



Lodz University
of Technology

Study programme

Faculty:	Faculty of Technical Physics, Information Technology and Applied Mathematics
Major:	Actuarial Sciences and Financial Analysis
Level of study:	first-cycle programme (licencjat)
Form of study:	full-time studies
Academic year:	2026/27

Table of contents

Basic information	3
Learning outcomes (in relation to the PQF)	4
Matrix of course modules in relation to learning outcomes and curriculum content	5
ECTS - subjects	12
ECTS indicators	15
Methods of verifying and assessing learning outcomes	16
Professional internships	17
Characteristics of the course	18
Education program	20

Basic information

Name of the field of study:	Actuarial Sciences and Financial Analysis
Level of study:	first-cycle programme (licencjat)
Study profile:	general academic
Form of studies:	full-time studies
Duration of studies (number of semesters):	6
The number of ECTS points required to complete studies:	180
Total number of hours of classes:	2250
The number of ECTS points a student obtains as part of classes conducted with the direct participation of academic teachers or other persons conducting classes:	90
Professional title awarded to graduates:	licencjat
ISCED code:	0542
Language of study:	polish

Assigning the course to the disciplines to which the learning outcomes relate

Discipline	Percentage share
Maths	91%
Management science and quality	9%

Learning outcomes (in relation to the PQF)

No.	Learning outcome code	Learning Outcome Content	Reference to the universal characteristics of the first level of PRK	Reference to the second-level characteristics of the PRK, taking into account the second-level characteristics enabling the acquisition of engineering competences
1	1AAF1	Knows and understands at an advanced level selected elements of mathematical theories and their complex relationships, enabling the analysis of theoretical and practical actuarial problems.	P6U_W	P6S_WG
2	1AAF2	Knows and understands at an advanced level selected actuarial, financial and economic models and the principles of operation of financial and insurance markets.	P6U_W	P6S_WG
3	1AAF3	Knows and understands at an advanced level the basics of economics, including managerial economics, project management, and running a business, taking into account legal, ethical, and intellectual property protection aspects; understands the social conditions under which financial and insurance markets operate.	P6U_W	P6S_WG, P6S_WK
4	1AAF4	Is able to carry out inferences, including statistical ones and those requiring an unconventional approach, selecting appropriate methods and tools and critically assessing the substantive content of information sources, with the possible support of IT systems.	P6U_U	P6S_UW
5	1AAF5	Can solve advanced business problems using actuarial methods.	P6U_U	P6S_UW, P6S_UK
6	1AAF6	Can participate in debates, including those with socio-economic backgrounds, using critical thinking to assess the credibility of information and the principles of logical justification for their own judgments. Communicates in a foreign language at a minimum level of B2 of the Common European Framework of Reference for Languages, including actuarial terminology.	P6U_U	P6S_UW, P6S_UK
7	1AAF7	Is able to prepare a solution to a problem in the field of applied mathematics, also using proper methods and tools, including IT techniques.	P6U_U	P6S_UW
8	1AAF8	Is able to assume and effectively implement various roles in teamwork and plan and undertake activities aimed at systematically improving one's own competences in the perspective of lifelong learning.	P6U_U	P6S_UO, P6S_UU
9	1AAF9	Is ready to critically evaluate his/her knowledge and skills; during solving cognitive problems in the field of finance, insurance or economics uses possible assistance from specialists.	P6U_K	P6S_KK, P6S_KR
10	1AAF10	Is ready to act in an entrepreneurial manner and to responsibly fulfill professional roles in the finance and insurance market and to initiate activities for the benefit of the social environment.	P6U_K	P6S_KO, P6S_KR

Matrix of course modules in relation to learning outcomes and curriculum content

No.	Course name	Program content	1AAF1	1AAF2	1AAF3	1AAF4	1AAF5	1AAF6	1AAF7	1AAF8	1AAF9	1AAF10
1	Linear Algebra with Elements of Analytic Geometry	Vector spaces. Basis and dimension of a vector space. Linear transformations. Matrices. Solving systems of linear equations. The dot product. Elements of geometry of the three-dimensional real Euclidean affine space.	x			x						
2	Mathematical Analysis I	The field of real numbers. Elementary functions. Number sequences and series. Basics of differential and integral calculus of real functions of one real variable.	x			x						
3	Introduction to R	Elements of the R environment, basic data structures in R: atomic vectors, lists, matrices, and data frames; selected operations: arithmetic, logical, and relational; aggregate functions, types of indexing, filtering atomic vectors, selected operations on lists: combining, unlisting, and replicating, applying functions to all elements of a list, functions from the purrr package; basic string operations; functions and instructions for their invocation, control flow: conditional expressions if and if...else, switch expression, loops: while, for, and the break and next instructions; arrays, creating and indexing arrays, operations on arrays; data frames, functions from the dplyr package, pipelines, importing data into R, data visualization, constructing plots.				x			x			
4	The Logical Principles of Reasoning and Communication	The concept of language and its functions; construction of expressions; expression categories; text; errors in verbal communication of thoughts. Recognition and justification; arising; inference; argumentation; eristic holds.						x			x	
5	Introduction to Mathematics	Propositional, set, and quantifier calculus, including generalized operations; mathematical induction. The Cartesian product and selected relations: orders and functions. Properties of images and preimages of sets obtained by functions.	x									
6	Introduction to Probability Theory	Model of a random experiment with a countable number of possible outcomes. Basic properties of probability. Conditional probability. Independence of events. Random variables with the following distributions: binomial, Poisson, geometric, negative binomial. Expected value and variance. Poisson's theorem on the convergence of the binomial distribution. Random vectors and their characteristics. Covariance and correlation coefficient. Independent random variables. Conditional distributions. Conditional expectation and conditional variance. Law of large numbers.	x			x						
7	Critical Thinking	The idea of critical thinking. The types of names and the basis of concept analysis. Forms and types of definitions. Relations between propositions and propositional calculus. Deductive and inductive reasoning. Types of arguments. Sources of beliefs. Typical flaws of reasoning.						x			x	
8	Introduction to Financial Analysis	Time value of money. Money accumulation models. Annuities certain. Loans and their repayment analysis. Financial investment analysis. Types of bonds, bond valuation, yield to maturity, duration. Treasury bills valuation.		x			x	x				
9	Computer Calculations in Finance	Practical use of spreadsheets for typical business calculations and the creation of actuarial and financial models.		x			x		x			

No.	Course name	Program content	1AAF1	1AAF2	1AAF3	1AAF4	1AAF5	1AAF6	1AAF7	1AAF8	1AAF9	1AAF10
10	Basics of Entrepreneurship	The course combines the fundamentals of entrepreneurship and enterprise operations with technology transfer, with a focus on academic entrepreneurship. Students learn about competitiveness mechanisms, the fundamentals of R&D commercialization, intellectual property instruments, and the identification of legal and business risks. The course outline supports the competencies of an insurance analyst (market, risk, data, and innovation/InsurTech analysis).			x							x
11	English B2 module I	The first part of a business language course with elements of industry-specific terminology; development of all language skills; development and improvement of interpersonal skills oriented around the future working environment of the university graduate.						x				
12	English B2+ module I	The first part of a business language course with elements of industry-specific terminology; development of all language skills; development and improvement of interpersonal skills oriented around the future working environment of the university graduate.						x				
13	English C1 module I	The first part of a business language course with elements of industry-specific terminology; development of all language skills; development and improvement of interpersonal skills oriented around the future working environment of the university graduate.						x				
14	German B2 module I	The first part of a business language course with elements of industry-specific terminology; development of all language skills; development and improvement of interpersonal skills oriented around the future working environment of the university graduate.						x				
15	Probability Theory I	The concept and properties of probability. Conditional probability. Independence of events. Discrete and continuous random variables and their characteristics. Pairs of random variables. Characteristics of random pairs. Conditional expected value.	x			x						
16	Mathematical Analysis II	Limit, continuity, and differentiability of functions of several variables. Extrema of functions of several variables. Convex functions and Taylor's formula for functions of several variables. Multiple integrals, Fubini's theorem, and the change of variables theorems for multiple integrals.	x			x						
17	Elements of Descriptive Statistics	Statistical population, statistical sample, statistical unit, statistical feature. Basic numerical characteristics and methods of their determination; measures of location and dispersion. Sample variance, other sample moments and their interpretation. Grouping data (sample values) into classes. Frequency distribution table. Data distribution analysis. Analysis of dependencies in data. Determination of the covariance matrix and the vector of expectations for a dataset. Elements of statistical inference; applications of selected statistical methods.	x			x						
18	Selected Topics of Mathematical Modelling	Selected, simple applications of ordinary and partial differential equations. Searching for model solutions and/or analyzing them using dedicated solvers. Interpreting the obtained results.	x			x						
19	English B2 module II	The second part of a business language course with elements of industry-specific terminology; development of all language skills; development and improvement of interpersonal skills oriented around the future working environment of the university graduate.						x				

No.	Course name	Program content	1AAF1	1AAF2	1AAF3	1AAF4	1AAF5	1AAF6	1AAF7	1AAF8	1AAF9	1AAF10
20	English B2+ module II	The second part of a business language course with elements of industry-specific terminology; development of all language skills; development and improvement of interpersonal skills oriented around the future working environment of the university graduate.						x				
21	English C1 module II	The second part of a business language course with elements of industry-specific terminology; development of all language skills; development and improvement of interpersonal skills oriented around the future working environment of the university graduate.						x				
22	German B2 module II	The second part of a business language course with elements of industry-specific terminology; development of all language skills; development and improvement of interpersonal skills oriented around the future working environment of the university graduate.						x				
23	Fundamentals of Actuarial Sciences	The theory of survival. Life tables. Life annuities. Risk, excess risk, risk ordering. Basic information on insurance contracts. Basic measures of risk (examples and properties). Basic information on reinsurance (definition, properties). Macaulay duration, application to protection against the risk of changes interest rates.		x			x					
24	Mathematical Analysis III	Conditional extrema: problems with equality and inequality constraints. Ordinary differential equations: separable equations, first and second order linear equations, systems of linear equations.	x			x						
25	Basics of Programming	Algorithmic thinking, algorithmization of problem solving. Basic programming constructs and data structures. Implementation of selected algorithms. Elements of object oriented programming. Selected packages and utility classes.				x			x			
26	Modeling and Valuation of Financial Instruments	Review and characteristics of financial markets. Characteristics of shares (price and value of shares, purchase on credit, short sale, discount model of share valuation). Futures contracts (basic concepts, forward price, contract value). Options (underlying, option price, option price restrictions, basic properties of American options). Financial mathematics of discrete models (basic binomial model, European option valuation, option valuation for fixed dividend instruments). Black - Scholes formula. Sensitivity analysis. Applications of derivatives to cover risk. Construction of investment portfolios - the classic Markowitz Model. CAPM model.		x	x					x	x	
27	Database Fundamentals	Database management systems, SQL, the most popular database architectures and data models. The relational database model, concepts of primary and foreign key. Types of processed data. ACID properties and normalization. Fundamental problems in database design. Query performance optimization. Basic concepts related to transactions in databases.				x			x			
28	Credit Risk	Classification of financial risk, including key banking risks: credit, model, cyber, market, product, liquidity, operational, balance sheet, strategic, reputation, climate and legal risk. Basic principles of cybersecurity when using banking products; the role of the Bank Guarantee Fund. Credit risk factors and basic notions related to it. Value-at-Risk - an introduction. Consumer credit. Conditions for the existence and uniqueness of Internal Rate of Return. Annual Percentage Rate (APR). A credit scoring method; credit risk scorecards. Selected non-scoring methods of risk assessment. Credit risk vs. insolvency risk.		x			x					

No.	Course name	Program content	1AAF1	1AAF2	1AAF3	1AAF4	1AAF5	1AAF6	1AAF7	1AAF8	1AAF9	1AAF10
29	Qualitative and Quantitative Data Analysis	Data analysis and preparation (data types and structure, data quality, missing data, outliers and duplicates), exploratory data analysis (distributions, descriptive statistics, differences between groups), analysis of categorical data and relationships between quantitative and categorical variables, classification using logistic regression (estimation, significance, assessment of model quality), elements of multivariate analysis and clustering.				x						
30	Probability Theory II	Random vectors and their characteristics. Independent random variables. Conditional distributions. Conditional expected value. Strong laws of large numbers. Central limit theorem. Elements of stochastic process theory.	x			x						
31	English B2 module III	The third part of a business language course with elements of industry-specific terminology; development of all language skills; development and improvement of interpersonal skills oriented around the future working environment of the university graduate.						x				
32	English B2+ module III	The third part of a business language course with elements of industry-specific terminology; development of all language skills; development and improvement of interpersonal skills oriented around the future working environment of the university graduate.						x				
33	English C1 module III	The third part of a business language course with elements of industry-specific terminology; development of all language skills; development and improvement of interpersonal skills oriented around the future working environment of the university graduate.						x				
34	German B2 module III	The third part of a business language course with elements of industry-specific terminology; development of all language skills; development and improvement of interpersonal skills oriented around the future working environment of the university graduate.						x				
35	Life Insurance	Interpolation assumptions n survival theory. Basic life insurance products. Single premium for basic life insurances. Periodic premiums. Reserves. Multi-option insurance.		x	x		x			x		
36	Statistics	Statistical space. Empirical distribution function. Order statistics. Sufficient statistics. Classical and Bayesian estimation methods. Confidence intervals. Statistical hypothesis testing. Correlation and regression analysis.	x			x						
37	Intriduction to Time Series	Basic models of time series, classical examples of stationary and non-stationary series, autoregressive models, basic properties of Markov chains, the Galton-Watson branching process.				x						
38	Reporting and Data Visualization	Characteristics of a good report: structure and components, objectives, variety, and flexibility. A report serves as a link between information analysis and analysis-based decisions. Creating a report with elements of simulation, scenarios, and the use of artificial intelligence methods to support data analysis and interpretation. Interactive environments focused on data visualization.				x			x			

No.	Course name	Program content	1AAF1	1AAF2	1AAF3	1AAF4	1AAF5	1AAF6	1AAF7	1AAF8	1AAF9	1AAF10
39	Number Theory with Applications in Cryptography	Basic issues of number theory, divisibility theory and congruence theory, factorization; cryptosystems, classical cryptography, symmetric and asymmetric public-key cryptography paradigm, Diophantine and congruent equations, basic numerical-theoretical algorithms; computational complexity, complexity of factorization problems, discrete logarithm; classic ciphers, structures of the DES and RSA cryptosystem, Rabin, etc., applications of encryption: digital signature, identification protocols, sharing secrets, etc., cryptographic protocols.							x			
40	Elements of Combinatorics and Graph Theory	Counting techniques; the principle of inclusion and exclusion. Variations and combinations without and with repetition. The pigeonhole principle. Recurrence equations. Graphs and basic graph problems. Graph traversal. Trees, spanning trees, counting spanning trees. Graph coloring. Matching in graphs. Permutations, permutation groups.	x						x			
41	Monte Carlo Methods	Modular arithmetic. Pseudorandom number generators: additive, multiplicative, Lehmer, Fibonacci. Testing generators: runs test, monotonic runs test. Generators for different probability distributions: inverse transform method, acceptance method, Box-Muller algorithm. Monte Carlo methods: optimization, EM algorithm.				x						
42	Economics	Economic tools, market, consumer, company, market structures, factor markets, risk, national income, AE model, money market, labor market, and inflation.			x		x				x	
43	Risk Modeling in Insurance	Basic concepts of insurance risk theory. Selected risk models. Selected insurance products and their interpretation. Elements of Credibility Theory - an introduction. Elements of generalized linear models - an introduction.		x	x		x					
44	Financial Investments	The Fisher equality, inflation rate and real rate of interest, Consumer Price Index. Methods repayment of debt: Different payment periods and interest conversion periods, the equivalence rule of debt and installment, prospective and retrospective method, amortization schedules, sinking funds, interest payment in one installment, the current payment of interest and repayment of capital in the last installment, step-rate amounts of principal, real return rate of debt, debt with the additional charge, consolidation loan, types of financial instruments. The concept and classification of shares, the rights of ownership of the shares. The structure of Warsaw stock exchanges, KDPW, UTP system, types of market orders in the UTP system, determination of the equilibrium exchange rate Bond valuation, clean and dirty price, yield to maturity, realized compound yield, current yield, rules for trading in bonds on the Catalyst market.		x	x						x	
45	Professional Ethics and Intellectual Property Protection	The areas of research and the main problems of ethics. The employment codes and ethical standards. The concept of Corporate Social Responsibility. The discussion of the intellectual property protection meaning in the international, European and national law. Selected problems of the industrial property protection.			x							x
46	Managerial Economics	A course that combines economic theory with practical decision-making in business. Students learn tools for analysing demand, costs, revenues, and optimizing decisions under risk and uncertainty. Particular emphasis is placed on the use of quantitative models and statistical methods in evaluating project performance and pricing strategies. The course also covers issues related to market competition, regulation, and the functioning of financial and insurance markets.			x		x				x	
47	English B2 module IV	The fourth part of a business language course with elements of industry-specific terminology; development of all language skills; development and improvement of interpersonal skills oriented around the future working environment of the university graduate.						x				

No.	Course name	Program content	1AAF1	1AAF2	1AAF3	1AAF4	1AAF5	1AAF6	1AAF7	1AAF8	1AAF9	1AAF10
48	English B2+ module IV	The fourth part of a business language course with elements of industry-specific terminology; development of all language skills; development and improvement of interpersonal skills oriented around the future working environment of the university graduate.						x				
49	English C1 module IV	The fourth part of a business language course with elements of industry-specific terminology; development of all language skills; development and improvement of interpersonal skills oriented around the future working environment of the university graduate.						x				
50	German B2 module IV	The fourth part of a business language course with elements of industry-specific terminology; development of all language skills; development and improvement of interpersonal skills oriented around the future working environment of the university graduate.						x				
51	Non-Life Insurance	Individual and collective risk models. Claim's frequency and severity distributions and their estimation methods; discrete, continuous and mixed distributions. Premium calculation methods. Reserves, IBNR reserves, run-off triangle. Chain ladder method. Bonus - malus method. Credibility theory elements. Risk theory elements.		x	x		x				x	
52	Computational Aspects of Functional Inequalities	Numerical verification and visualization of functional inequalities using computational and simulation methods, including the use of Monte Carlo methods to empirically test the validity of selected functional inequalities, such as subadditivity and submultiplicity. Analysis of the concepts of convexity and concavity from the perspective of the minimax theorem. Introduction to stochastic game theory involving functional inequalities, game simulation, and the identification and evaluation of optimal strategies.	x						x			
53	Programming in Data Analysis	Create windowed applications in a modern, object-oriented or functional programming language of your choice. Extract data from local files, remote collections, and web services. Efficiently process large data sets, monitor resource usage, and manage computer memory responsibly.				x			x			
54	Algorithms of Linear Algebra	Selected topics of algebra and their application to computational methods, including algorithms for solving systems of linear equations, finding particular matrix decompositions. Project-based problems include practical task involving the study and implementation selected algorithms in a given programming language (e.g. in Python).	x						x			
55	Summative Module	Revision, consolidation, and expansion of the most important theoretical and applied components of mathematics, with possible inclusion of specialized topics in actuarial mathematics or data analysis. Selected topics in project management, device, product, or process lifecycle analysis, and basic cybersecurity principles.					x		x	x	x	
56	Selected Issues of Mathematical Statistics	Statistical space. Estimators and their properties. Confidence intervals. Testing statistical hypotheses. Regression analysis.				x						
57	Selected Topics of Finance	Interest. Discount. Interest rates. Financial flows. Pensions. Valuation of investment efficiency (NPV, IRR). Zero Coupon Bonds. Coupon bonds. The term structure of interest rates. Duration. Treasury bills. Futures contracts. European options. American options. Investment portfolio. The Markowitz model. CAPM model.		x		x		x			x	

No.	Course name	Program content	1AAF1	1AAF2	1AAF3	1AAF4	1AAF5	1AAF6	1AAF7	1AAF8	1AAF9	1AAF10
58	Selected Topics of Insurance	Survival theory. Life annuities. Basic risk measures. Selected risk models. Premium calculation methods. Reinsurance. Credit insurance.		x		x		x			x	
59	Pension Funds	Classification of pension plans. General rules for valuation of assets and liabilities, optimal amortization of the plan's deficit. Some valuation methods of the assets and liabilities: unit credit method, entry-age-normal method. Random variability of the valuation results and their confidence intervals. Pension plans risk management - risk classification, immunization method of the insolvency risk.		x	x						x	
60	Diploma Seminar	Improving the substantive content related to the prepared thesis and key learning outcomes. Developing public speaking skills through the presentation of selected excerpts from the thesis. Familiarizing students with the research conducted at the Institute of Mathematics. Selected topics in preparation for the competency exam.		x				x	x		x	
61	Finance Psychology	Utility theory and behavioral theory. Cumulative prospect theory. Reference dependence. Risk aversion. Loss aversion. Distorted probabilities. Law of small numbers. Framing effect. Speculative bubbles. Pyramid schemes.									x	x
62	Business Ethics	Research areas and main problems of ethics. Economics and ethics. Moral value of work. Professional codes and ethical standards. Ethical standards of good management. The concept of social responsibility. Ethical aspects of creating a company's image.			x							x
63	Basics of Insurance Law	Introduction to insurance law; the social insurance system in Poland; types of social insurance; parties to the insurance relationship; insurance obligation; social insurance contributions; social insurance benefits; proceedings in insurance matters; control and liability; appeals and protection of insured persons' rights; private insurance; contemporary challenges of the insurance system.			x						x	
64	Internship	Research on the labor market and selection of a workplace suitable. Work during a total time corresponding to a five-day work week for at least six weeks. Performing tasks ordered by the supervisor from the workplace individually or in a team of several people.									x	x
65	Final Project	Independently deepen mathematical and actuarial competencies under the guidance of a supervisor, including developing skills in applying mathematical or economic concepts to practical or theoretical problems, possibly utilizing IT tools and methods. Students conduct a literature review, formulate thesis objectives, identify specific tasks, and select appropriate methods and tools for their implementation. The final stage of the thesis preparation involves developing a coherent text presenting the obtained results or reasoning.							x		x	

ECTS - subjects

No.	Course name	ECTS	Subjects in the field of humanities and social sciences	Elective subjects	Profile items	Classes in a foreign language
1	Linear Algebra with Elements of Analytic Geometry	6			6	
2	Mathematical Analysis I	8			8	
3	Introduction to R	4				
4	The Logical Principles of Reasoning and Communication	3	3			
5	Introduction to Mathematics	3			3	
6	Introduction to Probability Theory	6			6	
7	Critical Thinking	3	3			
8	Introduction to Financial Analysis	5			5	5
9	Computer Calculations in Finance	3		3	3	
10	Basics of Entrepreneurship	2	2			
11	English B2 module I	2		2		
12	English B2+ module I	2		2		
13	English C1 module I	2		2		
14	German B2 module I	2		2		
15	Probability Theory I	5			5	
16	Mathematical Analysis II	6			6	
17	Elements of Descriptive Statistics	4		4		
18	Selected Topics of Mathematical Modelling	4		4		
19	English B2 module II	2		2		
20	English B2+ module II	2		2		
21	English C1 module II	2		2		

No.	Course name	ECTS	Subjects in the field of humanities and social sciences	Elective subjects	Profile items	Classes in a foreign language
22	German B2 module II	2		2		
23	Fundamentals of Actuarial Sciences	4			4	
24	Mathematical Analysis III	5			5	
25	Basics of Programming	4				
26	Modeling and Valuation of Financial Instruments	6			6	
27	Database Fundamentals	4		4		
28	Credit Risk	4		4		
29	Qualitative and Quantitative Data Analysis	4		4		
30	Probability Theory II	5			5	
31	English B2 module III	2		2		
32	English B2+ module III	2		2		
33	English C1 module III	2		2		
34	German B2 module III	2		2		
35	Life Insurance	6			6	
36	Statistics	5			5	
37	Intriduction to Time Series	4				
38	Reporting and Data Visualization	2		2		
39	Number Theory with Applications in Cryptography	3		3		
40	Elements od Combinatorics and Graph Theory	3		3		
41	Monte Carlo Methods	3		3		
42	Economics	5	5		5	
43	Risk Modeling in Insurance	3			3	

No.	Course name	ECTS	Subjects in the field of humanities and social sciences	Elective subjects	Profile items	Classes in a foreign language
44	Financial Investments	4				
45	Professional Ethics and Intellectual Property Protection	2	2			
46	Managerial Economics	5	5		5	
47	English B2 module IV	3		3		
48	English B2+ module IV	3		3		
49	English C1 module IV	3		3		
50	German B2 module IV	3		3		
51	Non-Life Insurance	5			5	
52	Computational Aspects of Functional Inequalities	3		3		
53	Programming in Data Analysis	3		3		
54	Algorithms of Linear Algebra	3		3		
55	Summative Module	8		8		
56	Selected Issues of Mathematical Statistics	4		4	4	
57	Selected Topics of Finance	4		4	4	
58	Selected Topics of Insurance	4		4	4	
59	Pension Funds	3			3	
60	Diploma Seminar	3			3	
61	Finance Psychology	4	4	4		
62	Business Ethics	4	4	4		
63	Basics of Insurance Law	4	4	4		
64	Internship	6				
65	Final Project	10		10		

ECTS indicators

Name	Value
The total number of ECTS credits that a student must obtain through elective courses (amounting to no less than 30% of the total ECTS credits required to obtain the qualification corresponding to the given level of study)	54/180 (30%)
The total number of ECTS credits to be earned by a student through courses in the fields of humanities or social sciences	24
The total number of ECTS credits that a student must obtain from courses related to research conducted at the university, amounting to more than 50% of the total ECTS credits required to graduate from a given level of study	101/180 (56.11%)

Methods of verifying and assessing learning outcomes

Verification of the achieved learning outcomes requires the application of diverse forms of student assessment, appropriate to the categories of knowledge, skills, and social competences to which these outcomes relate. The selection of appropriate tools depends on the specifics of the course and the form of instruction, and is specified in the syllabi of individual courses. The achievement of the required learning outcomes is verified through:

written assignments (exams, quizzes, reports, essays, projects, posters, thesis, etc.);
oral responses (oral knowledge tests, public speaking assignments such as delivering a paper, presentation, etc.);
practical and/or project-based tasks (team-based or individual);
observation and assessment of student activity during classes;
self-assessment and peer assessment (especially in the case of group projects);
a competency exam and a diploma examination.

Verification may be formative (conducted partially and repeatedly during the course) and/or summative (final assessment). The final result of the verification is expressed using the currently applicable grading scale.

The course coordinator or instructor is obliged, during the first class, to discuss the course syllabus and to define and formally communicate to students the methods of verification and the conditions under which learning outcomes will be assessed.

Professional internships

The Professional Internship in the Actuarial Science and Financial Analysis program lasts 6 weeks. The principles and forms of Professional Internship are regulated by the relevant Order of the Rector of Lodz University of Technology (currently Order No. 66/2021 of October 29, 2021). Students receive 6 ECTS credits for completing the Professional Internship.

Characteristics of the course

Graduate profile

Graduates of the Actuarial Science and Financial Analysis program possess advanced mathematical knowledge, which forms the core of the curriculum, 91% of which is allocated to mathematics, supplemented with content from management and quality sciences. The general academic curriculum provides a solid theoretical foundation and prepares students for practical application in the financial and insurance markets. Graduates possess advanced knowledge of probability theory, mathematical statistics, mathematical analysis, and financial and actuarial mathematics. They are familiar with methods of modeling insurance and market risk and understand the mathematical foundations of insurance products and financial instruments. They possess a structured knowledge of the mathematics of life and property insurance, including methods for calculating premiums, technical reserves, and solvency margins. They understand the mechanisms of operation of financial markets and insurance institutions in the context of macro- and microeconomic conditions. They also understand the basic legal regulations governing insurance activities and the institutional framework for the financial sector. Graduates can construct and analyze mathematical models describing financial and insurance phenomena, conduct risk analysis, value financial instruments, and estimate the costs of loans and financial liabilities. They can apply statistical methods to data analysis and utilize IT tools and programming environments (such as Python, R, and Power BI) for data processing, modeling, and visualization. They can interpret the results of quantitative analyses in an economic and regulatory context and formulate conclusions that support decision-making processes in financial and insurance institutions. Graduates are prepared to make responsible decisions under conditions of uncertainty, taking into account economic, social, and ethical consequences. They possess communication skills enabling clear and reliable presentation of analytical results and collaboration in interdisciplinary teams, as well as the ability to reason precisely, identify logical errors, and critically evaluate information.

The relationship between the field of study and the university's strategy

The Actuarial Science and Financial Analysis program aligns with the university's long-term strategy, as expressed in the adopted Lodz University of Technology Strategy for 2025–2030, whose central theme is the pursuit of excellence in education, science, and cooperation with the socio-economic environment.

The curriculum implements strategic assumptions by building interdisciplinary competencies in mathematics, economics, finance, and IT, which aligns with the university's priority in the area of Education and Talent – strategic features that assume the development of competencies crucial for the future of the labor market and prepare students to function in a complex and global financial environment. The program promotes interdisciplinary education, combining mathematics as a core discipline with management and quality sciences, which aligns with Lodz University of Technology's strategic goal of supporting interdisciplinary collaboration and the holistic development of student competencies. By preparing graduates to use modern analytical and technological tools, the program also supports the University's strategic areas related to Innovation and Impact – equipping students with practical skills in data processing, risk modeling, and result analysis, which consequently fosters the creation of added value for the knowledge-based economy. Incorporating ethics and philosophy into the curriculum not only strengthens students' professional competencies but also fulfills the University's strategic priority of developing attitudes of social responsibility, critical thinking, and communication, which are essential in the context of contemporary civilizational, social, and economic challenges.

Finally, preparing graduates for work in financial institutions, insurance companies, banks, and consulting firms, as well as for pursuing postgraduate studies, aligns with Lodz University of Technology's strategic aspiration to build a strong position for its educational offerings, recognizable both domestically and internationally, and to support internationalization and active student participation in the global labor market. In this way, the Actuarial and Financial Analysis major contributes to the achievement of the key objectives of the Lodz University of Technology Strategy for 2025–2030, in particular by educating highly qualified specialists equipped with interdisciplinary analytical skills that respond to the current and future needs of society and the economy.

Educational objectives and employment and continuing education opportunities

The aim of the Actuarial and Financial Analysis program is to prepare specialists with advanced mathematical, financial, and insurance knowledge who understand the mechanisms of financial markets and insurance institutions and can analyze them in the context of economics and managerial economics. The program aims to develop interdisciplinary analytical, IT, and economic competencies that enable effective risk modeling, financial instrument valuation, credit cost analysis, and assessment of an organization's financial stability. An integral part of the education is the development of critical thinking skills, business ethics, and regulatory awareness, including knowledge of the fundamentals of insurance law, which prepares students for responsible functioning in the financial and insurance environment. The program provides graduates with competencies enabling employment in financial institutions, insurance

companies, banks, consulting firms, and risk analysis and management departments, both in Poland and internationally. The theoretical and practical preparation obtained also enables the continuation of studies in second-cycle studies in fields combining mathematics and economics, including finance, actuarial and IT, which promotes the further development of analytical and managerial competences.

Description of the process and outcome of consultations on the proposed study program with the socio-economic environment

The Actuarial Science and Financial Analysis program is regularly consulted with representatives of the socio-economic community. The review process for the presented program was primarily conducted by representatives of the insurance and financial sectors (Warta SA, Uniq, mBank, Commerzbank, epruf, and USP Zdrowie). The changes, which expanded the program to include economics, including managerial economics, as well as a component developing soft skills in the humanities, were positively assessed. Representatives from external stakeholders emphasized that this significantly enriches the educational offering, enabling students to acquire additional actuarial competencies. They particularly noted that the proposed range of economic subjects corresponds to the Economics section of the actuarial exam, providing graduates with a realistic opportunity to take the exam. The combination of advanced mathematics in finance and insurance subjects with modern IT tools was also positively assessed, as it was considered particularly valuable given the current needs of the labor market. Another important element of the program is the opportunity to collaborate with practitioners in teaching or co-teaching selected courses in the field of financial and insurance risk, taking into account the latest trends in their practical application. The importance of using active learning methods, such as project-based learning, case studies, and flipped education, was also emphasized. During the consultations, suggestions were also made to consider the broader use of cloud tools (including artificial intelligence) in courses devoted to the analysis of various types of risks. The presented program of study received a unanimously high and positive evaluation from representatives of the socio-economic community.

Description of competencies expected from a candidate applying for admission to studies

In accordance with the Admissions Resolution currently in force at Lodz University of Technology.

The unit organizing education

Faculty of Technical Physics, Information Technology and Applied Mathematics

Education program

Semester 1

Course	Number of hours	ECTS points	Form of verification	Obligatory
Linear Algebra with Elements of Analytic Geometry	Tutorials: 30 Lecture: 30	6	Exam	Obligatory
Mathematical Analysis I	Tutorials: 45 Lecture: 45	8	Exam	Obligatory
Introduction to R	Laboratory classes: 30 E-learning: 25	4	Graded assignment	Obligatory
The Logical Principles of Reasoning and Communication	Tutorials: 30	3	Graded assignment	Obligatory
Introduction to Mathematics	Tutorials: 15 Lecture: 15	3	Graded assignment	Obligatory
Introduction to Probability Theory	Tutorials: 30 Lecture: 30	6	Exam	Obligatory
Sum	325	30		

Semester 2

Course	Number of hours	ECTS points	Form of verification	Obligatory
Critical Thinking	Lecture: 30	3	Graded assignment	Obligatory
Introduction to Financial Analysis	Tutorials: 30 Lecture: 30	5	Exam	Obligatory
Computer Calculations in Finance	Project work: 30	3	Graded assignment	Obligatory subjects to choose from
Basics of Entrepreneurship	Lecture: 30	2	Graded assignment	Obligatory

Course	Number of hours	ECTS points	Form of verification	Obligatory
Foreign Language Module 1		2	Graded assignment	Obligatory group
The student chooses one module from the group.				
English B2 module I	Tutorials: 30	2	Graded assignment	Optional
English B2+ module I	Tutorials: 30	2	Graded assignment	Optional
English C1 module I	Tutorials: 30	2	Graded assignment	Optional
German B2 module I	Tutorials: 30	2	Graded assignment	Optional
Probability Theory I	Tutorials: 30 Lecture: 30	5	Exam	Obligatory
Mathematical Analysis II	Tutorials: 45 Lecture: 30	6	Exam	Obligatory
Elective Course 1		4	Graded assignment	Obligatory group
The student chooses 1 course from the group.				
Elements of Discriptive Statistics	Laboratory classes: 15 Project work: 15 Lecture: 15	4	Graded assignment	Optional
Selected Topics of Mathematical Modelling	Laboratory classes: 15 Project work: 15 Lecture: 15	4	Graded assignment	Optional
Physical Education 1	Tutorials: 30	0	Pass	Obligatory
Sum	390	30		

Semester 3

Course	Number of hours	ECTS points	Form of verification	Obligatory
Foreign Language Module 2		2	Graded assignment	Obligatory group
The student chooses one module from the group.				

Course	Number of hours	ECTS points	Form of verification	Obligatory
English B2 module II	Tutorials: 30	2	Graded assignment	Optional
English B2+ module II	Tutorials: 30	2	Graded assignment	Optional
English C1 module II	Tutorials: 30	2	Graded assignment	Optional
German B2 module II	Tutorials: 30	2	Graded assignment	Optional
Fundamentals of Actuarial Sciences	Tutorials: 30 Lecture: 30	4	Graded assignment	Obligatory
Mathematical Analysis III	Tutorials: 30 Lecture: 30	5	Exam	Obligatory
Basics of Programming	Laboratory classes: 30 Project work: 10 Lecture: 30	4	Graded assignment	Obligatory
Modeling and Valuation of Financial Instruments	Tutorials: 30 Project work: 15 Lecture: 30	6	Graded assignment	Obligatory
Elective Courses 2		4	Graded assignment	Obligatory group
The student chooses 1 course from the group.				
Database Fundamentals	Laboratory classes: 30 Lecture: 15	4	Graded assignment	Optional
Credit Risk	Tutorials: 30 Lecture: 15	4	Graded assignment	Optional
Qualitative and Quantitative Data Analysis	Laboratory classes: 15 Project work: 15 Lecture: 15	4	Graded assignment	Optional
Probability Theory II	Tutorials: 45 Lecture: 30	5	Exam	Obligatory
Physical Education 2	Tutorials: 30	0	Pass	Obligatory
Sum	445	30		

Semester 4

Course	Number of hours	ECTS points	Form of verification	Obligatory
Foreign Language Module 3		2	Graded assignment	Obligatory group
The student chooses one module from the group.				
English B2 module III	Tutorials: 30	2	Graded assignment	Optional
English B2+ module III	Tutorials: 30	2	Graded assignment	Optional
English C1 module III	Tutorials: 30	2	Graded assignment	Optional
German B2 module III	Tutorials: 30	2	Graded assignment	Optional
Life Insurance	Tutorials: 30 Project work: 30 Lecture: 30	6	Exam	Obligatory
Statistics	Tutorials: 30 Project work: 20 Lecture: 30	5	Exam	Obligatory
Intriduction to Time Series	Tutorials: 15 Laboratory classes: 15 Lecture: 30	4	Graded assignment	Obligatory
Reporting and Data Visualization	Project work: 30	2	Graded assignment	Obligatory subjects to choose from
Elective Courses 3		3	Graded assignment	Obligatory group
The student chooses 1 course from the group.				
Number Theory with Applications in Cryptography	Lecture: 45	3	Graded assignment	Optional
Elements od Combinatorics and Graph Theory	Tutorials: 15 Lecture: 30	3	Graded assignment	Optional
Monte Carlo Methods	Laboratory classes: 15 Lecture: 30	3	Graded assignment	Optional
Economics	Tutorials: 30 Lecture: 30	5	Graded assignment	Obligatory

Course	Number of hours	ECTS points	Form of verification	Obligatory
Risk Modeling in Insurance	Tutorials: 15 Lecture: 30	3	Exam	Obligatory
Sum	440	30		

Semester 5

Course	Number of hours	ECTS points	Form of verification	Obligatory
Financial Investments	Laboratory classes: 30 Project work: 15 E-learning: 15	4	Graded assignment	Obligatory
Professional Ethics and Intellectual Property Protection	Lecture: 30	2	Graded assignment	Obligatory
Managerial Economics	Tutorials: 30 Lecture: 30	5	Graded assignment	Obligatory
Foreign Language Module 4		3	Exam	Obligatory group
The student chooses one module from the group.				
English B2 module IV	Tutorials: 30	3	Exam	Optional
English B2+ module IV	Tutorials: 30	3	Exam	Optional
English C1 module IV	Tutorials: 30	3	Exam	Optional
German B2 module IV	Tutorials: 30	3	Exam	Optional
Physical Education 3	Tutorials: 30	0	Pass	Obligatory
Non-Life Insurance	Tutorials: 45 Lecture: 45	5	Exam	Obligatory
Elective Courses 4		3	Graded assignment	Obligatory group
The student chooses 1 course from the group.				
Computational Aspects of Functional Inequalities	Laboratory classes: 30 Lecture: 15	3	Graded assignment	Optional

Course	Number of hours	ECTS points	Form of verification	Obligatory
Programming in Data Analysis	Laboratory classes: 15 Project work: 15 Lecture: 15	3	Graded assignment	Optional
Algorithms of Linear Algebra	Project work: 30 Lecture: 15	3	Graded assignment	Optional
Summative Module	Project work: 90	8	Graded assignment	Obligatory subjects to choose from
Sum	435	30		

Semester 6

Course	Number of hours	ECTS points	Form of verification	Obligatory
Elective Course 5		4	Graded assignment	Obligatory group
The student chooses 1 course from the group.				
Selected Issues of Mathematical Statistics	Seminar: 60	4	Graded assignment	Optional
Selected Topics of Finance	Seminar: 60	4	Graded assignment	Optional
Selected Topics of Insurance	Seminar: 60	4	Graded assignment	Optional
Pension Funds	Project work: 15 Lecture: 30	3	Exam	Obligatory
Diploma Seminar	Seminar: 45	3	Graded assignment + exam	Obligatory
Elective Courses 6		4	Graded assignment	Obligatory group
The student chooses 1 course from the group.				
Finance Psychology	Seminar: 15 Lecture: 30	4	Graded assignment	Optional
Business Ethics	Seminar: 15 Lecture: 30	4	Graded assignment	Optional

Course	Number of hours	ECTS points	Form of verification	Obligatory
Basics of Insurance Law	Project work: 15 Lecture: 30	4	Graded assignment	Optional
Internship	Internship: 0	6	Pass	Obligatory
Final Project	Diploma Thesis: 0	10	Pass	Obligatory subjects to choose from
Sum	195	30		