MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
CENTRAL UKRAINIAN NATIONAL TECHNICAL UNIVERSITY
FACULTY OF ACCOUNTING AND FINANCE

DEPARTMENT OF FINANCE, BANKING AND INSURANCE

ACTUARIAL CALCULATIONS

METHODICAL RECOMMENDATIONS FOR THE STUDY OF DISCIPLINE
by applicants of institutional form of higher education on educational level «Master»
specialty 072 «Finance, banking and insurance»

KROPYVNYTSKYI 2022

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CONTENT

INTRODUCTION

The variability of the economic environment requires the business entities to make balanced management decisions of a strategic and tactical nature. For insurers, the validity of management decisions is based on the accuracy, adequacy and correctness of the calculated insurance rates, determined by actuarial calculations.

The absence of specialists who are well aware of the peculiarities of actuarial calculations in insurance, at the macro level leads to misunderstanding and ignoring the opportunities of the insurance market in the economic and social development of the country. The result is: adoption of laws and regulations in the field of insurance, contrary to the economic essence and logic of its existence; errors in taxation of insurance companies; in the regulation of their finances and risk management; delay in the pace of integration processes into the European Union and the international space in the field of insurance and misunderstanding of the processes that taking place there.

At the level of insurance companies, insufficient professionalism of employees in the field of actuarial calculations leads to significant mistakes in the choice of risk management' strategy and tactics; to the development of insurance products that don't meet the real needs of potential insurers; to calculate insurance tariffs, which don't cover the true level of risk, due to the inadequacy and incompleteness of the primary statistical database, which leads to the choice of a non-optimal method of actuarial assessment for the analyzed risks.

Thus, the need for qualified specialists who understand the specific features of actuarial risk management is evident both at the macro- and micro-level.

The purpose of the discipline «Actuarial calculations» is the formation of a system of theoretical and practical knowledge on the theory and practice of calculating tariff rates as the basis of the insurance company and the formation of insurance reserves to ensure the stability of operations on risk and accumulative types of insurance.

The subject of the discipline is the theoretical and practical basis of actuarial calculations, the adequate and accurate application of the tools of which ensures the

financial stability of insurance companies, the balance and financial reliability of the fulfillment by insurance companies of their obligations under the concluded contracts on risk and cumulative types of insurance.

The tasks of the discipline are aimed at forming competence among higher education applicants: the study and understanding of basic concepts and specific terms in insurance, systems of mathematical and statistical regularities that regulate the relationship between the insurer and insurants, the basics of actuarial activity in insurance, issues of financial stability of insurance company.

The discipline «Actuarial calculations» refers to the number of selective disciplines and allows to form a comprehensive understanding of the scientific bases of actuarial calculations, to familiarize and instill practical skills in applying the tools of actuarial calculations to determine the size of insurance tariffs, funds and reserves of the insurance company in order to ensure its profitability and financial stability.

The discipline «Actuarial calculations» is based on a preliminary study of the disciplines «Investment», «Statistics», «Insurance», «Finance», «Insurance management», «Financial mathematics», etc.

1. CONTENT OF THE DISCIPLINE «ACTUARIAL CALCULATIONS»

Theme 1. The essence of actuarial calculations. Tariff rate and insurance statistics

History of actuarial calculations.

Etymology of the word «actuary». International Actuaries Congresses. Tasks of actuarial services.

Tasks and classification of actuarial calculations.

Basic definitions. Insurance calculation. The main tasks of actuarial calculations. Classification of actuarial calculations by insurance industry, time of conduct, hierarchical equality.

Tariff rate structure. Insurance premium.

Tariff rate and its structure. Gross rate and net rate. Insurance costs and their classification. Insurance premium (insurance premium). Division of the insurance premium by purpose, nature of risks, form of payment, time of payment, reflection in the balance of the insurer.

Indicators of insurance statistics.

Insurance statistics as an analysis of certain indicators. Determination of calculation indicators. Frequency of insurance events. Coefficient (degree) of loss. Devastation of the insurance event (risk cumulation coefficient). Loss of Sum insured. The rate of loss. Average insurance amount for one object (contract) of insurance. Average insurance amount for one affected object.

Recommended literature

1. Kinash O.M., Sorokivskyi V.M., Papka (Sorokivska) M.V. Fundamentals of actuarial calculations. Lviv: Ivan Franko National University of Lviv, 2012. 188 p.

2. Kovtun I. O., Denysenko M. P., Kabanov V.G. Basics of actuarial calculations: textbook. K.: VD «Professional», 2008. 480 p.

3. Kozmenko O.V., Kuzmenko O.V. Actuarial calculations: textbook. Sumy: University Book, 2014. 224 p.

4. Patsuriya N. Legal regulation in the field of insurance and reinsurance: problems of theory and practice. Monograph. K.: Lira, 2017. 256 p.

5. Sokyrynska I. G., Zhuravleva T.O., Abernichina I. G. Insurance management: textbook. Dnipropetrovsk, Porohy, 2016. 300 p.

Theme 2. Actuarial calculations toolkit

Effective interest rate.

The concept of the effective interest rate. Income from investment. Increased (accumulated) amount.

A scheme of simple interest and complex interest.

Total income. Accumulated amount. The final interest rate. The formula of simple interest. Formula of complex interest.

Effective interest rate on time.

The concept of the effective interest rate on a partial time interval. Accumulation processes.

Nominal interest rate.

The concept of the nominal interest rate. Interest accrual period (rotation period, conversion period).

Intensity of interest.

The concept of the interest intensity (growth strength, percentage strength).

Recommended literature

1. Kozmenko O.V., Kuzmenko O.V. Actuarial calculations: textbook. Sumy: University Book, 2014. 224 p.

2. Kopych I. M., Sorokivskyi V.M., Cherkasova S.V., Sorokivska M.V. Actuarial calculations: textbook. Lviv: Novyi Svit, 2019. 214 p.

3. Haletska Z. P., Dovhenko Ya. O. Fundamentals of actuarial mathematics. Kropyvnytskyi: V. Vynnychenko CUDPU, 2018. 180 p.

Theme 3. Models of individual claims

Discrete models of individual claims.

Discrete values and probabilities. Mean, variance, average quadratic deviation, variation coefficient.

Structured models of individual claims.

Random variable distribution and event injector. Distribution of factors influence on the amount of damage.

Continuous models of individual claims.

Uniform distribution. Exponential distribution. Pareto distribution. Gamma distribution.

Randomization of distributions.

Individual claim from the position of the portfolio as a single whole. Change distribution parameters.

Modeling of special conditions of insurance agreements.

Limited amount of refund. Compensation threshold.

Recommended literature

1. Bazylevich V.D. Insurance: workshop. K., Znannia, 2011. 607 p.

2. Bazylevich V.D. Insurance: textbook. K., Znannia, 2012. 1019 p.

3. Kozmenko O.V., Kuzmenko O.V. Actuarial calculations: textbook. Sumy: University Book, 2014. 224 p.

4. Kopych I. M., Sorokivskyi V.M., Cherkasova S.V., Sorokivska M.V. Actuarial calculations: textbook. Lviv: Novyi Svit, 2019. 214 p.

Theme 4. Models of claims' dynamics

Static model for the number of claims in a fixed period of time.

Assumptions of a statistical model. Binomial distribution. Poisson's theorem.

Dynamic model for the number of claims in a fixed period of time.

Interaction of the number of claims. Stationary and residency of the process of claims' receipt. Poisson division.

Negative binomial distribution.

Distribution of the number of claims in a fixed period of time. The main numerical characteristics of the negative binomial distribution.

Recommended literature

1. Bazylevich V.D. Insurance: workshop. K., Znannia, 2011. 607 p.

2. Bazylevich V.D. Insurance: textbook. K., Znannia, 2012. 1019 p.

3. Kozmenko O.V., Kuzmenko O.V. Actuarial calculations: textbook. Sumy: University Book, 2014. 224 p.

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5. Haletska Z. P., Dovhenko Ya. O. Fundamentals of actuarial mathematics. Kropyvnytskyi: V. Vynnychenko CUDPU, 2018. 180 p.

Theme 5. Calculation of tariffs for life insurance contracts

Features of building a tariff rate on life insurance and its structure.

Tariff rate. Gross rate. Net rate. Load. Structure of the tariff rate of mixed life insurance: life insurance; insurance in case of death; accident insurance.

Mortality table.

Methodology for compiling mortality tables.

The rate of profitability.

The concept of the rate of profitability. Table of percentage factors. Discounting multiplier. Table of discount multipliers

Tariff rates for mixed life insurance.

Net rate on life. Net rate in case of death. Net rate in case of disability. Load.

Annual net rate.

Special installment odds (annuities). Installment ratio. Formula for calculating annual net bets for living.

Gross rate.

Formula gross rate.

Analytical laws of mortality.

Model de Muavra. Model Gompertz. Model Makeham. Weibull model.

Recommended literature

1. Gorbach L.M., Kadebska E.V. Insurance: textbook. K.: Condor-Publishing, 2016. 544 p.

2. Govorushko T.A., Stetsyuk V.M. Insurance: textbook. K., «Magnolia 2006», 2014. 328 p.

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Theme 6. Life insurance reserves

Reserve of long-term liabilities.

Net bonus reserve and its modification. Basic requirements for the procedure of modifying the net bonuses' reserve. Reserve of costs for conducting business. Reserve alignment. Reserve of bonuses. Requirements for the basis of mathematical reserves' calculation.

Reserve of proper payments of insurance amounts.

Reserve of declared losses, but not settled. Reserve of arised losses, but not declared. Regulations on the formation of reserves for life insurance and its constituent elements.

Recommended literature

1. Gorbach L.M., Kadebska E.V. Insurance: textbook. K.: Condor-Publishing, 2016. 544 p.

2. Kopych I. M., Sorokivskyi V.M., Cherkasova S.V., Sorokivska M.V. Actuarial calculations: textbook. Lviv: Novyi Svit, 2019. 214 p.

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4. Haletska Z. P., Dovhenko Ya. O. Fundamentals of actuarial mathematics. Kropyvnytskyi: V. Vynnychenko CUDPU, 2018. 180 p.

Theme 7. Determination of tariffs for general insurance contracts

General principles of insurance premiums' calculation. The main part of the net rate. Partial damage. The value of the loss factor of insurance amounts in insurance calculations.

Calculation of tariffs based on the average value, tendencies of loss. Effect of sample size on the values of risk load.

Franchise and liability limit. Set of independent risks. Load and gross bonus on general insurance.

Recommended literature

1. Gorbach L.M., Kadebska E.V. Insurance: textbook. K.: Condor-Publishing, 2016. 544 p.

2. Kozmenko O.V., Kuzmenko O.V. Actuarial calculations: textbook. Sumy: University Book, 2014. 224 p.

3. Kopych I. M., Sorokivskyi V.M., Cherkasova S.V., Sorokivska M.V. Actuarial calculations: textbook. Lviv: Novyi Svit, 2019. 214 p.

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5. Haletska Z. P., Dovhenko Ya. O. Fundamentals of actuarial mathematics. Kropyvnytskyi: V. Vynnychenko CUDPU, 2018. 180 p.

Theme 8. Insurance reserves for risk types of insurance

Content and structure of technical reserves in accordance with international and national legislative standards.

Reserve of unearned bonuses. The procedure for forming of the unearned premiums' reserve by insurers of Ukraine. Methods for calculating of the unearned premiums' reserve.

Reserve of losses. Types of reserve losses. The procedure for the formation of the losses' reserve according to the known requirements of insurers. The procedure for determining of the reinsurer' part in the reserve of losses.

Reserve of loss fluctuations. Normative level of payments. Calculation of loss on the reporting date.

Disaster reserve. Order of disaster reserve's formation.

Order of other reserves' formation.

Recommended literature

1. Gorbach L.M., Kadebska E.V. Insurance: textbook. K.: Condor-Publishing, 2016. 544 p.

2. Kopych I. M., Sorokivskyi V.M., Cherkasova S.V., Sorokivska M.V. Actuarial calculations: textbook. Lviv: Novyi Svit, 2019. 214 p.

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4. Haletska Z. P., Dovhenko Ya. O. Fundamentals of actuarial mathematics. Kropyvnytskyi: V. Vynnychenko CUDPU, 2018. 180 p.

Theme 9. Risk reduction by reinsurance

Essence, types and functions of reinsurance.

The concept of reinsurance. Cedent. Healing. Cessia. Retrocession. Retrocessionary. The cost of reinsurance. Coefficient of professor F.V. Konshin. Types of reinsurance.

Reinsurance as a risk management method.

Total claim. Probability of the insurance company's ruin.

Risk diversification by reinsurance.

Overall risk level. Model Vasichek. Covariance of random values. Method of Lagrange multipliers. Lagrange function.

Recommended literature

1. Kopych I. M., Sorokivskyi V.M., Cherkasova S.V., Sorokivska M.V. Actuarial calculations: textbook. Lviv: Novyi Svit, 2019. 214 p.

2. Kuzmenko O.V., Boyko A.O., Koibichuk V.V., Bozhenko V.V. Actuary calculations: lectures' compendium. Sumy: Sumy State University, 2019. 225 p.

3. Patsuriya N. Legal regulation in the field of insurance and reinsurance: problems of theory and practice. Monograph. K.: Lira, 2017. 256 p.

4. Haletska Z. P., Dovhenko Ya. O. Fundamentals of actuarial mathematics. Kropyvnytskyi: V. Vynnychenko CUDPU, 2018. 180 p.

Theme 10. Model of insurance market participants' balance

Analysis of the insured person's balance.

Mathematical model of the client. Balance of the insurance company's client.

Analysis of the insurance company's tactics.

The profit of the insurance company and its usefulness. Neutrality to the risk of the insurance company. Terms of the insurance company's profitability.

Recommended literature

1. Kopych I. M., Sorokivskyi V.M., Cherkasova S.V., Sorokivska M.V. Actuarial calculations: textbook. Lviv: Novyi Svit, 2019. 214 p.

2. Kuzmenko O.V., Boyko A.O., Koibichuk V.V., Bozhenko V.V. Actuary calculations: lectures' compendium. Sumy: Sumy State University, 2019. 225 p.

3. Haletska Z. P., Dovhenko Ya. O. Fundamentals of actuarial mathematics. Kropyvnytskyi: V. Vynnychenko CUDPU, 2018. 180 p.

Distribution of study hours for the discipline «Actuarial calculations»

Theme	Hours' amount for		
	lectures	practical	independent work
Theme 1. The essence of actuarial calculations. Tariff rate and insurance statistics	2	1	2
Theme 2. Actuarial calculations toolkit	2	1	2
Theme 3. Models of individual claims	4	2	4
Theme 4. Models of claims' dynamics	4	2	4
Theme 5. Calculation of tariffs for life insurance contracts	4	2	4
Theme 6. Life insurance reserves	4	2	4
Theme 7. Determination of tariffs for general insurance contracts	4	2	4
Theme 8. Insurance reserves for risk types of insurance	4	2	4
Theme 9. Risk reduction by reinsurance	4	2	4
Theme 10. Model of insurance market participants' balance	4	2	4
Total per semester	36	18	36

2. PLANS OF PRACTICAL CLASSES FOR DISCIPLINE «ACTUARIAL CALCULATIONS»

Theme 1. The essence of actuarial calculations. Tariff rate and insurance statistics.

Theme 2. Actuarial calculations toolkit

Plan

1. Tasks and classification of actuarial calculations.
2. Tariff rate structure. Insurance premium.
3. Indicators of insurance statistics.
4. Effective and nominal interest rate.
5. A scheme of simple interest and complex interest.
6. Effective interest rate on time.
7. Intensity of interest.

Key terms and concepts

Actuary, insurance service, insurance calculation, tariff rate, insurance premium, insurance costs, calculation indicators, effective interest rate, accrual period, increased (accumulated) amount, simple interest, complex interest, nominal interest rate, accumulation process

Example of test tasks for preliminary knowledge control

1. The tariff rate is:

1) the form in which the expenses for certain insurance are calculated

2) the price of insurance risk and other expenses, adequate monetary expression of the insurer's obligations with the concluded insurance contract

3) mathematical justification of the necessary costs for conducting business by the insurer and forecasting trends in their development

2. Net bonus is:

1) risk premium

2) accumulated contribution

3) net premium

4) gross premium

3. The insurance premium's part that is required to cover insurance payments for a certain period of time for a certain type of insurance is:

11) risk premium

2) accumulated contribution

3) net premium

4) gross premium

4. Actuarial calculations are classified according to the insurance industry by:

1) payments from personal insurance

2) reporting calculations

3) planned calculations

4) regional calculations

5. According to the nature of risks, insurance premiums are divided into:

1) natural and permanent

2) simultaneous and current

3) risky and accumulative

4) transitional and effective

Control questions

1. Determine the effective interest rate.

2. What is the accrual period?

3. What is the main task of actuarial services?

4. Give a definition of the actuarial calculations' concept.

5. Name the main tasks of actuarial calculations.

List of recommended sources

1. Kinash O.M., Sorokivskyi V.M., Papka (Sorokivska) M.V. Fundamentals of actuarial calculations. Lviv: Ivan Franko National University of Lviv, 2012. 188 p.

2. Kovtun I. O., Denysenko M. P., Kabanov V.G. Basics of actuarial calculations: textbook. K.: VD «Professional», 2008. 480 p.

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4. Patsuriya N. Legal regulation in the field of insurance and reinsurance: problems of theory and practice. Monograph. K.: Lira, 2017. 256 p.

5. Sokyrynska I. G., Zhuravleva T.O., Abernichina I. G. Insurance management: textbook. Dnipropetrovsk, Porohy, 2016. 300 p.

Theme 3. Models of individual claims

Plan

1. Discrete models of individual claims.
2. Structured models of individual claims.
3. Continuous models of individual claims.
4. Randomization of distributions.
5. Modeling of special conditions of insurance agreements.

Key terms and concepts

Individual claim, discrete model of individual claim, numerical characteristics of individual claim, insurance event indicator, structured model of individual claim, continuous model of individual claim, distribution function, distribution density, uniform distribution, exponential distribution, Pareto distribution, gamma distribution, randomization of distributions

Typical tasks

1. The probability of getting into an accident for an insured car worth 100 000 UAH equals q = 0.0003. In case of accident, the cost of damages Y is evenly divided from zero to the full cost of the car. Calculate the expectation and variance of the value of the claim X.

2. The insurance company pay offspring in case of the client's death from an accident b1 = 10 000 UAH, and in case of death from "natural causes" b2 = 5000 UAH. The probability of death within a year from an accident q1 = 0. 004, and the probability of death within a year from "natural causes" q2 = 0.01. Calculate the basic numerical characteristics of an individual claim.

3. The amount of damage for a car accident (provided that the accident occurred) may have an exponential distribution with an average value of 10 000 UAH. The insurance company has set the upper limit of its payments, which is equal to 20 000 UAH. Calculate the expected value of the claim that was actually filed.

Control questions

1. Why can the claim's value be described as a random value?

2. What is the distribution of the individual claim's value, if the distribution of the claim's value is given, what will be really filed, and the distribution of the insurance event's indicator?

3. What is the Pareto density?

List of recommended sources

1. Bazylevich V.D. Insurance: workshop. K., Znannia, 2011. 607 p.

2. Bazylevich V.D. Insurance: textbook. K., Znannia, 2012. 1019 p.

3. Kozmenko O.V., Kuzmenko O.V. Actuarial calculations: textbook. Sumy: University Book, 2014. 224 p.

4. Kopych I. M., Sorokivskyi V.M., Cherkasova S.V., Sorokivska M.V. Actuarial calculations: textbook. Lviv: Novyi Svit, 2019. 214 p.

Theme 4. Models of claims' dynamics

Plan

1. Static model for the number of claims in a fixed period of time.
2. Dynamic model for the number of claims in a fixed period of time.
3. Negative binomial distribution.

Key terms and concepts

The process of claims, static model for the number of claims for a fixed period of time, dynamic model for the number of claims for a fixed period of time, Poisson distribution, Poisson process, negative binomial distribution

Typical tasks

1. The insurance company provides insurance for 10,000 customers in case of illness. During the year, statistics were collected on the number of claims that was filed by the insurance policies' owners. It turned out that 8103 clients did not file claims at all, 1515 appealed to the company once, 331 two times, 39 three times, 10 four times, and two clients filed claims five times. Choose the model that preferably describes the actual number of transactions with a certain claims' number.

Control questions

1. What are the assumptions for the simplest model that describes the process of claims' receipt?
2. In what cases, the binomial distribution can be approximated by Poisson's?
3. What does stationarity, residency and lack of postponement of the receipt claims process mean?
4. What are the main numerical characteristics of the negative binomial distribution?

5. Why the claim's value can be described as a random value?

List of recommended sources

1. Bazylevich V.D. Insurance: workshop. K., Znannia, 2011. 607 p.

2. Bazylevich V.D. Insurance: textbook. K., Znannia, 2012. 1019 p.

3. Kozmenko O.V., Kuzmenko O.V. Actuarial calculations: textbook. Sumy: University Book, 2014. 224 p.

4. Kopych I. M., Sorokivskyi V.M., Cherkasova S.V., Sorokivska M.V. Actuarial calculations: textbook. Lviv: Novyi Svit, 2019. 214 p.

5. Haletska Z. P., Dovhenko Ya. O. Fundamentals of actuarial mathematics. Kropyvnytskyi: V. Vynnychenko CUDPU, 2018. 180 p.

Theme 5. Calculation of tariffs for life insurance contracts

Plan

1. Features of building a tariff rate on life insurance and its structure.
2. Mortality table.
3. The rate of profitability.
4. Tariff rates for mixed life insurance.
5. Annual net rate.
6. Gross rate.
7. Analytical laws of mortality

Key terms and concepts

Gross rate, net rate, load, life, mortality, accident, rate of profitability, disposable net rate, annual net rate, annuity, Gompertz model, de Muavra model, Maykham model, Weibull model

Typical tasks

1. Calculate the probability for a thirty-year-old man not to live to 65 years.

2. For a person of 45 years to calculate: 1) the probability of living next year; 2) the probability of dying during the coming year of life; 3) the probability of living next two years; 4) the probability of dying within the next two years; 5) the probability of dying in the third year of life.

3. Determine the contribution's amount, if the child (girl) up to 18 years is expected to pay in the amount of 10000 UAH. Annual interest rate - 5%.

4. Calculate a one-time gross premium for the insured (male) at the age of 44 years, that was insured on mixed life insurance for a period of five years. The rate of profitability is 8%. Insure sum - 25 000 UAH. The share of the load in the gross rate is 10%.

5. Calculate a one-time gross premium for pure living for a period of 6 years for a man aged 41 years from an insurance sum of 28 000 UAH for an annual interest rate of 5%. Purchase costs are 1.9% of the insurance sum, charges for collecting payments - 2.9% of the payment amount, administrative expenditures - 0.7% of the insurance sum of the policy's annual validity.

Control questions

1. What are the features of building life insurance tariffs?
2. Give a definition of the term «rate of profitability».
3. Give the definition of a one-time net rate on life insurance.
4. Give the definition of a one-time net rate in case of death.
5. Describe the concept of annual net rate.

List of recommended sources

1. Gorbach L.M., Kadebska E.V. Insurance: textbook. K.: Condor-Publishing, 2016. 544 p.

2. Govorushko T.A., Stetsyuk V.M. Insurance: textbook. K., «Magnolia 2006», 2014. 328 p.

3. Kozmenko O.V., Kuzmenko O.V. Actuarial calculations: textbook. Sumy: University Book, 2014. 224 p.

4. Kopych I. M., Sorokivskyi V.M., Cherkasova S.V., Sorokivska M.V. Actuarial calculations: textbook. Lviv: Novyi Svit, 2019. 214 p.

Theme 6. Life insurance reserves

Plan

1. Net bonus reserve.
2. Reserve of costs for conducting business.
3. Reserve alignment.
4. Reserve of bonuses.
5. Reserve of declared losses, but not settled.
6. Reserve of arised losses, but not declared.

Key terms and concepts

Reserve, costs, losses, bonuses, alignment, mathematical reserves, adjusted losses, reserve alignment, declared losses, arised losses, net bonus reserve, business

Example of test tasks for preliminary knowledge control

1. Insurers are obliged to create and keep records of the following reserves for life insurance:

1) loss reserve

2) reserve of long-term obligations;

3) reserve of unearned bonuses;

4) reserve of insurance amounts' proper payments.

2. The type of assets that most fully corresponds to the liquidity principle is:

1) real estate

2) cash on the current account

3) bank deposits

4) equities

3. Current insurance legislation of Ukraine divides insurance reserves into:

1) mandatory and voluntary

2) reserves of short-term and long-term liabilities

3) risky and not risky

4) technical and mathematical

4. To change the list of insurance reserves and the procedure for their calculations can:

1) State Commission for Regulation of Financial Services Markets

2) The Law of Ukraine «On Insurance»

3) Cabinet of Ministers of Ukraine

4) Ministry of Finance of Ukraine

5. Free reserves of the insurer are formed by:

1) retained profit

2) authorized capital

3) reserve capital

4) additional capital

Control questions

1. What is life insurance reserve?

2. Describe the disaster reserve.

3. What are the main requirements for the procedure of the net bonus reserve's modifying?

4. What are the requirements for the basis of mathematical reserves' calculation?

5. Name the components of the provisions on the formation of reserves for life insurance.

List of recommended sources

1. Gorbach L.M., Kadebska E.V. Insurance: textbook. K.: Condor-Publishing, 2016. 544 p.

2. Kopych I. M., Sorokivskyi V.M., Cherkasova S.V., Sorokivska M.V. Actuarial calculations: textbook. Lviv: Novyi Svit, 2019. 214 p.

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4. Haletska Z. P., Dovhenko Ya. O. Fundamentals of actuarial mathematics. Kropyvnytskyi: V. Vynnychenko CUDPU, 2018. 180 p.

Theme 7. Determination of tariffs for general insurance contracts

Plan

1. Basics of tariff calculation.
2. The basic principles of the insurance premium's calculating.
3. Upper limit of expected losses and risky surcharge.
4. Determination of tariff rates for new types of insurance.

Key terms and concepts

Tariff rate, tariff net rate, insured event, probability of insured event, unprofitability, risk surcharge, average arithmetic loss, variation coefficient, selectivity coefficient, predictable level of insurance development

Typical tasks

1. Net rate for home property insurance is determined in the amount of 0.20 UAH from 100 UAH insure sum, and load items constitute: costs for entering the business (including remuneration of insurance agents) - 0,06 UAH; the cost of preventive measures - 4% gross rate; profit - 15% gross rate. Determine the amount of the gross rate.

2. Determine the main part of the tariff net rate and net of insurance in case of death as a result of an accident. The probability of the insured event during the year is p = 0.002, the insure sum S = 10 000 UAH.

3. Determine the main part of the tariff net rate when insurance against fire, if the probability of the insured event is p = 0.013, the average value of the object destruction degree is b = 0.5.

4. Determine the ratio of risks (the ratio of the average insurance sum of the burning object to the insured average sum of the insured object) on the basis of the following data: the number of insured yards — 220 000, the insurance amount - 990000000 UAH, the number of yards that burned - 1100, the insurance amount of yards that burned and damaged by fire - 4510000 UAH.

5. Determine the tariff net rate and net contribution for insurance in case of death as a result of an accident. The probability of an insured event during the year p = 0.002, the insurance sum S = 10000 UAH, the number of insured objects n = 3000, the level of security guarantee is $\gamma = 0.95$.

6. Determine the tariff net rate for insurance against fire, if the probability of the insured event p = 0.013, the number of insured objects n = 500, the average value of the object destruction degree b = 0.5, the average deviation from the average value is 0.2. The level of security guarantee to take equal $\gamma = 0.9$.

Control questions

1. What are the methods of calculating net rates on mass risk types of insurance?
2. What is the net rate for?
3. What is a risk surcharge?
4. In what cases is quantitative risk assessment possible?
5. What is the loss of insure sum?

List of recommended sources

1. Gorbach L.M., Kadebska E.V. Insurance: textbook. K.: Condor-Publishing, 2016. 544 p.

2. Kozmenko O.V., Kuzmenko O.V. Actuarial calculations: textbook. Sumy: University Book, 2014. 224 p.

3. Kopych I. M., Sorokivskyi V.M., Cherkasova S.V., Sorokivska M.V. Actuarial calculations: textbook. Lviv: Novyi Svit, 2019. 214 p.

4. Sokyrynska I. G., Zhuravleva T.O., Abernichina I. G. Insurance management: textbook. Dnipropetrovsk, Porohy, 2016. 300 p.

5. Haletska Z. P., Dovhenko Ya. O. Fundamentals of actuarial mathematics. Kropyvnytskyi: V. Vynnychenko CUDPU, 2018. 180 p.

Theme 8. Insurance reserves for risk types of insurance

Plan

1. Content and structure of technical reserves in accordance with international and national legislative standards.
2. Reserve of unearned bonuses.
3. Methods for calculating of the unearned premiums' reserve.
4. Types of reserve losses.
5. The procedure for the formation of the losses' reserve according to the known requirements of insurers.
6. Reserve of loss fluctuations.
7. Order of the disaster reserve's formation.
8. Order of other reserves' formation.

Key terms and concepts

Technical reserves, unearned bonuses, disaster reserve, loss reserve, "1/365" method, 24 share method, 8 share method, RUP for premium paid in installments

Typical tasks

1. On August 1, the insurance company concluded an insurance contract for the first year with a one-time premium payment of 60 000 UAH. The share of the insurance premium intended for payment of commissions for the contract conclusion is 20%, the share of deductions for preventive measures is 10%. Determine the reserve of the unearned premium: 1) at the end of the III quarter; 2) at the end of the year.

2. Calculate the RuP by 24 particles. The insurance contract is considered to be concluded within August:

1) 3/24 of the year passed before the reporting date (October 1).

2) 9/24 of the year passed before the reporting date (January 1).

3. On August 1, the insurance company concluded an insurance contract for the first year with a one-time premium payment of 60 000 UAH. The share of the insurance premium intended for payment of commissions for the contract conclusion is 20%, the share of deductions for preventive measures is 10%. The insurance premium is made in two methods: the first half of the award - during the contract conclusion, the second - three months after: 1) before the reserve' assessment, half of the technical premium was made, 2) before the reserve' assessment, the entire technical premium was made.

Control questions

1. Describe the main types of reserves insurance company.
2. Give a definition of the concept «technical reserve».
3. What is the essence of the unearned bonuses' reserve.
4. Describe the methods of insurance reserves' formation.
5. What is the loss reserve? What are its components?

List of recommended sources

1. Gorbach L.M., Kadebska E.V. Insurance: textbook. K.: Condor-Publishing, 2016. 544 p.

2. Kopych I. M., Sorokivskyi V.M., Cherkasova S.V., Sorokivska M.V. Actuarial calculations: textbook. Lviv: Novyi Svit, 2019. 214 p.

3. Sokyrynska I. G., Zhuravleva T.O., Abernichina I. G. Insurance management: textbook. Dnipropetrovsk, Porohy, 2016. 300 p.

4. Haletska Z. P., Dovhenko Ya. O. Fundamentals of actuarial mathematics. Kropyvnytskyi: V. Vynnychenko CUDPU, 2018. 180 p.

Theme 9. Risk reduction by reinsurance

Plan

1. Concepts, types and functions of reinsurance.
2. Reinsurance as a risk management method.
3. Total claim. Probability of the insurance company ruin.
4. Risk diversification by reinsurance.
5. Overall risk level.
6. Model Vasichek.
7. Covariance of random values.

Key terms and concepts

Reinsurance, cedent, cession, retrocession, retrocessionary, own cedent maintenance, scarcity of funds, risk transfer method, obligatory insurance, optional insurance, optional-obligatory reinsurance

Example of test tasks for preliminary knowledge control

1. Reinsurance is:

1) insurance of the risk that the insurer took over

2) insurance of risk that the reinsurer took over

3) insurance of the risk that the co-insurer took over

4) economic mechanism of risk redistribution

2. Choose the right statements:

1) cedent - somebody who takes the risk of reinsurance

2) cession - the process of transferring a risk or part of it

3) retrocession - the process of further transfer of this risk to the next reinsurer

4) retrocessionary - insurer that reinsures the taken risks

3. The theoretical basis for determining the degree of funds scarcity probability is:

1) coefficient of professor F.V. Konshin

2) the sum for which the insurer has the right to conclude contracts for this type of insurance

3) coefficient of financial stability

4) the amount of funds in reserve funds

4. Choose the right answer:

1) optional reinsurance is used in the presence of particularly significant, dangerous risks with the possibility of cumulation of losses and possible catastrophic consequences

2) obligatory reinsurance involves the mandatory transfer to reinsurance of the previously agreed risk share on all coatings, determination of the limit of liability, reinsurance commission, restrictions on coverage

3) optional-obligatory reinsurance is characterized by a certain freedom of the parties to the reinsurance agreement, the possibility of regulation by the insurer of the amount of own maintenance.

5. Types of proportional form of reinsurance are:

1) quota

2) the excedent of the sum

3) quota- excedent

4) loss excedent

Control questions

1. Give a definition of «reinsurance».

2. Describe the scheme of insurance risk transmission.

3. Define the concepts of cession and retrocession.

4. Give the components of the reinsurance cost.

5. What are the types of reinsurance operations by risk transfer method?

List of recommended sources

1. Kopych I. M., Sorokivskyi V.M., Cherkasova S.V., Sorokivska M.V. Actuarial calculations: textbook. Lviv: Novyi Svit, 2019. 214 p.

2. Kuzmenko O.V., Boyko A.O., Koibichuk V.V., Bozhenko V.V. Actuary calculations: lectures' compendium. Sumy: Sumy State University, 2019. 225 p.

3. Patsuriya N. Legal regulation in the field of insurance and reinsurance: problems of theory and practice. Monograph. K.: Lira, 2017. 256 p.

4. Haletska Z. P., Dovhenko Ya. O. Fundamentals of actuarial mathematics. Kropyvnytskyi: V. Vynnychenko CUDPU, 2018. 180 p.

Theme 10. Model of insurance market participants' balance

Plan

1. Mathematical model of the client.
2. Balance of the insurance company's client.
3. Analysis of the insurance company' tactics.
4. Neutrality to the risk of the insurance company.
5. Terms of the insurance company's profitability.

Key terms and concepts

Customer behavior variants, expected utility derivative function, risk neutrality, expected profit

Control questions

1. Describe the customer behavior.model.
2. What are the possible behaviors of the insurance company client?
3. What are the conditions of customer behavior model balance?

4. Define the concept «insurance company profit».

5. What will be the insurance company activity if it is neutral to risk?

List of recommended sources

1. Kopych I. M., Sorokivskyi V.M., Cherkasova S.V., Sorokivska M.V. Actuarial calculations: textbook. Lviv: Novyi Svit, 2019. 214 p.

2. Kuzmenko O.V., Boyko A.O., Koibichuk V.V., Bozhenko V.V. Actuary calculations: lectures' compendium. Sumy: Sumy State University, 2019. 225 p.

3. Haletska Z. P., Dovhenko Ya. O. Fundamentals of actuarial mathematics. Kropyvnytskyi: V. Vynnychenko CUDPU, 2018. 180 p.

3. INDEPENDENT WORK OF APPLICANTS

The organization of the study process in the discipline «Actuarial calculations» involves independent study of certain program material by the applicants.

Independent work consists in the study of scientific literary sources on theoretical and practical aspects of determining tariff rates, insurance funds and reserves.

The goal of independent work is to increase the effectiveness of the educational process by organizing outside the classroom training according to the personal abilities and professional interests of each applicant. At the same time, teachers provide guidance and control over the performance of the tasks received by the applicants.

Themes for independent work of applicants:

1. Classification of actuarial calculations.
2. International Actuaries Conventions (ISA).
3. Principles of differentiation of insurance rates.
4. Insurance costs.
5. Randomization of distributions.
6. Limited amount of refund.
7. Gamma distribution.
8. Paretto distribution.
9. Compensation threshold
10. Distribution of individual amounts of payments on applications.
11. Properties of mixed Poisson distribution.
12. Approximation of the distribution of the payments random sum on applications.
13. Negative binomial distribution.
14. Mortality table.
15. The norm of profitability, its concept.
16. Tablet of percentage multipliers. Discounting multiplier.
17. Analytic laws of mortality.

18. General requirements for mathematical reserves' calculating.

19. General requirements for the calculation of the insurance sum proper payments reserve.

20. Modification of the net bonus reserve.

21. Requirements for the basis of mathematical reserves' calculation.

22. Calculation of the risk premium.

23. Methods of tariff factors' selection.

24. Use of utility function in actuarial calculations.

25. Determination of insurance tariff in autoinsurance.

26. Formation of the unearned bonuses' reserve.

27. Formation of reserve of declared but not paid losses.

28. Formation of reserve losses that have arisen but are not declared.

29. Formation of loss oscillations reserve.

30. Disaster reserve.

31. Determination of the amount of deferred acquisition costs.

32. Reinsurance of exceeding expenses.

33. Lundberg inequality.

34. Asymptotic Kramer-Lundberg.

35. Containment limit.

4. THEMES, REQUIREMENTS FOR ABSTRACTS

Writing and formatting of the abstract is carried out in accordance with the standard of registration of text documents DSTU 3008-2015 «Documentation. Reports in the field of science and technology. Structure and design rules» on sheets format A4 (210 × 297 mm). Font Times New Roman Cyr normal, font size - 14pt, line spacing - 1,5. The margins of the sheet should be: on the left - 30 mm, on the right - at least 10 mm; top and bottom - at least 20 mm. Page numbering is done in arabic numerals in the right corner of the header.

The amount of the abstract should not exceed 12 pages.

The abstract should have a clear construction, a logical sequence of arguments, accuracy of formulation, validity of conclusions and recommendations, verbatim rewriting of materials and quoting of literary sources is not allowed to fill the required number of pages.

The structure contains (in the order of enumeration):

- title sheet;
- CONTENT;
- INTRODUCTION;
- the main part;
- CONCLUSIONS;
- LIST OF USED SOURCES.

Headings of structural parts «CONTENT», «INTRODUCTION», «1. ITEM NAME», «CONCLUSIONS», «LIST OF USED SOURCES», printed in capital letters in the center relative to the text.

The distance between the item header and the text should be 1 line spacing.

The CONTENT of the abstract is given at the beginning. The content corresponds to the scheduled abstract, the only difference is the indication of page numbers.

The table of contents is located on the second page with the title «TABLE OF CONTENTS». The content is generated automatically using the function Word Links > Content.

In front of each part name of the abstract, indicate the page number from which it begins. All digital page marks must be placed in one line.

INTRODUCTION reveals the essence and state of the scientific problem (relevance of the abstract), the purpose and content of the tasks. The amount is 0.5 sheet.

The main part contains the key aspects that reveal the purpose and objectives of the abstract, a characteristic of the basic issues being investigated.

The information presented in the abstract should be accurate, transparent and consistently highlighted. In order to confirm the authenticity, it is necessary to make references to the relevant sources in the abstract.

The main part involves a direct presentation of the content of the abstract theme, a deep and comprehensive coverage of its main provisions. It contains:

a) review of literature on the theme;

b) processing of analytical information.

The review of literature on the abstract theme is the theoretical basis of the problem being studied and is used to argue, generalize and deepen the main provisions of the theme, concretize further proposals.

The recommended amount of each item is from 3 to 4 sheets.

The abstract must be typed on the computer and printed on one side of the sheet.

Each ITEM of the abstract begins with a new page. The text is preceded by the title of the part (title), written in headings.

In the presence of diagrams, graphs, diagrams, etc. they should be called figures. Illustrations are marked with the word «Fig.» and are numbered sequentially within the box. The number of the illustration consists of a serial number of the illustration.

For example: Fig. 2. The number of the illustration, its name and explanatory captions are placed sequentially under the illustration and in the middle.

For example:

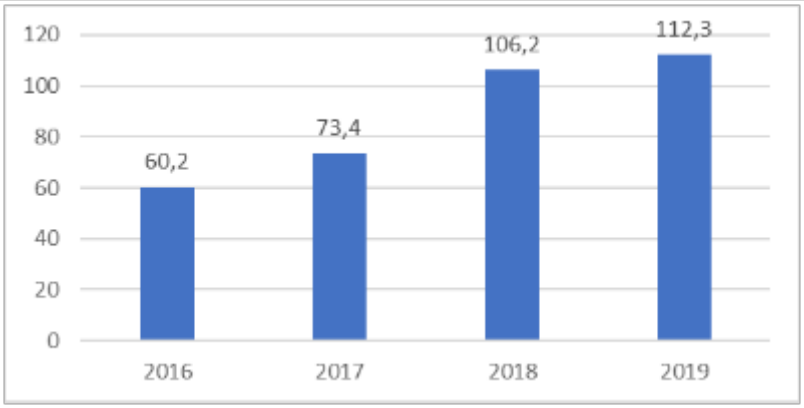

Fig 2. Dynamics of income tax revenues to the Consolidated Budget of Ukraine

Tables are also numbered sequentially within the item. In the upper right corner above the corresponding title of the table place the inscription «Table» indicating its number. The table number consists of a serial number of the table, between which a point is placed, for example: «Table 1». The name of the table is placed in the next row in the middle and the font is selected in bold. For example:

Table 1

The main directions of Western schools of management theory

Period of development	**Scientists**	**Main scientific schools**
60-70s	Gvishiani D., Kunz G., Chandler A., Simon H.	Process (classical); Human relations; Social systems; Empirical; Quantitative; Cooperative systems.
70-80s	Greenwood W., Williams O., Woodward D.	Production and personnel management; Comparative theories. Theories of administration. Scientific management; Process.

When moving part of the table to another sheet, the word «Table» and its number point once to the right above the first part of the table, the words «Continuation of the table» are written above the other parts and indicate a number, for example: «Continuation of table 1».

Formulas are numbered within a item. The formula number consists of the ordinal number of the formula in the abstract. Formula numbers are written near the right side

of the sheet at the level of the corresponding formula in parentheses in Arabic numerals, for example: (3)

$$Вр = \frac{ОВ}{Чр}, \quad (3)$$

де, Вр – average annual production of one worker;
ОВ – volume of production;
Чр – average number of workers.

Only the formulas referenced in the text should be numbered. Others are not recommended to number.

The CONCLUSIONS outline the most important generalizations, scientific conclusions, practical recommendations to which the author reached in the process of solving the chosen scientific problem. Further, the conclusions and recommendations on the scientific and practical use of the obtained results are formulated. The amount is 0.5 sheets.

THE LIST OF USED SOURCES is placed after the conclusions on the work on the through numbering. The list should indicate only the sources that were directly used by the author when writing the abstract, and not all viewed on the subject of the source.

The list of sources is placed in alphabetical order the names of the first authors or titles, in chronological order (not less than 2 sources and not more than 5 sources).

Bibliographic description of the sources in accordance with DSTU 8302:2015 «Information and documentation. Bibliographic link. General requirements and rules of drawing up» and submitted in the original language.

Information about the sources included in the list should be given in accordance with the requirements of the state standard with the mandatory naming of works. For example:

LIST OF USED SOURCES

1. Franco Modigliani and Merton H. Miller The American Economic Review Vol. 49, № 4 (Sep., 1959), pp. 655-669.
2. Бланк И. А. Основы финансового менеджмента. Київ: Ника-Центр, Эльга, 2004. 624 с.
3. Воробьв Ю.М. Особливості формування фінансового капіталу підприємств. *Фінанси України*. №4. 2010. С. 77–85.
4. Опешко Н.С. Управління достатністю капіталу страхових компаній: дис. ... канд. екон. наук : 08.00.08 / Харківський національний університет будівництва та архітектури. Харків, 2016. 391 с.
5. Про акціонерні товариства: Закон України від 17 вересня 2008 р. №514-IV Дата оновлення: 10.01.2020. URL: https://zakon.rada.gov.ua/laws/show/514-17

Abstracts themes:

1. Actuary as an insurance entity.
2. Bayes' decisive rule.
3. Classification of life insurance contracts.
4. Stages of actuarial calculations development in the world and in Ukraine.
5. Foreign practice of building insurance rates.
6. Actuarial calculations in maritime insurance.
7. Non-state pension schemes: concept, classification.
8. Net rate formation in insurance of additional pension.
9. Calculation of net bonuses when using various pension schemes.
10. Legal regulation of actuaries.
11. Assessment of the insurer’s risk and ways its reduction.
12. Analysis of the insurer’s behavior in the insurance market.
13. Essence and types of annuities.
14. Calculation of premiums in rent insurance contracts.
15. Actuarial calculations in reinsurance.
16. Properties of net bonuses.
17. Determination of risk level in actuarial calculations.

18. Periodic bonuses.
19. The main financial indicators in actuarial calculations.
20. Methods for determining damage in property insurance.
21. Insurance sum in the personal insurance contract.
22. Damage in personal insurance.
23. Actuarial calculations in life insurance.
24. Insurance company stability.
25. Utility function.

5. APPROXIMATE QUESTIONS FOR FINAL CONTROL OF THE DISCIPLINE «ACTUARIAL CALCULATION»

1. History of actuarial calculations.
2. Problems and classification of actuarial calculations.
3. Tariff rate structure and its structure.
4. Insurance costs.
5. Insurance premium.
6. The concept of the effective interest rate.
7. A scheme of simple interest. The formula of simple interest.
8. Scheme of complex interest. Accumulation processes.
9. Nominal interest rate: concept.
10. The concept of interest intensity.
11. The concept of risk, its place in insurance.
12. Classification of insurance risks, evaluation methods.
13. Method of individual assessments.
14. Medium value method.
15. Interest method.
16. Modeling risks in insurance.
17. Distribution of losses. Uniform distribution.
18. Distribution of payments. Total payments on the portfolio.
19. Comparison of risk situations.
20. Signs and parameters of the insurance portfolio.
21. Homogeneous insurance portfolio. Homogeneity ratio. Homogeneity criteria.
22. Formalization of models
23. Large number of contracts in the portfolio, consisting of the same risks.
24. Small number of contracts in the portfolio, consisting of the same risks.
25. Determination of the probability of using the company's obligations on the portfolio of property insurance contracts.
26. Determination of the irregularity probability at any time.

27. Security surcharge.
28. Insurer reserves. Types of reserves.
29. Order of reserves' formation.
30. Methods of reserves' forming.
31. Reserve of unearned premium for one-time insurance premium.
32. Reserve of unearned bonus for the premium, packed in installments.
33. Calculation of loss on reporting data.
34. Assessment of investment income.
35. Features of the tariff rate building for life insurance.
36. The tariff rate structure of mixed life insurance.
37. Mortality table.
38. The norm of profitability, its concept.
39. Table of percentage factors. Discounting multiplier.
40. Analytical laws of mortality.
41. The concept of reinsurance.
42. Types of reinsurance.
43. Probability of the insurance company ruin.
44. Risk diversification by reinsurance.
45. Overall risk level.
46. Pareto distribution.
47. Gamma distribution.
48. Balance of the insurance company client.
49. Analysis of the insurance company tactics.
50. Accumulation processes.

6. SYSTEM OF CURRENT AND FINAL CONTROL OF KNOWLEDGE IN THE DISCIPLINE «ACTUARIAL CALCULATIONS»

Current control

Objects of current control of knowledge of applicants are:

- current testing and surveys;
- individual task in the form of the abstract.

When controlling the systematic and activity of work at seminar classes, the assessment is subject to: the level of knowledge demonstrated in answers and speeches at seminar classes; activity in the discussion of issues delivered to seminar classes, the correctness of writing written control at the seminar; results of the pilot survey.

During the control over the implementation of individual tasks for self-evaluation are subject to: preparation and presentation of abstracts, as well as participation in the scientific student conference of the Central Ukrainian National Technical Univercity (section of the Department of Finance, Banking and Insurance).

Final control of the discipline «Actuarial calculations» is carried out in the form of the semester exam. The assessment of the final semester control in the form of the exam is the sum of points based on the results of ruble controls and points scored by the higher education applicant during the semester exam. The total number of points allocated for the semester exam by the working program of the discipline is 40 points. The number of points received by the higher education applicant in the exam is added to the results of the ruble controls, which together constitutes the assessment of the knowledge of the applicant of higher education in the discipline on a 100-point scale and is translated into an assessment on the ECTS scale and the national scale («Excellent», «Good», «Acceptably», «Unacceptably»).

The total assessment for the study of the discipline is exhibited on the national and ECTS scale.

Knowledge of higher education applicants is evaluated during the examination control both on theoretical and practical training according to the following criteria:

− "excellent" - the applicant of higher education perfectly learned theoretical material, deeply and comprehensively knows the content of the curriculum, the main provisions of scientific sources and recommended literature, logically thinks and builds answers, freely uses the acquired theoretical knowledge in the analysis of practical material, expresses his attitude to certain problems, demonstrates a high level of mastering practical skills;

− "good" - the applicant of higher education has well learned theoretical material, reasonably teaches it, possesses the basic aspects of primary sources and recommended literature, has practical skills, expresses his thoughts on certain problems, but assumes certain inaccuracies and errors in the logic of presentation of theoretical content or in the analysis of practical material;

− "acceptably" - the applicant of higher education, basically, has theoretical knowledge of the curriculum, oriented in primary sources and recommended literature, but unconvincingly answers, additional questions cause uncertainty or lack of stable knowledge; answering questions of practical nature, shows inaccuracies in knowledge, does not know how to evaluate facts and phenomena, associate them with future activities;

− "unacceptably" - the applicant of higher education has not mastered the educational material of the discipline, does not know scientific facts, definitions, is hardly oriented in the primary sources and recommended literature, there is no scientific thinking, practical skills are not formed. To translate the final assessment for the study of the educational discipline expressed in the scores into the examination (credits) assessment on the national scale and in the examination (credits) assessment on the ECTS scale, a scale is used.

Table 1

Correspondence of the ECTS assessment scale to the national evaluation system

Evaluation by the ECTS scale	Definition	Evaluation	
		According to the national system	According to the CUNTU system
A	EXCELLENT - excellent execution with only a small number of errors	5 (excellent)	90-100
B	VERY GOOD - above average level with multiple errors	4 (good)	82-89
C	GOOD - generally correct work with a certain number of gross errors		
D	ACCEPTABLY - not bad, but with significant number of disadvantages	3 (acceptably)	64-73
E	ENOUGH - implementation satisfies the minimum criteria		
FX	UNACCEPTABLY - need to work before moving	2 (unacceptably)	35-59
F	UNACCEPTABLY - erious further work is required		

7. LIST OF RECOMMENDED SOURCES

1. Bazylevich V.D. Insurance: textbook. K., Znannia, 2012. 1019 p.

2. Bazylevich V.D. Insurance: workshop. K., Znannia, 2011. 607 p.

3. Govorushko T.A., Stetsyuk V.M. Insurance: textbook. K., «Magnolia 2006», 2014. 328 p.

4. Govorushko T.A. Insurance services. Textbook. K.: Center for Educational Literature, 2017. 376 c.

5. Holod A., Felenchak Yu. Insurance in tourist activity: training. in 2 p. Lviv: LDUFK , 2016. 156 c.

6. Gorbach L.M., Kadebska E.V. Insurance: textbook. K.: Condor-Publishing, 2016. 544 p.

7. Kinash O.M., Sorokivskyi V.M., Papka (Sorokivska) M.V. Fundamentals of actuarial calculations. Lviv: Ivan Franko National University of Lviv, 2012. 188 p.

8. Kozmenko O.V., Kuzmenko O.V. Actuarial calculations: textbook. Sumy: University Book, 2014. 224 p.

9. Kopych I. M., Sorokivskyi V.M., Cherkasova S.V., Sorokivska M.V. Actuarial calculations: textbook. Lviv: Novyi Svit, 2019. 214 p.

10. Kovtun I. O., Denysenko M. P., Kabanov V.G. Basics of actuarial calculations: textbook. K.: VD «Professional», 2008. 480 p.

11. Kuzmenko O.V., Boyko A.O., Koibichuk V.V., Bozhenko V.V. Actuary calculations: lectures' compendium. Sumy: Sumy State University, 2019. 225 p.

12. Patsuriya N. Legal regulation in the field of insurance and reinsurance: problems of theory and practice. Monograph. K.: Lira, 2017. 256 p.

13. Sokyrynska I. G., Zhuravleva T.O., Abernichina I. G. Insurance management: textbook. Dnipropetrovsk, Porohy, 2016. 300 p.

14. Haletska Z. P., Dovhenko Ya. O. Fundamentals of actuarial mathematics. Kropyvnytskyi: V. Vynnychenko CUDPU, 2018. 180 p.

Educational and methodical online edition

ACTUARIAL CALCULATIONS

Methodical recommendations for the study of the discipline

Author-compiler: O. Kotsiurba