), a_i.

Solution: Alternative 1 ≈ 2.5; Alternative 2 $= 2.5$; Alternative 4 $= 2$.
Thus, $a_4 \succ a_1 \sim a_2$.

(c) (2 points) Using the *Maximax criterion*, calculate the best alternative(s), a_i.

Solution: $a_4 \sim a_1 \sim a_2$

(d) (2 points) Using the *Minimax criterion*, calculate the best alternative(s), a_i.

Solution: $a_4 \succ a_1 \sim a_2$.

(e) (9 points) Using *Körth's Maximin-Rule*, calculate the best alternative(s), a_i. Explain in detail the procedure to calculate the solution.

	z_1	z_2	z_3	z_4	Φ
a_1	1	8/9	7/8	6/9	6/9
a_2	6/9	7/9	1	1	6/9
a_4	8/9	1	8/8	7/9	7/9

Please go on to the next page…

Solution: $a_4 \succ a_1 \sim a_2$.

(f) (4 points) Suppose the probability of occurrence are given as follows:

$$p_1 = 0.5; \quad p_2 = 0.5; \quad p_3 = 0; \quad p_4 = 0.$$

Find the order of preference based on the aggregated expected utility **and consider all five alternatives**.

Solution:

Alternative $1 = 1.5$;
Alternative $2 = 3.5$;
Alternative $3 = 3$;
Alternative $4 = 1.5$;
Alternative $5 = 2$.

Thus, $a_1 \sim a_4 \succ a_5 \succ a_3 \succ a_2$.

4. (5 points) **[Nash equilibrium]** Define what we mean by a *Nash equilibrium*. Can you find one or multiple Nash equilibria in the normal form of the following game?

		Player 2	
		P	V
Player 1	P	$4, 2$	$0, 3$
	V	$3, 0$	$1, 1$

Solution: The Nash equilibrium is a concept of game theory where the optimal outcome of a game is one where no player has an incentive to deviate from his chosen strategy after considering an opponent's choice.

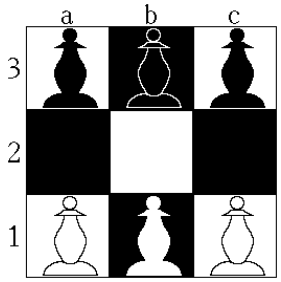
		Player 2	
		P	V
Player 1	P	$4^*, 2$	$0, 3^*$
	V	$3, 0$	$1^*, 1^*$

In the game above the point where both play *V* with (1,1) is a Nash-Equilibrium Nash

equilibrium.

5. (10 points) **[Elements of a game]**

   Hexapawn is a simple game with the following rules: As in chess, each pawn may be moved in two different ways: it may be moved one square forward, or it may capture a pawn one square diagonally ahead of it. A pawn may not be moved forward if there is a pawn in the next square. Unlike chess, the first move of a pawn may not advance it by two spaces. A player loses if they have no legal moves or the other player reaches the end of the board with a pawn. Hexapawn on a 3×3 board like shown below is a solved game; with perfect play: the first player to move will always lose in 3 moves.



   (a) Name the elements of this game.

   (b) What class of game is *Hexapawn*.

6. (6 points) **[Rational models of decision making]**

   Discuss the advantages of rational models of decision making. Also address the fact that some simplifying assumptions on which some rational models of decision making are based are not met in reality. Therefore, are alternative methods of decision making preferable?

End of exam

22-11_jdm.pdf

This box is for the examiner only.

Question:	1	2	3	4	5	Total
Points:	45	24	5	10	6	90
Score:						

Questions from Don L. Kirk

1. **[Behavioral Decision Making]**

   (a) (5 points) The process of rational decision making can be divided into several steps. Describe these steps and explain the methods you use to complete these steps.

   (b) (5 points) In what ways is our rationality bounded? Discuss the aspects that are bounded in our judgment and how they are bounded.

   (c) (5 points) Why, according to research, do people tend to be overconfident in estimating outcomes? Suggest a mechanism for tackling overconfidence.

   (d) (5 points) What are the three criteria on negotiating between the "want" self and the "should" self?

   (e) (5 points) What are the reasons for the difference between groups and individuals in the likelihood of escalating commitment and in the degree to which commitment is escalated?

   (f) (5 points) When meeting separately with each side to a negotiation, what two things can mediators to increase the chances of agreement? Why do they work?

   (g) (5 points) Explain the paradox that a manager faces when choosing between changing course of action and escalating commitment to it.

   (h) (5 points) In many organizations the most competent employers are usually poor in tutoring subordinates and new employees. indicate the bias that is responsible this phenomenon and explain how this phenomenon occurs.

   (i) (5 points) Which bias accounts for the *"sophomore jinx"* phenomenon in which athletes who did exceptional well in their rookie season usually follow with a disappointing second season? Explain the reason for this phenomenon.

Questions from Stephan Huber

2. **[Decision Making Under Uncertainty]** Below, you see a payoff table where high numbers indicate high utility, ranging from 1 (low utility) to 10 (high utility). z_i denote different states of nature and a_j denote different alternative actions.

	z_1	z_2	z_3	z_4
a_1	7	1	1	1
a_2	4	3	2	1
a_3	5	3	3	3
a_4	2	2	2	4
a_5	2	2	3	3

Please go on to the next page...

(a) (4 points) Using this payoff table, indicate which alternatives can be excluded because they are dominated by other alternatives. *(Hint: You can exclude dominant alternatives in the calculations of the following questions. However, do this only if you are really sure!)*

(b) (3 points) Using the *Laplace criterion*, compute the preferred order of alternative(s), a_i.

(c) (2 points) Using the *Maximax criterion*, compute the preferred order of alternative(s), a_i.

(d) (2 points) Using the *Minimax criterion*, calculate the preferred order of alternative(s), a_i.

(e) (9 points) Using *Körth's Maximin-Rule*, calculate the preferred order of alternative(s), a_i. Explain in detail the procedure to calculate the solution.

(f) (4 points) Suppose the probability of occurrence are given as follows:

$$p_1 = 0.0; \quad p_2 = 0.5; \quad p_3 = 0; \quad p_4 = 0.5.$$

Find the order of preference based on the aggregated expected utility **and consider all five alternatives**.

3. (5 points) **[Nash equilibrium]** Define what we mean by a *Nash equilibrium*. Can you find one or multiple Nash equilibria in the normal form of the following game? Please note that the numbers that indicate a negative utility.

		Player 2	
		P	V
Player 1	P	$4, 2$	$0, 3$
	V	$3, 0$	$1, 1$

4. (10 points) **[Elements of a game]**

   (a) Explain briefly the elements and the classes of games that can be helpful to give games a structure.

   (b) Explain briefly two different representations of games.

5. (6 points) **[Rational models of decision making]**

   Discuss the advantages of rational models of decision making. Also address the fact that some simplifying assumptions on which some rational models of decision making are based are not met in reality.

References

End of exam

23-07_me.pdf

This box is for the examiner only.

Question:	1	2	3	4	5	Total
Points:	35	20	11	8	16	90
Score:						

1. **[Monopoly]**

   (a) (20 points) Discuss in detail the price setting behavior of a monopolist. How is the profit-maximizing level of output defined? Compare the prices and the output of a market with a monopolist and a market under perfect competition. Additionally, discuss the impact of the monopolists action on economic welfare and the possibilities of the government to interfere and reduce the bad consequences of a monopolist rational behavior.

   (b) (15 points) A company which is a monopolist in his market has estimated its demand and total cost functions as follows:

   $$Q = 40 - 4P.$$
   $$C = 1 + 2Q + Q^2.$$

   Where P denotes the price in €, Q in thousands of units, and C is measured in thousands of €.

   i) Calculate the total revenue function.

   ii) Calculate the profit-maximizing price and output.

   iii) Calculate the profits made at the profit-maximizing price.

2. (20 points) **[Von Thünen model of land use]**

   Describe the approach of Heinrich von Thünen, discussing the fundamental questions, assumptions, and observations of his model. Illustrate your explanations graphically, and explain the concept of *Thünen's circles*. Assume the existence of two different production methods ($i = a, b$) when creating the graph. Provide the names of the intercept and slope for the curves depicted in the graph.

3. **[Decision Making Under Uncertainty]**

	z_1	z_2	z_3
a_1	0	3	8
a_2	5	7	8
a_3	1	10	1
a_4	2	2	2
a_5	2	3	7

   Above you see a payoff table where high numbers indicate high utility, ranging from 0 (no utility) to 10 (high utility).

   (a) (3 points) Using this payoff table, indicate which alternatives can be excluded because they are dominated by other alternatives. (Hint: Exclude dominated alternatives in the calculations of the following questions).

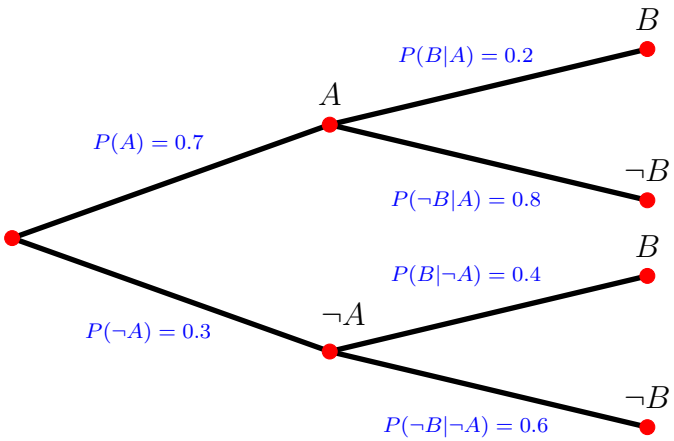
   (b) (4 points) Using the *Laplace criterion*, calculate the preferred alternative(s), a_i.

Please go on to the next page...

(c) (2 points) Using the *Maximax criterion*, calculate the best alternative(s), a_i.

(d) (2 points) Using the *Minimax criterion*, calculate the best alternative(s), a_i.

4. (8 points) **[Bayes Theorem]**



Using the *tree diagram* above, calculate the probability $P(A|B)$.

5. (16 points) **[Financial mathematics]**

- Explain the difference of *simple interest* and *compound interest*. In that respect, why is the number 2.718 something special and what does it tell us?
- Suppose you had \$100 in a savings account and the interest rate was 4% per year. Calculate how much you had in the account after 10 years and after 18 years.
- Use the *Rule of 70* to approximately get the years it takes to double your income when it growth at a constant rate of 4% each year.

End of exam

23-11_me.pdf

This box is for the examiner only.

Question:	1	2	3	4	5	Total
Points:	43	14	11	6	16	90
Score:						

1. **[Monopoly]**

   (a) (23 points) Provide an in-depth analysis of a monopolist's price-setting behavior. Explore how the profit-maximizing level of output is determined and draw comparisons between pricing and output in a monopolistic market and a market operating under perfect competition. Utilize a graphical representation of a downward-sloping demand curve to illustrate the contrasting effects on revenue that monopolists must consider when determining the optimal production level and pricing strategies. Furthermore, evaluate the impact of a monopolist's actions on economic welfare and examine potential government interventions aimed at mitigating adverse consequences resulting from a monopolist's rational behavior.

   (b) (6 points) Discuss what happens to consumer surplus, producer surplus and total welfare when a monopolist can discriminate prices perfectly.

   (c) (14 points) A company which is a monopolist in his market has estimated its demand and total cost functions as follows:

   $$Q = 90 - 2P.$$
   $$C = 100 + 10Q + 2Q^2.$$

   Where P denotes the price in €, Q in thousands of units, and C is measured in thousands of €.

   i) Calculate the total revenue function.

   ii) Calculate the profit-maximizing price and output.

   iii) Calculate the profits made at the profit-maximizing price.

2. (14 points) **[Von Thünen model of land use]**

   Describe the approach of Heinrich von Thünen, discussing the fundamental questions, assumptions, and observations of his model. Illustrate your explanations graphically, and explain the concept of *Thünen's circles*. Assume the existence of two different production methods ($i = a, b$) when creating the graph. Provide the names of the intercept and slope for the curves depicted in the graph.

3. **[Decision Making Under Uncertainty]**

	z_1	z_2	z_3
a_1	1	3	8
a_2	2	7	8
a_3	3	100	0
a_4	6	2	2
a_5	5	7	8

   Above you see a payoff table where high numbers indicate high utility, ranging from 0 (no utility) to 10 (high utility).

Please go on to the next page...

(a) (3 points) Using this payoff table, indicate which alternatives can be excluded because they are dominated by other alternatives. (Hint: Exclude dominated alternatives in the calculations of the following questions).

(b) (4 points) Using the *Laplace criterion*, calculate the preferred alternative(s), a_i.

(c) (2 points) Using the *Maximax criterion*, calculate the best alternative(s), a_i.

(d) (2 points) Using the *Minimax criterion*, calculate the best alternative(s), a_i.

4. (6 points) **[Bayes Theorem]**

   Given the following probabilities:

$$\begin{aligned} P(A) &= 0.6, \\ P(\neg A) &= 0.4, \\ P(B|A) &= 0.2, \\ P(\neg B|A) &= 0.8, \\ P(B|\neg A) &= 0.9, \\ P(\neg B|\neg A) &= 0.1. \end{aligned}$$

   calculate $P(B)$ and $P(A|B)$.

5. (16 points) **[Financial mathematics]**

   - Explain the difference of *simple interest* and *compound interest*. In that respect, why is the number 2.718 something special and what does it tell us?
   - Suppose you had \$100 in a savings account and the interest rate was 2% per year. Calculate how much you had in the account after 10 years and after 18 years.
   - Use the *Rule of 70* to approximately get the years it takes to quadruple your income when it growth at a constant rate of 7% each year.

End of exam

24-01_me.pdf

This box is for the examiner only.

Question:	1	2	3	4	5	Total
Points:	41	9	14	20	6	90
Score:						

1. **[Monopoly]**

   (a) (21 points) Provide an in-depth analysis of a monopolist's price-setting behavior. Explore how the profit-maximizing level of output is determined and draw comparisons between pricing and output in a monopolistic market and a market operating under perfect competition. Utilize a graphical representation of a downward-sloping demand curve in a price quantity diagram to illustrate the contrasting effects on revenue, i.e., the quantity effect and the price effect, that monopolists must consider when determining the optimal production level and the optimal price, respectively. Furthermore, evaluate the impact of a monopolist's actions on economic welfare and examine potential government interventions aimed at mitigating adverse consequences resulting from a monopolist's rational behavior.

   (b) (6 points) Discuss what happens to consumer surplus, producer surplus and total welfare when a monopolist can discriminate prices perfectly.

   (c) (14 points) A company which is a monopolist in his market has estimated its demand and total cost functions as follows:

$$P = 45 - \frac{1}{4}Q$$
$$C = 100 + 10Q + 2Q^2.$$

   Where P denotes the price in €, Q in thousands of units, and C is measured in thousands of €.

   i) Calculate the total revenue function.

   ii) Calculate the profit-maximizing price and output.

   iii) Calculate the profits made at the profit-maximizing price.

2. (9 points) **[Conditions of decision making]**

   In the lecture, we covered three general conditions that influence the design of the optimal decision-making process. Describe these three conditions and provide one example of a decision that typically needs to be made under each condition.

Please go on to the next page...

3. (14 points) **[Von Thünen model of land use]**

   Describe the approach of Heinrich von Thünen, discussing the fundamental questions, assumptions, and observations of his model. Illustrate your explanations graphically, and explain the concept of *Thünen's circles*. Assume the existence of two different production methods ($i = a, b$) when creating the graph. Provide the names of the intercept and slope for the curves depicted in the graph.

4. **[Decision Making Under Uncertainty]**

	z_1	z_2	z_3
a_1	1	3	8
a_2	2	7	8
a_3	3	100	0
a_4	6	2	2
a_5	5	7	8

   Above you see a payoff table where high numbers indicate high utility, ranging from 0 (no utility) to 10 (high utility).

   (a) (3 points) Using this payoff table, indicate which alternatives can be excluded because they are dominated by other alternatives. (Hint: Exclude dominated alternatives in the calculations of the following questions).

   (b) (4 points) Using the *Laplace criterion*, calculate the preferred alternative(s), a_i.

   (c) (2 points) Using the *Maximax criterion*, calculate the best alternative(s), a_i.

   (d) (2 points) Using the *Minimax criterion*, calculate the best alternative(s), a_i.

   (e) (9 points) Using *Körth's Maximin-Rule*, calculate the preferred order of alternative(s), a_i. Explain in detail the procedure to calculate the solution.

5. (6 points) **[Bayes Theorem]**

   Given the following probabilities:

$$\begin{aligned} P(A) &= 0.4, \\ P(\neg A) &= 0.6, \\ P(B|A) &= 0.3, \\ P(\neg B|A) &= 0.7, \\ P(B|\neg A) &= 0.8, \\ P(\neg B|\neg A) &= 0.2. \end{aligned}$$

   calculate $P(B)$ and $P(A|B)$.

References

End of exam