Saint-Petersburg Branch of the Federal State Autonomous Institution of Higher Education "National Research University

"Higher School of Economics"

Faculty Saint-Petersburg school of economics and management

Management department

Program of the course

Games Theory and Applications

For the educational program

Bachelor in "Management" 38.03.02

Program Author:

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Approved by the Head of DEPS

_____ 2017

Approved by the Academic Council of the educational program "Management"

"__" _____2017, protocol № _____

Academic director of the educational program "Management"

Saint-Petersburg, 2017.

1. Field of Application and Normative References.

This course program establishes minimum requirements for the knowledge and skills of the student and determines the content and types of studies and reports.

The program was developed for lectures of the discipline Game Theory, teaching assistants and students of the program 38.03.02 Management, enrolled in the educational program bachelor in Management 38.03.02.

The program was developed in accordance with:

- Educational standards of the Federal State Autonomous Institution of Higher Education "National Research University "Higher School of Economics" (http://www.hse.ru/standards/standard).
- Educational program "Management" 38.03.02.
- Joint university curriculum for the educational program bachelor in Management 38.03.02, approved in 2017.

2. Course Objectives.

The Game Theory course objectives are:

- Acquirement of core competencies in the sphere of Game Theory;
- Acquirement of necessary theoretical base and practical skills in the sphere of Game Theory;
- Students' preparation for managerial, analytical, research and entrepreneurial roles in companies and organizations.

3. Competencies acquired by students within the course.

Levels of competencies formation:

RB - resource base, theoretical and subject bases (knowledge, skills).

WA - work approaches which form the core of the competence.

MV - motivational and value component, which reflects the degree of awareness of the value of the competence and readiness to apply it.

The course develops the following competencies:

Competence	HSE Code	Competence level	Descriptors - the learning outcomes (the indicators of achievement)	Forms and methods of teaching which contribute to the formation and development of competencies	Form of control of competence maturity
Able to solve problems in professional activities on the basis of analysis and synthesis.	UC- 3(SC- B4)	RB	In tests student should demonstrate ability to solve Game Theory related problems applying approaches, studied during the course.	Lectures, seminars, homework and in- class activity	tests
Able to work with information: find, assess and apply information from different sources, necessary for solving scientific and professional problems (including application of systemic approach).	UC- 5(SC- B6)	WA	In tests student should demonstrate information search and analysis skills.	Lectures, seminars, homework and in- class activity	tests
Able to conduct research, including the problem analysis, setting goals and objectives, selection of the object and subject of the study, choice of research method and approaches and their quality assessment.	UC- 6(SC- B7)	WA	In tests student should demonstrate problem analysis skills, choose and apply research methods.	Lectures, seminars, homework and in- class activity	tests, Seminars activity
Able to critically assess and reassess the experience (their own and the others'), to reflect the professional and social activities.	UC- 9(SC- B10)	RB	During the seminars student should demonstrate ability to critically assess the others' experience and suggest problem-solving approaches.	Seminars	Seminars activity

Competence	HSE Code	Competence level	Descriptors - the learning outcomes (the indicators of achievement)	Forms and methods of teaching which contribute to the formation and development of competencies	Form of control of competence maturity
Aware of the social importance of his/her future profession, has a high motivation to perform his/her professional activities.	PC-1	MV	During the seminars student should demonstrate his/her awareness of the social importance of his/her future career and demonstrate interest and motivation in his/her future development.	Lectures (corporate social responsibility), Seminars	Seminars activity
Able to offer organizational - managerial decisions and assess the conditions and consequences of decisions.	PC-2	WA	Student should demonstrate ways of solving Game Theory related problems and predict consequences of the actions performed.	Lectures, seminars	Test, seminar activity
Able to take into account the consequences of managerial decisions and actions from the social responsibility perspective.	PC-10	RB	During the seminars, student should demonstrate application of knowledge, received on lectures, covering social responsibility and sustainability topics.	Lectures (corporate social responsibility), seminars	Seminar activity
Able to participate in development of Game Theory strategies of organizations, able to plan and implement measures aimed at its realization.	PC-11	WA	Student should demonstrate in his/her tests Game Theory strategy development skills.	Lectures, seminars	Seminar activity, tests
Able to participate in the implementation of technological and product innovation.	PC-12	WA	Student should demonstrate in his/her tests innovative approach to products.	Lectures, seminars	tests
Able to analyze economical goods	PC-19	WA	Student should demonstrate his/her skills in management's	Lectures, seminars	Seminar activity

Competence	HSE Code	Competence level	Descriptors - the learning outcomes (the indicators of achievement)	Forms and methods of teaching which contribute to the formation and development of competencies	Form of control of competence maturity
consumer's behavior and the demand.			Behavior analysis during seminars.		
Able to carry out analysis of the competitive environment.	PC-20	WA	Student should demonstrate ability to perform competitive environment analysis.	Lectures, seminars	Seminar activity, tests
Able to analyses the market and specific risks to make managerial decision.	PC-25	WA	Student should demonstrate ability to evaluate business and market risks in his/her tests and during seminars.	Lectures, seminars	Seminar activity, tests
Able to find and evaluate new market opportunities and formulate a business idea.	PC-27	WA	Student should demonstrate ability to identify and evaluate market opportunity and to develop a business idea in his/her tests.	Lectures, seminars	tests
Able to apply modern technologies and information technologies for solving analytical and research problems.	PC-35	WA	In the final exam student should demonstrate his/her knowledge of IT instruments, applied in Game Theory.	Lectures	Final exam

4. The Course place in the program structure.

The course is a part of the professional profile (Major), basic profile part.

For the development of the discipline, students must possess the following knowledge and competencies:

- know and be able to apply the main results studied in the course mathematical analysis, including optimization techniques, and set theory.

For the course study, students should possess the following skills and competencies:

- UC-1(SC-B2) Able to learn, acquire new knowledge, skills, including areas other than the professional.
- UC-5(SC-B6) Able to work with information: find, assess and apply information from different sources, necessary for solving scientific and professional problems (including application of systemic approach).
- UC-8(SC-B9) Able to correctly perform communication, according to the objectives and the situation.

The main concepts of the course should be further used in studying the following disciplines:

- Strategic management,
- Microeconomics,
- The theory of industrial organization,
- Theory of contracts,
- Labor Economics.

5. Course topics plan.

Scope of the course - 4 credits.

№	Section topic	Hours in total	In-class hours		Self-study
			Lectures	Seminars Practical classes	
Module 1, 2.					
1	Basic concepts of game theory. Classification and description of games	20	4	4	12
2	Static games	20	4	4	12
3	Dynamic games with complete information	20	4	4	12
4	Repeated games	20	4	4	12
5	Games with incomplete information	20	4	4	12
6	Dynamic games with imperfect information	20	4	4	12
7	Auctions. The theorem of equivalence income. The elements of cooperative game theory. The concept of core, Shapley value	32	4	4	24
In total		152	28	28	96

6. Forms of control of students' knowledge.

Type of control	Form of control	3 year module				Parameters
		1	2	3	4	
Current (week)	Test	*	*			Written test1 (test open questions and/or tasks), 60 min. Written test 2 (8-10 small tasks), 60 min. Written test 3 (1 task in 6 parts), 60 min.
	Practical classes participation	*	*			Participation and activity on seminars during the course. Group project presentation in MS Power Point (10-15 slides).
	Home works	*	*			Writing assignment (can be divided) provided after each lecture. As the rating out 4 of the best work.
	Class activity	*	*			Active participation in solving class tasks
Final	Exam		*			Written final exam (test open questions and tasks), 80 min.

7. Knowledge and skills assessment criteria.

Type of control	Form of control	Parameters
Current	Project presentation	Students should make a group present of a project, made on the base of the task, given to students on the first lecture. The project is presented in groups; presentation should contain 10-15 slides and describe the problem analysis, methods and approaches of problem solving, decision, made by the group and decision justification explanation. The project is evaluated on the following criteria: quality of analysis (2 points), proper application of knowledge, gained on lectures and from the recommended literature (2 points), presentation persuasiveness (2 points), presentation structure, punctuality and time management skills (2 points), and practical examples of use in management (2 points).
	Homework	Student should present an individual homework. The HW is evaluated on the following criteria: paper quality and structure (1 point), quality of problem analysis (2 points), proper application of theory (2 points), originality and creativity of approaches and suggested decision (2 points), critical thinking skills in risk analysis and personal contribution description (3 points). The final mark is calculated as the rating out 4 of the best work.
	Test	During 60 minutes student should answer: 1. 4 multiple choice questions, 2 open questions and solve out of 3 tasks. Each correct answer to a multiple choice question is evaluated as 0,5 points, for each open question student receives from 0 to 1 points. For each solved task student can receive from 0 to 2 points. 2. Solve out of 5 the basic tasks and 3 additional tasks. For each solved task student can receive from 0 to 2 points. For each solved additional task student can receive from 0 to 4 points. 3. Solve out of 1 task in 6-8 parts. For each solved part student can receive from 0 to 6 points.
	Class activity	Assessment - one point for each right decision during class work
Final	Exam	During 80 minutes student should answer 10 multiple-choice questions and solve 1 task in 5 parts. Each correct answer to a multiple choice question is evaluated as 0,25 points. For each solved task student can receive from 0 to 2 points. The tasks are assessed based on application of related theoretical knowledge, gained during the course (1 points), effectiveness and applicability of the suggested problem solving approach (1 points).

8. Course content.

8.1 Lectures Content.

Topic 1. Basic concepts of game theory. Classification and description of games

Basic concepts of game theory. Classification of games. Form game description.

Main literature

1. Shagin, V. L. Game Theory: tutorial and workshop / L. V. Shagin. — 2nd ed. Rev. and extra — M.: Urait, 2017. — 223 p. — (Series: Author's textbook). — ISBN 978-5-534-03263-5. — Pp. 7-15
2. Martin J.Osborne, An Introduction to Game Theory, Oxford University Press, 2009 — Chapter 2-3.

Theme 2. Static games

Dominating and non-dominated strategy. Two players with opposing interests. Cautious (minimax and Maximin) strategy. The lower and upper price of the game. Saddle point. Mixed strategies and the minimax theorem on the matrix for antagonistic games. The solution of games 2 × n and m × 2. The reduction of the final matrix game to a linear programming problem. The solution of antagonistic games in MS Excel. Games with interests. Nash Equilibrium. Pareto-optimality. The balance trembling hands. Infinite game. Economic application. Tasks for independent work

Main literature

1. Shagin, V. L. Game Theory: tutorial and workshop / L. V. Shagin. — 2nd ed. Rev. and extra — M.: Urait, 2017. — 223 p. — (Series: Author's textbook). — ISBN 978-5-534-03263-5. — Pp. 16-81
2. Martin J.Osborne, An Introduction to Game Theory, Oxford University Press, 2009 — Chapter 4.

Theme 3. Dynamic games with complete information

Dynamic games with complete and perfect information. A model of duopoly Stackelberg. Consistent bargain (Rubinstein model). Sequential game with complete but imperfect information. Modified model of Stackelberg. An extensive form representation of games. Bodyglove perfect Nash equilibrium. Sequential game involving Nature. Tasks for independent work

Main literature

1. Shagin, V. L. Game Theory: tutorial and workshop / L. V. Shagin. — 2nd ed. Rev. and extra — M.: Urait, 2017. — 223 p. — (Series: Author's textbook). — ISBN 978-5-534-03263-5. — Pp. 82-123
2. Martin J.Osborne, An Introduction to Game Theory, Oxford University Press, 2009 — Chapter 5.

Theme 4. Repeated games

Twice-repeated game. Infinitely repeated games. Strategy switching. Achievable payments and a theorem of Friedman. A model of duopoly Cournot (an infinite number of times repeated game). Marginal Pareto-optimal profiles of the strategies. Tasks for independent work

Main literature

1. Shagin, V. L. Game Theory: tutorial and workshop / L. V. Shagin. — 2nd ed. Rev. and extra — M.: Urait, 2017. — 223 p. — (Series: Author's textbook). — ISBN 978-5-534-03263-5. — Pp. 124-148
2. Martin J.Osborne, An Introduction to Game Theory, Oxford University Press, 2009 — Chapter 6

Theme 5. Games with incomplete information

Normal form representation of static Bayesian games. The separating equilibrium is Bayes — Nash. The Stackelberg model with asymmetric information. Auctions. Tasks for independent work

Main literature

1. Shagin, V. L. Game Theory: tutorial and workshop / L. V. Shagin. — 2nd ed. Rev. and extra — M.: Urait, 2017. — (Series: Author's textbook). — ISBN 978-5-534-03263-5. — Pp. 149-173
2. Martin J.Osborne, An Introduction to Game Theory, Oxford University Press, 2009 — Chapter 7

Topic 6. Dynamic games with imperfect information

Signaling game. Examples of games with incomplete and imperfect information. Tasks for independent work

Main literature

1. Shagin, V. L. Game Theory: tutorial and workshop / L. V. Shagin. — 2nd ed. Rev. and extra — M.: Urait, 2017. — (Series: Author's textbook). — ISBN 978-5-534-03263-5. — Pp. 174-216
2. Martin J.Osborne, An Introduction to Game Theory, Oxford University Press, 2009 — Chapter 8

Topic 7. Auctions. The theorem of equivalence income. The elements of cooperative game theory. The concept of core, Shapley value

The basic formats of auctions. The theorem of equivalence income. Matchings. The elements of cooperative game theory. The concept of the kernel of the Shapley value.

Main literature

1. A. V. Zakharov Game Theory in the social Sciences. – Moscow: Publishing house of HSE, 2015— Pp.259-274
2. Martin J.Osborne, An Introduction to Game Theory, Oxford University Press, 2009 — Chapter 8.
3. The Nobel prize for Economics — 2012: Information for the Public: Stable matching: Theory, evidence, and practical design; Scientific Background: Stable allocations and the practice of market design.

8.2 Required Reading.

1. *Martin J.Osborne, An Introduction to Game Theory, Oxford University Press, 2009*

In Russian:

2. *A. V. Zakharov Game Theory in the social Sciences. – Moscow: Publishing house of HSE, 2015*
3. *Shagin, V. L. Game Theory: tutorial and workshop / L. V. Shagin. — 2nd ed. Rev. and extra — M.: Urait, 2017. — 223 p. — (Series: Author's textbook). — ISBN 978-5-534-03263-5.*

8.3 Additional Reading.

4. *Aumann, Robert. (1995). Backward Induction and Common Knowledge of Rationality. Games and Economic Behavior. 8. 6–19.*
5. *Akerlof, George. (1970). The Market for "Lemons": Quality Uncertainty and the Market Mechanism. The Quarterly Journal of Economics. 84. 488–500.*
6. *K.G. Binmore Playing for Real: A Text on Game Theory, Oxford University Press, 2007.*
7. *Downs, Antony (1957). An Economic Theory of Democracy. New York6.*
8. *D. Fudenberg & J. Tirole, "Game Theory", MIT Press, 1998*
9. *Gneezy U & Smorodinsky, R (2005): All-pay auctions an experimental study. Forthcoming Publication Journal of Economic behavior and organization.*
10. *R.Gibbons Game Theory for Applied Economists, Princeton University Press, 1992*
11. *H.Moulin, Cooperative Microeconomics: A Game-Theoretic Introduction, Prentice Hall, London, 1995.*
12. *R. Myerson Game Theory: Analysis of Conflict, Harvard University Press, 1991*
13. *A.MasCollel, M.Whinston, J.Green, Microeconomic Theory, Oxford Univ. Press,1995.*
14. *H. W. Kuhn, "Classics in Game Theory", Princeton University Press, 1997*
15. *Kagel, J. & Levin. D. (1993): Independent Private Value auctions: Bidder Behavior in First-Second and Third Price Auctions with Varying numbers of Bidders. Economic Journal Vol. 103 p.2-5.*
16. *Kagel, J. and A.E. Roth(1995): Handbook of Experimental economics. Princeton University Press, Princeton.*
17. *Kreps, David and Wilson, Robert. (1982). Reputation and imperfect information. Journal of Economic Theory. 27. 253–279.*
18. *Holt , Charles A. &, A.E. Roth(2004): The Nash equilibrium - A perspective. PNAS vol 101,no12 p. 3999-4002.*
19. *Hotelling, Harold (1929). Stability in Competition. Economic Journal. 39. 41–57*
20. *Rubinstein, Ariel. (1982). Perfect Equilibrium in a Bargaining Model. Econometrics. 50. 97–109.*
21. *Selten, Reinhard. (1975). Reexamination of the perfectness concept for equilibrium points in extensive games. International Journal of Game Theory. 4. 25–55*
22. *Stiglitz, Joseph and Weiss, Andrew. (1981). Credit rationing in markets with imperfect information. The American Economic Review. 71. 393–410*
23. *M. J. Osbourne & A. Rubenstein, "A Course in Game Theory" MIT Press, 1994*
24. *Osborne, Martin J. (1995). Spatial Models of Political Competition Under Plurality Rule: A Survey of Some Explanations of the Number of Candidates and the Positions They Take. Canadian Journal of Economics. 27. 261–301. [preprint]*
25. *G. William Flake, "The Computational Beauty of Nature", MIT Press, 1999*
26. *Zermelo, Ernst. (1913). Über Eine Anwendung der Mengenlehre auf die Theorie des Schachspiels. Proceedings of the fifth international congress of mathematicians – II, Cambridge. 2. 501–504.*

In Russian:

27. *Конюховский, П. В. Теория игр: учебник для академического бакалавриата / П. В. Конюховский, А. С. Малова. — М. : Издательство Юрайт, 2017. — 252 с. — (Серия : Авторский учебник). — ISBN 978-5-9916-4220-0.*
28. *Челноков, А. Ю. Теория игр: учебник и практикум для бакалавриата и магистратуры / А. Ю. Челноков. — М. : Издательство Юрайт, 2017. — 223 с. — (Серия : Бакалавр и магистр. Академический курс). — ISBN 978-5-534-00233-1.*
29. *Шиловская, Н. А. Теория игр: учебник и практикум для прикладного бакалавриата / Н. А. Шиловская. — М. : Издательство Юрайт, 2017. — 318 с. — (Серия : Бакалавр. Прикладной курс). — ISBN 978-5-9916-8264-0.*

9. Educational Technologies.

During the lectures, the lecturer applies classical approach of material presentation with the use of MS Power Point presentation and blackboard. Small discussions on the material presented are also conducted during the lectures.

The practical classes include small case studies and problem discussions as well as short presentation of the homework tasks. When conducting classes used by the audience, equipped if necessary with a projector to display presentations.

Homework is recommended to require every 2 weeks and not to report the results to the full back. students not cooperated and had not his best work.

The project main goal is to simulate students' future career or business challenges in the sphere of Game Theory. The project offers wide opportunities for theory implementation. One of the key goals of the project is to develop critical thinking skills of students. The project is expected to demonstrate students how knowledge in the Game Theory sphere can help in opportunities identification, risks prediction and strategy planning.

9.2 Guideline for students.

Students are expected to prepare for the practical classes by reading the recommended literature and preparing homework. The final exam multiple choice questions and open questions would be based on the lecture materials, the tasks would be based on the materials and ability of students to implement the received knowledge.

The final project consists of a group presentation and individual homework. The HW should be handed in before the deadline and written according to the standards, listed below. Homework may also be presented in the manuscript version.

Element of formatting	Formatting requirements
Interval	Text - 1,5 Literature list - 1,5
Font	Times New Roman
Font size	Main text - 12 Chapter title - 14
Font colour	Black

10. Evaluation tools for students' progress monitoring and evaluation.

10.1 Assessment tools to assess the level of material comprehension during the current control.

Examples of open questions for current tests and class work.

1. Which means "zero-sum game"? Is the "prisoners dilemma" is a zero-sum game?
2. What is the smallest number of mixed equilibria may be in the two-player game with two strategies?
3. Give an example of a game where balance committed subgame, different from equilibria Bayes-Nash.
4. What are the real properties of strategic interactions in these cases reflect the equilibrium Bayes-Nash?
5. Specify "intuitive criterion".
6. The Games in normal form may not be in pure Nash equilibrium strategies. If true give an example, if not, why not.

For project presentation students should choose one the games from Game Theory.

Examples of tasks for homework

1. Give three examples (matrix payments) class matrix of 2x2 games, in addition to dilemma of the prisoners. Give an example of a situation that you can try to simulate this game.

2. Find all the equilibrium of all species studied to date, for the examples given.

3. Chinese poker. Two players simultaneously call the integers, the one who called more, gets a ruble from the losers. What balance is in this game? Why this result does not contradict the theorem of Nash?

4. A sequential variant of Bertrand duopoly.

Consider a variant of the game "in Bertrand duopoly", where the first firm chooses a price and only then a second firm chooses the price. Prices are assigned in whole numbers, the costs per unit of output is constant and the monopoly profits would be positive.

a. Formalities the game in extensive form to model this situation.
b. Give an example of the first strategy of the firm and an example of the strategy of the company.
c. Look for any equilibrium committed in subgame.

6. Five musicians want to make money in the subway. Every three of them can earn 5000 rubles per day, every four, except for the group without a drummer — 6000, a group of 4 without a drummer — 5500, all five together — 7000. Find the kernel and the Shapley value for a cooperative game.

7. Having a joint project, the company quarreled with each other because of the strategy of further development. As a result, they decided to divide the project into 2 directions A/B, hoping that everyone will be able to earn individually more than its partner.

The analysis showed that the matrix of winnings may be as follows:

In her tc and tm of a random variable, a possible value which the evaluation RnD Manager [0;21], and [0;8], respectively.

Find the separating equilibrium PBE (s,m) where:

Partner 1 chooses the direction A (tc>s), and accordingly disclaims B.

Partner 2 chooses the direction A (tm>m), and accordingly disclaims B.

2 1	A	B
A	0;0	1+tc;1
B	4:2+tm	0:0

10.2 Examples of current tests and final exam questions.

Examples of tasks.

Mr. Barchan has a company that makes tea. His only customer is Alex from 'ORIMI trade'. Mr. Barchan has to decide whether to make his tea good or bad. Good tea is more expensive to make. 'ORIMI trade' has to decide whether to buy one or two 40 ft. containers. All the 40 ft. containers in a given production run are of the same quality. Alex cannot tell the quality of the tea when he decides how much to buy, but he does discover the quality later once he tests it.

ORIMI trade's payoff is 3 if he buys two 40 ft. containers of tea and it is good; 2 if he buys one 40 ft. container and it is good; 1 if he buys one 40 ft. container and it is bad; and 0 if he buys two 40 ft. containers and it is bad.

Mr. Barchan's payoff is: 3 if he makes bad tea and sells two 40 ft. containers; 2 if he makes good tea and sells two 40 ft. containers; 1 if he makes bad tea and sells one 40 ft. container; and 0 if he makes good tea and sells one 40 ft. container.

1 part. [2 points] Now suppose that 'ORIMI trade' and Mr. Barchan have an on-going business relationship. That is, in each period, Mr. Barchan has to choose the tea quality for that period; 'ORIMI trade' has to choose the quantity to purchase that period; and payoffs are realized for that period (i.e., the tea is consumed). Write down payoff matrix for this game. Find the Nash equilibrium.

2 part [2 points] Let δA be ORIMI trade's discount factor, and let δB be Mr. Barchan's discount factor. Fist consider the case where the game is **infinitely repeated**, where $0 < \delta A < 1$ and $0 < \delta B < 1$.Prove that R = profile (3, 2) is Pareto dominates NE.

3 part [2 points] Now consider the case where the game is infinitely repeated, where $0 < \delta A < 1$ and $0 < \delta B < 1$. Describe an SPE of this game in which, along the equilibrium path (i.e., if no-one deviates), Mr. Barchan makes good tea in each period and 'ORIMI trade' buys two 40 ft. containers in each period. Specify the strategy profile-oriented for R. Describe grim trigger strategy for all parties involved. Be careful to write down a complete strategy for each player.

4 part [2 points] Determine the value of the discount factor for the grim trigger strategy in which these strategies will SPE. Be careful to explain why your proposed strategy profile is an SPE. If it depends on δA and δB, specify the minimum δA and minimum δB such that your strategy is an SPE.

5 part. [2 points] Now consider the case where the game **is played just twice and then ends** (i.e., there are just **two periods**). Moreover, to keep things simple, assume $\delta A = \delta B = 1$. Write down the tree for this game. Find the SPE of this game. Be careful to write down a complete strategy for each player, and to explain your answer.

<u>Additional parts</u>

Now suppose that instead of choosing the quality of fresh tea in each period, Mr. Barchan needs to establish quality once and for all before period one. That is, whatever quality choose Mr. Barchan for the first period, this quality is fixed for the rest of the game. Alex, as before, makes a fresh choice of one or two 40 ft. containers each period. Alex knows that the quality of tea, Mr. Barchan is fixed, but initially (as long as he does not feel it) he doesn't know what Mr. Barchan fixed it as well or decided to put a bad tea.

The payoffs in each period are the same as before, except if Mr. Barchan captures the quality of tea as good, and if Alex buys two 40 ft. container in time, Mr. Barchan payments be reduced from 2 to 1.

6 part [3 points] Suppose there are just **two periods**. Write down the tree for this game being careful to indicate what Alex knows and when he knows it.

7 part [2 points] Find the SPE of this game. Show your work or explain your answer.

8 part [3 points] What is the minimum number of periods in this game for there to be an SPE in which Mr. Barchan makes good tea. [Hint: although you can, you do not have to redraw the tree.]

Examples of multiple-choice questions.

1) If every player prefers not to switch (or is indifferent between switching and not) then the strategy profile is a Nash equilibrium

   Answer: True. False

2) A strictly dominated strategy can never be a best response.

   Answer: True. False

3) The equilibrium in the Cournot model, Stackelberg equilibrium is a SPNE.

   Answer: True. False

4) Two statements:
A. Every finite extensive game with perfect info has a subgame perfect equilibrium.
B. there is a SPNE, if all payments of all players are different, in a finite sequential game with complete information.

   Answer: We can include statements to the definition

A -Kuhn's Theorem **B- Kuhn's Theorem**	**A -Kuhn's Theorem** **B- SPNE**	**A -SPNE** **B- Kuhn's Theorem**	**A -SPNE** **B- SPNE**

11. The system of the course marks formation (grading system).

The mark for the current control is represented as a sum of the assessments on all current control approaches and is calculated by the formula:

$$Maccum=0.3\ *(Mpr\ +\ Mactiv)+0.3*Mhw+0.4*(M1+M2+M3)/3$$

where

M_{pr} - is the mark for the presentation, calculated as described in Section 7.

M_{activ} - is the mark for the in-class activity, which takes into account class attendance, activity and participation in communications and discussions during the practical classes.

M_{hw} - is the mark for the homework presentations, calculated as described in Section 7.

M1, M2, M3 - is the mark for the tests i.

The marks are not rounded. The amount *Mpr + Mactiv* may not exceed 10.

The final mark or result is calculated as:

$$Mresult=0.5\ *\ Maccum\ +\ 0.5\ *\ Mexam,$$

where M_{exam} is the mark for the final examination.

The marks *Mresult* are rounded according to the standard mathematical algorithm: up to half of the point are rounded down, more than half of the point - up).

If *Maccum* is greater than or equal to 8.000, it may, at the request of the student equated as *Mexam*. Come to the exam is not required in this case.

12. The teaching and informational support of the course.

12.1 Required reading.

1. *Martin J.Osborne, An Introduction to Game Theory, Oxford University Press, 2009*
2. *Barron, E.N. Game theory : an introduction/ E.N. Barron. - 2nd ed. - Hoboken : Wiley. 2013. - 555 p. - (Wiley series in operations research and management science)*

In Russian:

Shagin, V. L. Game Theory: tutorial and workshop / L. V. Shagin. — 2nd ed. Rev. and extra — M.: Urait, 2017. — 223 p. — (Series: Author's textbook). — ISBN 978-5-534-03263-5. — Pp. 82-123

12.2 Additional reading.

3. *Aumann, Robert. (1995). Backward Induction and Common Knowledge of Rationality. Games and Economic Behavior. 8. 6–19.*
4. *Akerlof, George. (1970). The Market for "Lemons": Quality Uncertainty and the Market Mechanism. The Quarterly Journal of Economics. 84. 488–500.*
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6. *Downs, Antony (1957). An Economic Theory of Democracy. New York6.*
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12.5 Computer programs.

For successful course mastering, student should apply the following software and programs:

MS Word, MS Excel, MS PowerPoint.

13. Course technical provision.

The following equipment is used during the course: projector, laptop, screen, microphone, remote control.