the fEDERAL STATE-funded educational institution of higher education “FINANCIAL UNIVERSITY UNDER THE GOVERNMENT OF THE Russian federation”

(FINANCIAL UNIVERSITY)

**Department of Mathematics**

**A.Y. Vladova**

**DECISION MAKING METHODS**

**(in English)**

**Syllabus of the course**

for the students learning the discipline

38.03.01 “Economics”, профиль “International Finance (in English)”, profile “International business of energy companies” (with a partial implementation in English)

**Moscow 2021**

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**APPROVED**

Vice-Rector on development

of educational programmes

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«\_\_\_\_» \_\_\_\_\_\_\_\_\_\_\_\_\_\_2021 г.

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Reviewer: O.E. Pyrkina Associated professor of the Department of Mathematics

**A.Y. Vladova**

**Decision making methods** **(in English)»**. Thesyllabus of the optional course of the educational programme for the students learning the discipline 38.03.01 “Economics”, profile “International Finance (in English)”, profile “International business of energy companies” (with a partial implementation in English) — М.: Financial University, Department of Mathematics, 2021 – 33 p.

The course “Decision making methods” (in English) is an optional course of the discipline 38.03.01 “Economics”, profile “International Finance (in English)”, profile “International business of energy companies” (with a partial implementation in English).

The syllabus contains the content of the educational course, interdisciplinary linkages of the topics, the themes of the seminars, the content of independent work, the forms of control and training and methodological guidance of the course.

*Educational edition*

DECISION MAKING METHODS

(in English)

Syllabus of the course

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# Name of the course

The course “Decision making methods” (in English) of the bachelor educational discipline 38.03.01 “Economics”, profile “International Finance (in English)”, profile “International business of energy companies” (with a partial implementation in English), face-to-face education, programme of training the bachelors.

# List of planned results of learning the educational programme (list of competences) with indicators of their achievement and planned results of learning the course

The course “Decision making methods” ensures the development of the following competences: **ПКН-3, ПКН-6.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Competence code** | **Name of the competence** | **Indicators of achieving the competence** | **Results of learning (abilities, skills and knowledge), combined with the competences/indicators of achieving the competence** |
| PKH-3 | Ability to gather, process statistical data and perform statistical data analysis, apply mathematical methods to solving standard financial and economic problems and interpret the results in a professional environment (PC-3) | 1. Gathers, processes statistical data and performs statistical data analysis to solve financial and economic problems.  2. Makes mathematical descriptions of financial and economic problems, moves from economic descriptions of problems to mathematical models.  3. Uses a systemic approach to selecting mathematical methods and information technology for solving specific financial and economic problems in a professional environment.  4. Examines the results of the analysis of financial and economic problems’ mathematical models and makes quantitative and qualitative conclusions and recommendations for financial and economic decision-makers using the results obtained. | 1.To know the basic tools to find and collect the information you need  To be able to find, visualize, and prepare data to solve a problem.  2.To know the basic characteristics of models and methods of decision theory  To be able to choose a model and method depending on the task at hand.  3.To know the basic methods of analysisl, related to cooperation, conflict, negotiation, auction bidding and other strategic situations in business  To be able to formalize real economic and business situations. |
| PC-6 | Ability to offer solutions to workplace problems in the changing financial and economic environment | 1. Understands the content and logic of the economic entity examination procedure, methods used to substantiate operational, tactical and strategic managerial decisions.  2. Offers solutions to workplace problems in the presence of uncertainty. | 1. To know decision-making techniques to justify operational, tactical and strategic management decisions.  To be able to choose a model and apply the method.  2.To know how to apply theoretical analysis to strategic business scenarios.  To be able to identify and evaluate standard strategic situations in business and other social conditions. |
| PKP-4 | Ability to perform professional duties to assess the efficiency of the decisions aimed at managing and regulating the basic structure elements of the international business of the energy companies | 1. Takes part in building a system of the key efficiency indicators of the international projects  2. Prepares analytical materials to assess the effectiveness of the foreign economic activities  3. Takes part in arranging Due Diligence  4. Takes part in supporting international transactions | 1. To know the basic principles and methods of assessment the level of efficiency and competitiveness of the investment projects in the international energy markets  To be able to analyze and interpret information and statistical data connected with realization of the investment projects in the international energy markets, and on this basis to develop a system of financial and economic indicators to assess the level of its viability and efficiency  2. To know the basics of conducting foreign economic activities  To be able to arrange the settlements on export and import transactions and to execute operations with international credits and various international securities  3. To know the basic principles of conducting Due Diligence of various types of international transactions and investment projects  To be able to find, select, analyze and interpret various sources of information for conducting Due Diligence in the international energy markets  4. To know the basics of preparing and realizing various types of international transactions with participation of energy corporations  To be able to prepare necessary information and documentation connected with realization of the international transactions aimed at arranging financing the activities of energy corporations |
| UC-3 | Ability to use foreign language skills at a level that is sufficient for interpersonal communication, learning and professional activities. | 1. Uses a foreign language in interpersonal communication and in a professional activity selecting the appropriate verbal and non-verbal means of communication.  2. Realizes communicative intentions in a foreign language in a verbal and written form using modern information communication technologies. | 1.To know the lexicon of professional activity  To be able to use a foreign language in professional activities.  2.To know modern information and communication technologies  To be able to communicate in a foreign language |

# The place of the course in the structure of the educational programme

The course “Decision-Making Methods” is an optional course aimed at deeper learning the profile of the educational programme

The course “Decision-Making Methods” bases on the knowledge gained from learning the previous training courses, such as “Mathematics”, “Audit and Risk Assessment”, and “Economy of Organizations”.

# The volume of the course in credits and in academic hours with an allocation of the class volume (lectures, seminars) and independent work of the students (in the semester, in the credit period)

The total workload of the course is 3 units.

Form of interim attestation - credit.

Form of control – a test.

|  |  |  |
| --- | --- | --- |
| **Type of educational activities on the course** | **Total**  **(in credits and hours)** | **Term 4**  **(in hours)** |
| **Total labour input of the course** | **3/108 hrs.** | **108 hrs.** |
| ***Contact work- Classes*** | **34** | **34** |
| *Lectures* | **16** | **16** |
| *Seminars* | **18** | **18** |
| ***Independent work*** | **74** | **74** |
| Type of current control | Test | Test |
| Type of interim attestation | Credit | Credit |

# Content of the course in accordance with the themes (sections) of the course indicating volume (in academic hours) and types of training sessions

## Content of the course

**1.** **Decision-making methods characteristic**

History of the decision making theory. Decision making methods: purposes and tasks, structure and content. Elements of the decision making process. Classification of models and decision-making methods. Static and dynamic games. Simultaneous move games. Antagonistic games. Information in Games. Definition of Games in Normal Form.

**2. Math model of a conflict**

Mathematical model of a conflict and its characteristics. Decision-making environment. Concepts of certainty, risk and uncertainty of an environment. Decision-making support tools.

**3. Decision making under Certainty**

Optimal solution of two-person zero-sum games. Prisoner’s Dilemma, Battle of the Sexes, the Chicken game. Nash Equilibrium. Maxmin and Minmax Strategies. Mixed strategies, Removal of Dominated Strategies. Linear, non-linear and discrete programming. Coalition and cooperative games.

**2. Multi-criterion selection tasks**

Multi-criterion optimization. Multi-criterion assessment methods. Pareto optimization. The quantitative and qualitative criteria.

**3. Decision Making under Uncertainty**

Games against Nature. Uncertainty about payoffs. Bayesian games. Information Sets. Extensive Form with Chance Moves. Strategies and Equilibria. Minimax criteria.

* 1. **Учебно-тематический план**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| № | **Course themes** | **Volume in hours** | | | | | | **Forms of current control of performance** |
| **Total** | **Classes** | | | | **Independent studies** |
| Total | Lectures | Seminars | Interactive studies |
| 1. | Decision making methods  characteristic | 24 | 10 | 2 | 4 | 4 | 10 | Survey, discussion |
| 2. | Math model of a conflict | 24 | 6 | 2 | 2 | 2 | 16 |
| 3. | Decision making under certainty | 30 | 6 | 4 | 6 | 4 | 20 |
| 4. | Multi-criterion selection tasks | 26 | 6 | 4 | 2 | 2 | 18 |
| 5. | Decision Making under uncertainty | 18 | 6 | 4 | 4 | 2 | 10 |
|  | Total, hrs. | 108 | 34 | 16 | 18 | 14 | 74 | Tests |
|  | Total, % |  |  | 47% | 53% | 41 % |  |  |

## Content of seminars

|  |  |  |
| --- | --- | --- |
| **Course themes** | **Issues to discuss at the seminars, practical exercises, recommended sources from the parts 8,9 (the part and sequence number of the source are specified)** | **Forms of studies** |
| Decision making methods  characteristic | 1. History of the decision making theory. Decision making methods: purposes and tasks, structure and content. Elements of the decision making process. Classification of models and decision-making methods. Static and dynamic games. Simultaneous move games. Antagonistic games. Information in Games. Definition of Games in Normal Form.  Рекомендуемые источники: п.8, [1]; п.9, [11-13] | Интерактивная форма, Практикум по решению задач по тематике занятия в малых группах (2-4 студента) и коллективное обсуждение решений |
| Math model of a conflict | 2. Mathematical model of a conflict and its characteristics. Decision-making environment. Concepts of certainty, risk and uncertainty of an environment. Decision-making support tools.  Рекомендуемые источники: п.8, [2], [4], [8]; п.9, [6-10] | Интерактивная форма, Практикум по решению задач по тематике занятия в малых группах (2-4 студента) и коллективное обсуждение решений |
| Decision making under certainty | 3. Optimal solution of two-person zero-sum games. Prisoner’s Dilemma, Battle of the Sexes, the Chicken game. Nash Equilibrium. Maxmin and Minmax Strategies. Mixed strategies, Removal of Dominated Strategies. Linear, non-linear and discrete programming. Coalition and cooperative games.  Рекомендуемые источники: п.8, [2], [3], [8], п.9, [1-5] | Интерактивная форма, Практикум по решению задач по тематике занятия в малых группах (2-4 студента) и коллективное обсуждение решений |
| Multi-criterion selection tasks | Multi-criterion optimization. Multi-criterion assessment methods. Pareto optimization. The quantitative and qualitative criteria.  Рекомендуемые источники: п.8, [2], [8], п.9, [2-4] | Интерактивная форма, Практикум по решению задач по тематике занятия в малых группах (2-4 студента) и коллективное обсуждение решений |
| Decision Making under Uncertainty | 4. Games against Nature. Uncertainty about payoffs. Bayesian games. Information Sets. Extensive Form with Chance Moves. Strategies and Equilibria. Minimax criteria.  Рекомендуемые источники: п.8, [5], [7], п.9, [8-10] | Интерактивная форма, Практикум по решению задач по тематике занятия в малых группах (2-4 студента) и коллективное обсуждение решений |

# Training and methodological guidance for independent study of the course students

## Forms of extra-curricular independent study

|  |  |  |
| --- | --- | --- |
| **Course themes** | **List of issues for independent study** | **Forms of extra-curricular independent study** |
| Decision making methods characteristic | Classification of models and decision-making methods. | Study of recommended textbooks and training manuals, search for appropriate information in the Internet |
| Math model of a conflict | Decision-making support tools. The quantitative and qualitative criteria. | Study of recommended textbooks and training manuals, search for appropriate information in the Internet |
| Decision making under certainty | Decision-making models in industry | Study of recommended textbooks and training manuals, search for appropriate information in the Internet |
| Decision Making under Uncertainty | Savage criteria | Study of recommended textbooks and training manuals, search for appropriate information in the Internet |

## Methodological guidance for curricular and extra-curricular independent study

**Issues to discuss and independently study**

For the upcoming planting season, the farm can plant corn (a1), plant wheat (a2), plant soybeans (a3), or use the land for grazing (a4). The payoffs associated with the different actions are influenced by the amount of rain: heavy rainfall (s1), moderate rainfall (s2), light rainfall (s3), or drought season (s4). The payoff matrix (in thousands of dollars) is estimated as

s1 s2 s3 s4

a1 -20 60 30 -5

a2 40 50 35 0

a3 -50 100 45 -10

a4 12 15 IS 10

Develop a course of action for the farm.

A student should describe a diagram of calculations with a result at every step.

# Fund of assessment tools for interim attestation of the course students

The list of competences developed in studying the course is in the section 2 “Planned results of studying the education programme (list of competences) with the indicators of their achievement and planned results of the course study”.

The criteria of scoring of various forms of current control of performance are in the appropriate methodological recommendations of the responsible departments.

The current control is performed during the training process and consulting the students, and in accordance with the results of completed independent works. The main forms of the current knowledge control are:

* discussion of the seminar topics and control issues;
* solving the tests, writing the control work;
* taking part in the discussion on the problem situations in order to learn to draw conclusions, make recommendations and make adequate management decisions;
* discussion of the results.

The interim attestation is carried out in the form of attestation. The attestation is carried out either in an oral or in a written form answering the questions contained in the section 7.3 “Typical control tasks or other materials necessary to assess knowledge and skills”.

The assessment of the students’ knowledge is given in points taking into account:

* marks for the work during the semester (marks for control works, answers to questions, participation in discussion at the seminars, etc.);
* marks for the attestation.

The allocation of the maximum points according to the work types is as follows:

|  |  |  |
| --- | --- | --- |
| № | Work types | Points |
| 1. | Work during the semester | 40 |
| 2. | Attestation | 60 |
| 3. | Total: | 100 |

The assessment of knowledge based on the 100 points scale is conducted in accordance with the regulations of the Financial University.

|  |  |
| --- | --- |
| Requirements regarding results of the course study | Mark or attestation |
| 86-100 points | Excellent |
| 70-85 points | Good |
| 51-69 points | Satisfactory |
| 50 points and less | Unsatisfactory |
| Less than 50 points | Credit |
| 50 points and more | Non-credit |

The course mark is based on the average mark including all competences to be developed when studying the course that is a mandatory requirement. The “non-credit” mark means the competence is not developed.

## 7.2 Typical control tasks or other materials necessary to assess knowledge and skills

**Typical profession oriented tasks**

* 1. An investor has 10000 rubles and thinks to invest it in a risky asset (stocks), which either brings 20% return (if the company performance is good) or zero return (if the company performance is bad). Or to invest in a safe asset (government bonds), which brings 10% return in a year. Construct a payoff matrix, that helps him to choose a decision.
  2. Two football teams beat penalties. Each team has two hits. In this series, a draw is possible; after two strikes of each team, the series ends up with some outcome. Draw a tree view for the game.
  3. There are two candidates A and B for an office, and N voters, N > 3 and odd. A majority of voters prefer A to win. Is there a strictly/weakly dominated action? What are the Nash equilibria of the game?
  4. Firm A is going to produce a product. If it enters the market, firm B will lose 10 %. If both firms get into the price war, then firm A loses 7%. In case, firm A does not enter the market and firm B cooperates, then both would earn nothing. Construct a payoff matrix, characterizing this economic situation.

**Typical test tasks**

1. Draw an extensive form for a payoff matrix. Eliminate dominated strategies for both players.
2. Write a payoff matrix for the tree view and solve the game.
3. Consider the Stag hunting game with two players and two strategies. Write a payoff matrix and find optimal strategies.
4. Find mixed strategies of a game and its profit.
5. Define optimal strategies of a bimatrix game.
6. Write the primal and dual forms of a game and find saddle points.
7. One left a heritage to his sons. They decided to split the heritage and did bids. Calculate the shares of each son using Sealed Bids method.
8. Use the linear programming method to find a solution of a game.
9. Describe the algorithm of highlighting economically sustainable coalitions in a cooperative game

**Typical control questions for the credit**

1. The min-max theorem for finite matrix games
2. The normal form of games
3. Overview of game theory (Rationality, Common Knowledge; Look forward, Reason back)
4. Static games and Nash Equilibrium: Simultaneous moves, discrete strategies, continuous strategies
5. Applications to industrial organizations (price setting; quantity setting; location choice)
6. Dominant strategies; rationalizability; mixed strategies
7. Extensive-form games, subgame-perfect Nash equilibrium, solving via backward induction
8. Tacit coordination, threats and promises for cooperation; Limits to cooperation
9. Bargaining; Trust; Reciprocity
10. Static Games with Incomplete Information; Bayes-Nash equilibrium; Auctions
11. Duality. Linear programming task.

# List of basic and supplementary training literature necessary to learn the course

**а) basic:**

1. Dixit, A.K. Games of Strategy / A.K. Dixit, S. Skeath., 2nd Ed., W. W. Norton & Company. 2004.– 688 p.
2. Watson, J. Strategy: An Introduction to Game Theory /J. Watson W. W. Norton & Company. 2002. – 432 p.
3. Aliprantis, C.D. Games and Decision Making /C.D. Aliprantis, S.K. Chakrabarti. – Oxford University Press, 2010. – 480 p.
4. Dixit, A.K. The Art of Strategy: A Game Theorist's Guide to Success in Business and Life / A.K. Dixit, B.J. Nalebuff. W. W. Norton & Company 2008. – 512 p.
5. Taha, Hamdy A. Operations research: an introduction /H.A. Taha. - 10th ed. Pearson, USA, 2016. - 500 p.  
   **б) additional:**
6. Лабскер Л.Г. Вероятностное моделирование в финансово-экономической области [электронный ресурс]: учебник / Л.Г. Лабскер. — М.: ИНФРА-М, 2017. — 172 с.— ЭБС: Znanium
7. Лабскер Л.Г. Экономические игры с природой. Практикум с решениями задач: учебник / Л.Г.Лабскер, Н.А.Ященко. — М.: КНОРУС, 2017. — 506 с. — ЭБС: Book.ru
8. Невежин В.П. Исследование операций и принятие решений в экономике: сборник задач и упражнений: учебное пособие для вузов / В.П. Невежин, С. И. Кружилов, Ю. В. Невежин.— М.: Форум, НИЦ ИНФРА-М, 2015. — 400 с. — ЭБС: Znanium
9. R. Savani, B. von Stengel. Game Theory Explorer – Software for the Applied Game Theorist. Computational Management Science 2012. - p. 5-33.

# List of Internet resources necessary to learn the course

* + 1. Electronic library http://elib.fa.ru/ (http://library.fa.ru/files/elibfa.pdf)
    2. Electronic library BOOK.RU http://www.book.ru
    3. Electronic library <http://biblioclub.ru/>
    4. Electronic library Znanium http://www.znanium.com
    5. Electronic library http://lib.alpinadigital.ru/en/library
    6. Electronic library https://e.lanbook.com/
    7. Electronic library https://www.biblio-online.ru/
    8. Electronic library eLibrary.ru <http://elibrary.ru>
    9. Computer Mathematics System Matlab <https://matlab.ru>
    10. Game Decision Guide. GitHub repository. <https://github.com/gambitproject/gte/wiki>

# Guidance instructions for the students to learn the course and complete various forms of independent work

It is recommended for students:

- to bring the literature recommended by the teacher for the specific seminar;

- prior to the next seminar study the theoretical material of the appropriate topic using basic and supplementary training literature;

- to use not only lectures and training literature, but also legal documents and legal practice materials when preparing for the seminars;

- to combine theoretical material with legal norms, as it can be changed and amended, and it may be not always reflected in the training literature;

- at the start of the seminar ask the teacher on the problem material and tasks for independent solving;

- at the seminar give exact and clear substantive answers.

# Certified programme and hardware information protection facilities

* Windows, Microsoft Office;
* Encyclopedia: <http://ru.wikipedia.org/wiki/Wiki>
* Econometric R package and RStudio interface, Matlab computer mathematics system, Game Theory Explorer <http://www.gambit-project.org/>

# Description of physical infrastructure necessary to ensure learning the course

To ensure learning the course it is necessary to have an audiovisual equipment in the audience.