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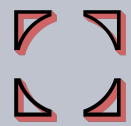
START ANALYZING YOUR FUTURE...



Kwarta

Agenda

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1. Problem description
2. Challenges

Agenda

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2. Challenges
3. Models and regressions

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Challenges
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Module overview
Module I — Basic Data
Module II — Simplified Pension Calculator
Module III — Value Of Money
Module IV — Extended Pension Calculator
Module V — Random Events Simulation
Module VI — Collecting Statistics And Generating An .xlsx Report
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Kamil Żak

Frontend

Team Kwarta

Kamil Żak
Frontend

Aleksander Kluska
Backend

Team Kwarta

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Backend

Karol Marszałek
Data models, Backend

Team Kwarta

Kamil Żak
Frontend

Aleksander Kluska
Backend

Karol Marszałek
Data models, Backend

Andrzej Legutko
Machine learning, data models

The state of pension calculators in 2025

- Publicly available tools ask users for a long list of input parameters

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- Publicly available tools ask users for a long list of input parameters
- Many people simply don't know how to estimate those inputs realistically
- As a result, outputs are highly uncertain — or people just give up and don't use the tool at all

Wybór wersji kalkulatora - nowe zasady

Kalkulator emerytalny oblicza **prognozowane wysokości emerytur**, które przyznamy po raz pierwszy, wypłacane z Funduszu Ubezpieczeń Społecznych.

> **Uwaga!**
> Obliczenia w kalkulatorze emerytalnym to prognoza a nie faktyczna emerytura (przeczytaj szczegółowe wyjaśnienia). **Prognozowana kwota emerytury, którą obliczysz przy pomocy kalkulatora, nie może być podstawą do jakichkolwiek roszczeń.**

Gdy wprowadzasz dane do kalkulatora emerytalnego wykorzystaj informacje o stanie konta, które otrzymałeś od nas. Jeśli masz profil na PUE ZUS, informacje te pobierz z PUE ZUS lub skorzystaj z kalkulatora na PUE ZUS.

Jeśli jesteś członkiem otwartego funduszu emerytalnego, dodatkowo wykorzystaj informację o stanie środków zgromadzonych w otwartym funduszu emerytalnym, którą otrzymałeś z Otwartego Funduszu Emerytalnego do którego należysz.

Kalkulator emerytalny umożliwia wybór wieku przejścia na emeryturę od 60 lat dla kobiet i od 65 lat dla mężczyzn.

Kalkulator oblicza prognozowaną wysokość emerytury na przyszły rok i kolejne lata. Dlatego, jeśli w tym roku osiągasz wiek emerytalny i chcesz poznać prognozowaną wysokość Twojej emerytury, przyjdź do naszej placówki i skorzystaj z usługi doradcy emerytalnego. Doradca emerytalny wyliczy prognozowaną wysokość emerytury na bieżący rok kalendarzowy i wyjaśni od czego zależy wysokość emerytury. Możesz również w tej sprawie zadzwonić do Centrum Kontaktu Klientów pod numer 22 560 16 00 (koszt połączenia wg umowy klienta z operatorem telekomunikacyjnym) lub umówić się na e-wizytę.

Kalkulator daje Ci możliwość wyboru – możesz przeprowadzić obliczenia w wersji uproszczonej lub zaawansowanej.

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◉ **wersja uproszczona**

W wersji uproszczonej masz mniejszą swobodę wyboru i podajesz mniejszą liczbę parametrów. W tej wersji Twoje wynagrodzenie (wyrażone w procencie przeciętnego wynagrodzenia w gospodarce narodowej) od teraz do momentu przejścia na emeryturę, nie zmienia się.

○ **wersja zaawansowana**

W wersji zaawansowanej kalkulatora masz większą swobodę wyboru, ale musisz podać większą liczbę parametrów niezbędnych do tego, by wyliczyć prognozowaną wysokość emerytury. Możesz podać różne wynagrodzenia (wyrażone w procencie przeciętnego wynagrodzenia w gospodarce narodowej) w poszczególnych latach. Możesz także – poprzez wpisanie w pewnych latach wynagrodzenia równego zero – wyłączyć te lata z okresu ubezpieczenia.

WYBIERZ ›

Kalkulator emerytalny wyliczy Ci prognozowaną wysokość emerytury z Funduszu Ubezpieczeń Społecznych według tzw. nowych zasad, na ogólnych zasadach, o których mowa w przepisach[1], łącznie z ewentualną kwotą okresowej emerytury kapitałowej. Prognozowaną wysokość emerytury wyliczamy przez podzielenie podstawy obliczenia emerytury przez średnie dalsze trwanie życia dla osób w wieku równym wiekowi przejścia na emeryturę. Podstawa obliczenia nowej emerytury to:

- kwota zwaloryzowanych składek na ubezpieczenie emerytalne, które są zapisane na Twoim koncie w ZUS,
- kwota zwaloryzowanego kapitału początkowego,
- kwota środków zapisanych na Twoim subkoncie w ZUS.

Emerytura na nowych zasadach uproszczona

Ostatnia Informacja o stanie konta w ZUS za rok:	2024		
Płeć:	Kobieta		
Miesiąc i rok urodzenia:	styczeń	1949	
Kwota zwaloryzowanych składek:		zł	
Kwota zwaloryzowanego kapitału początkowego:		zł	
Zwaloryzowana kwota ogółem na subkoncie:		zł	
Kwota składek za 12 miesięcy kalendarzowych:		zł	
Deklarowany wiek przejścia na emeryturę w latach i miesiącach:	77 lat	0 mies.	
Rok rozpoczęcia / wznowienia pracy:		1962	
Miesięczne obecne wynagrodzenie brutto:		zł	

Twoje obecne miesięczne wynagrodzenie stanowi 0% przeciętnego wynagrodzenia.

A tangle of unfamiliar concepts:

Which problems are we solving?

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- you don't know where to start

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A tangle of unfamiliar concepts:

- you don't know where to start
- explanations are *ignotum per ignotum* (the unknown explained by another unknown), often circular
- every individual case is different — there is no single template or universal formula

We use modern tools that let us address each of these challenges!

Selected technologies and data analysis methods

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- Historical data (inflation, GDP growth, sector wages) used as a reference context.
- Machine-learning models that classify occupation/industry and estimate the earnings trajectory.
- Large language models (LLMs) with RAG — verifying market rates and the freshness of data.

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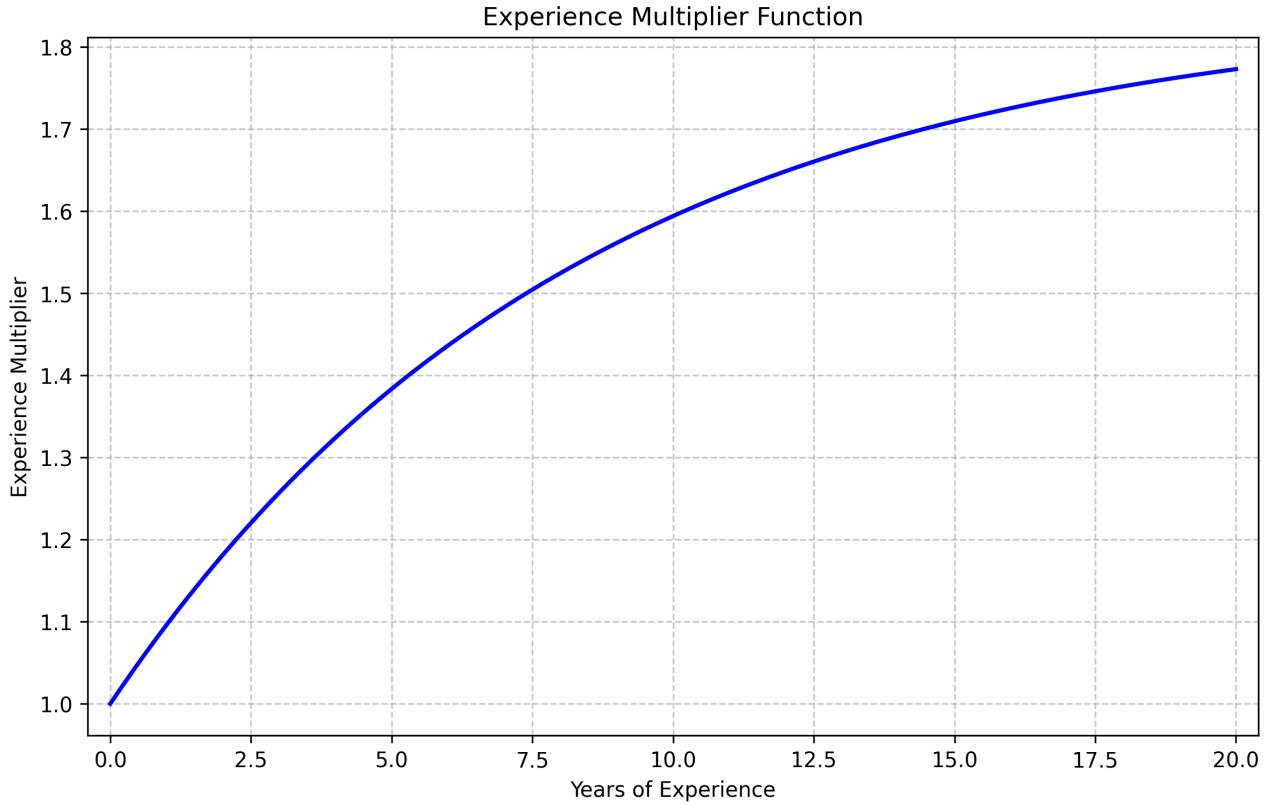
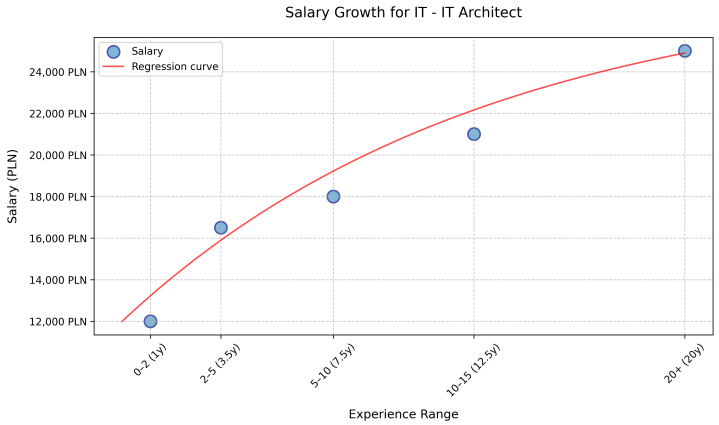
$$\text{salary} = \text{junior salary} \cdot k(x)$$


Experience Multiplier Function
Experience Multiplier
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
Years of Experience

Regressions for real-world data



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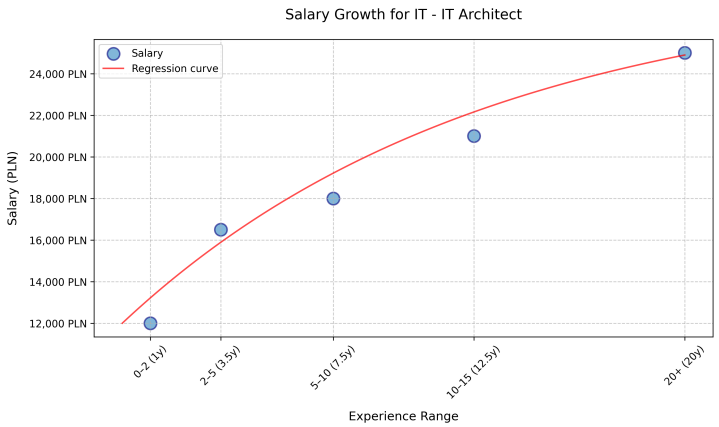

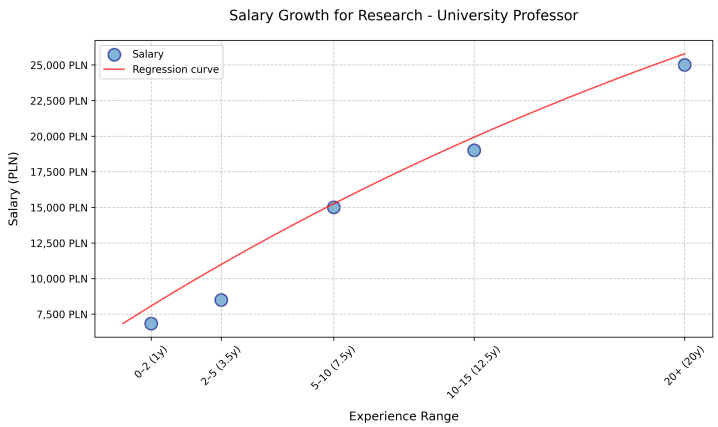

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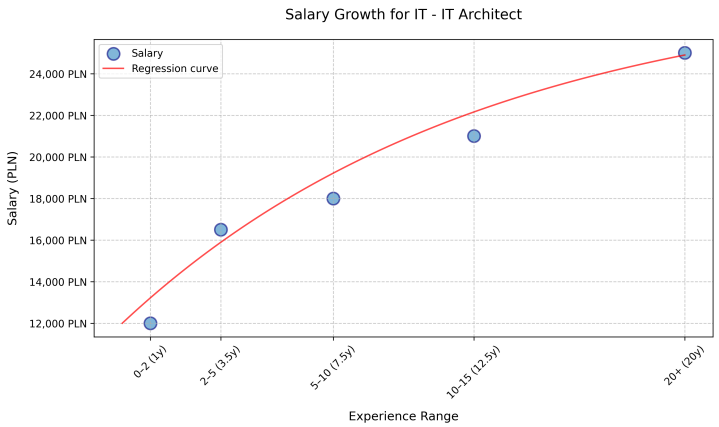

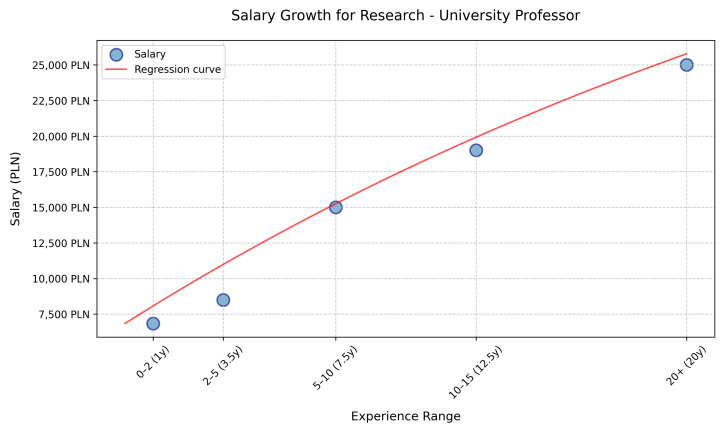

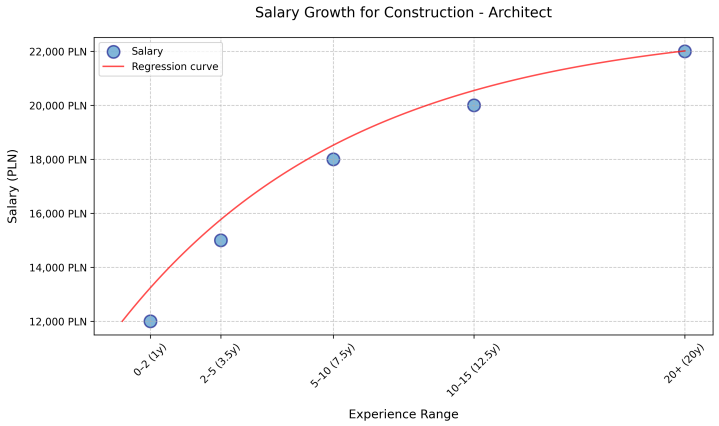

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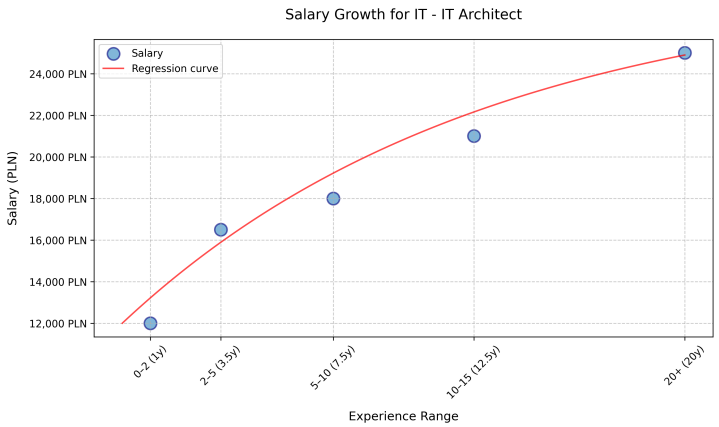

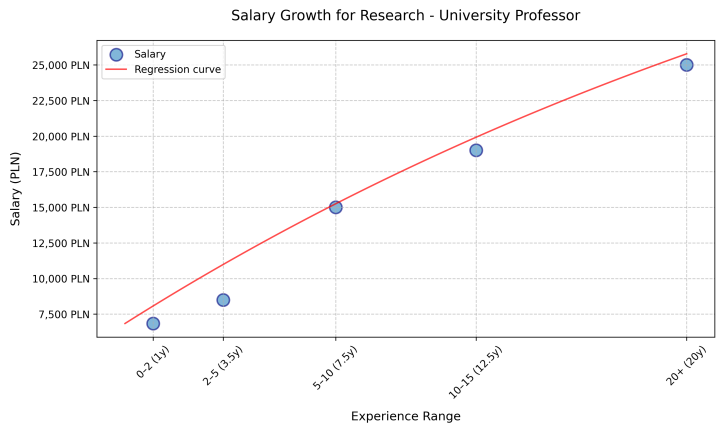

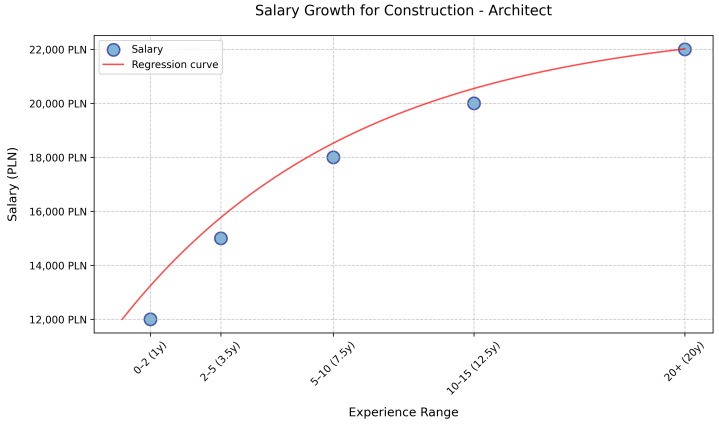

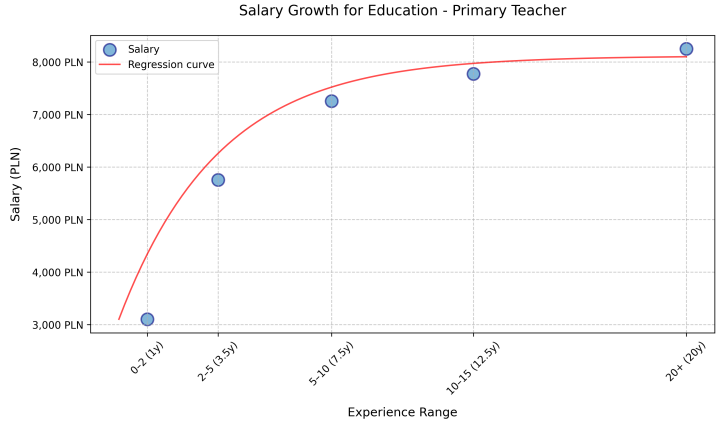

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With Retrieval-Augmented Generation (RAG) we retrieve the current starting (junior) market rate for the given industry

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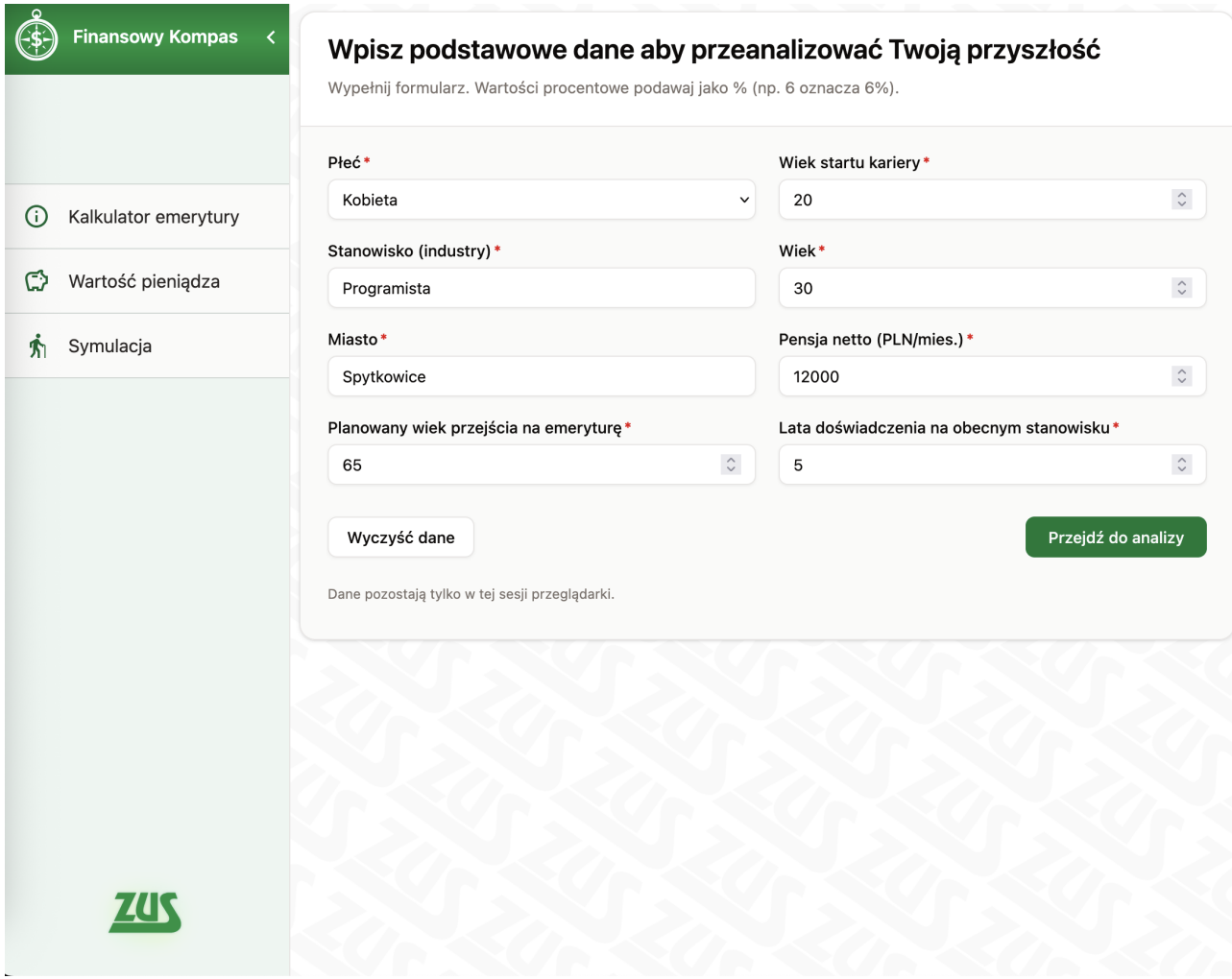
By adding a model of macroeconomic factors such as inflation and GDP growth, we can credibly estimate the user's entire financial history — both past and future!



With a minimal set of inputs from the user:

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- occupation/industry,

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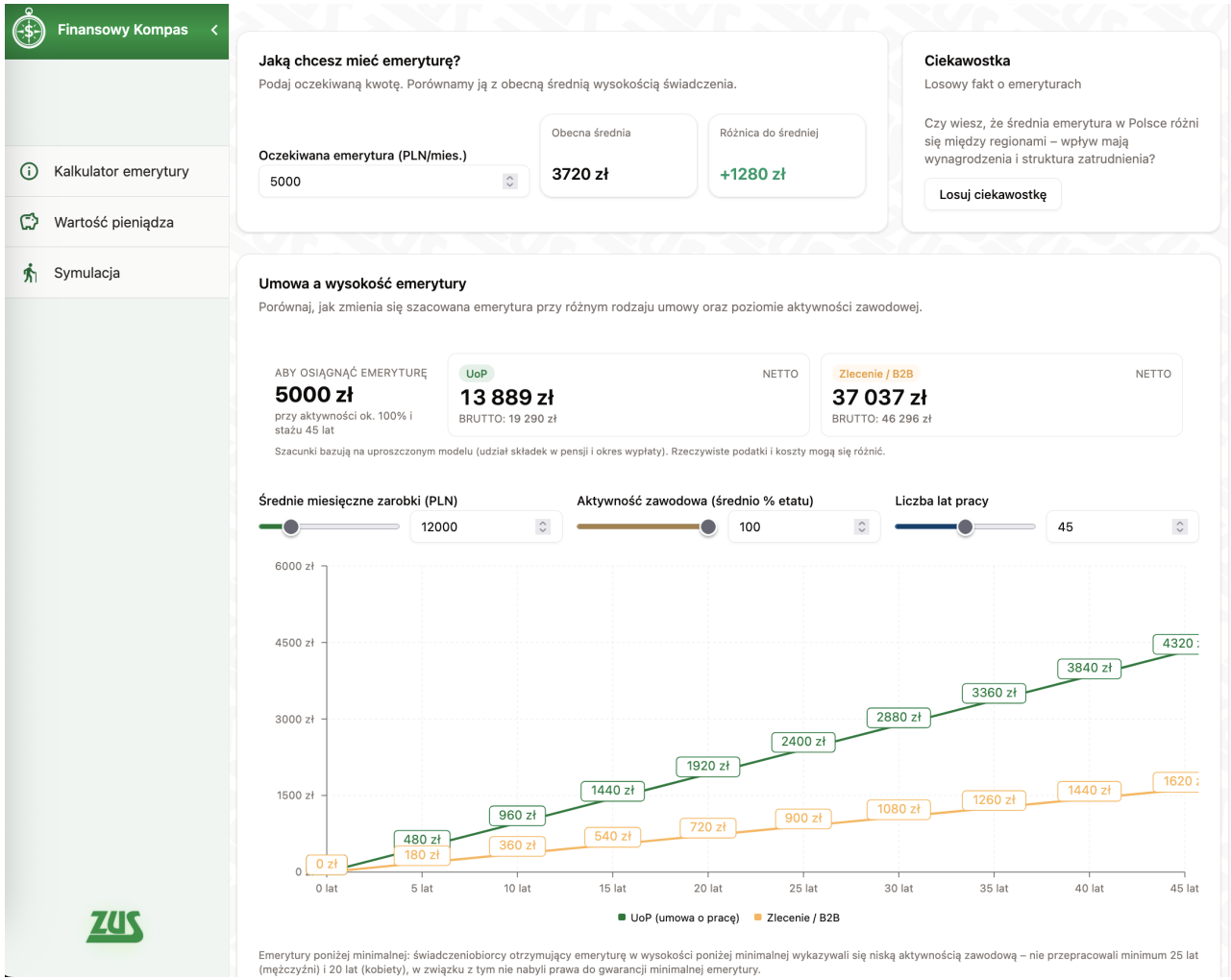
our system immediately builds a first-pass financial model:

- an earnings projection (in nominal and real terms),
- monthly expenses and savings, years of experience, retirement age — all values can be refined manually at any time.



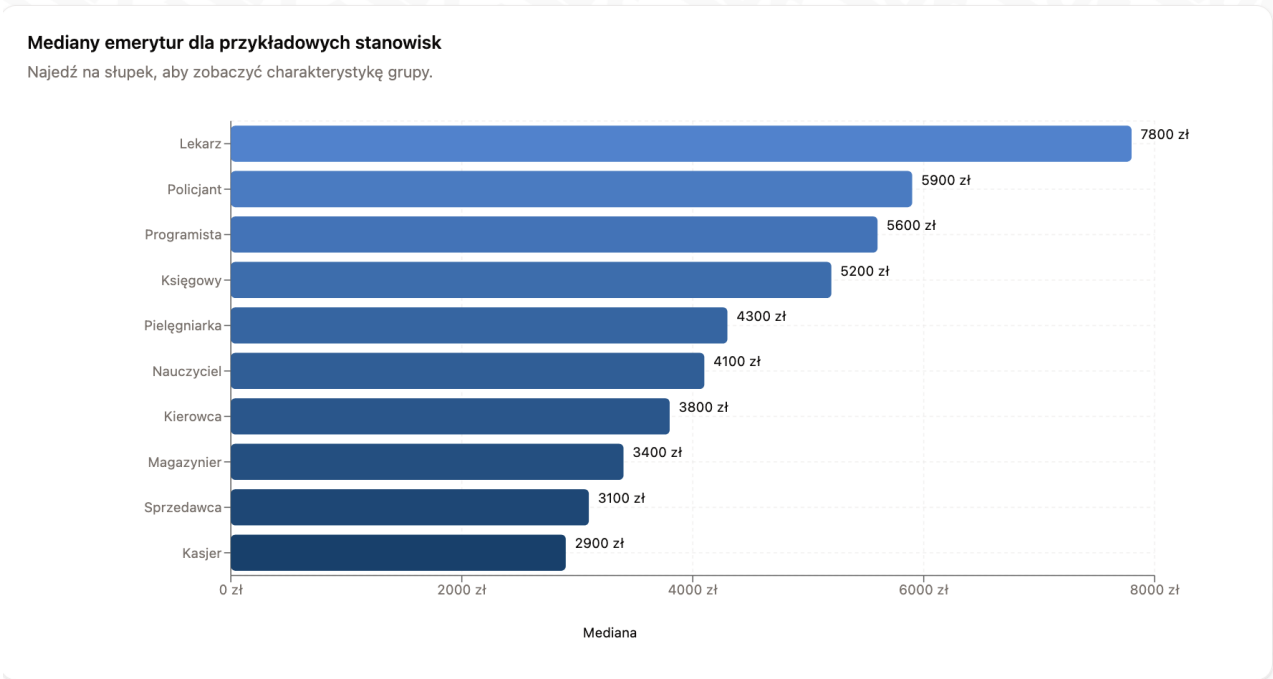
A dynamic chart illustrating the relationship between a planned nominal pension and employment history:

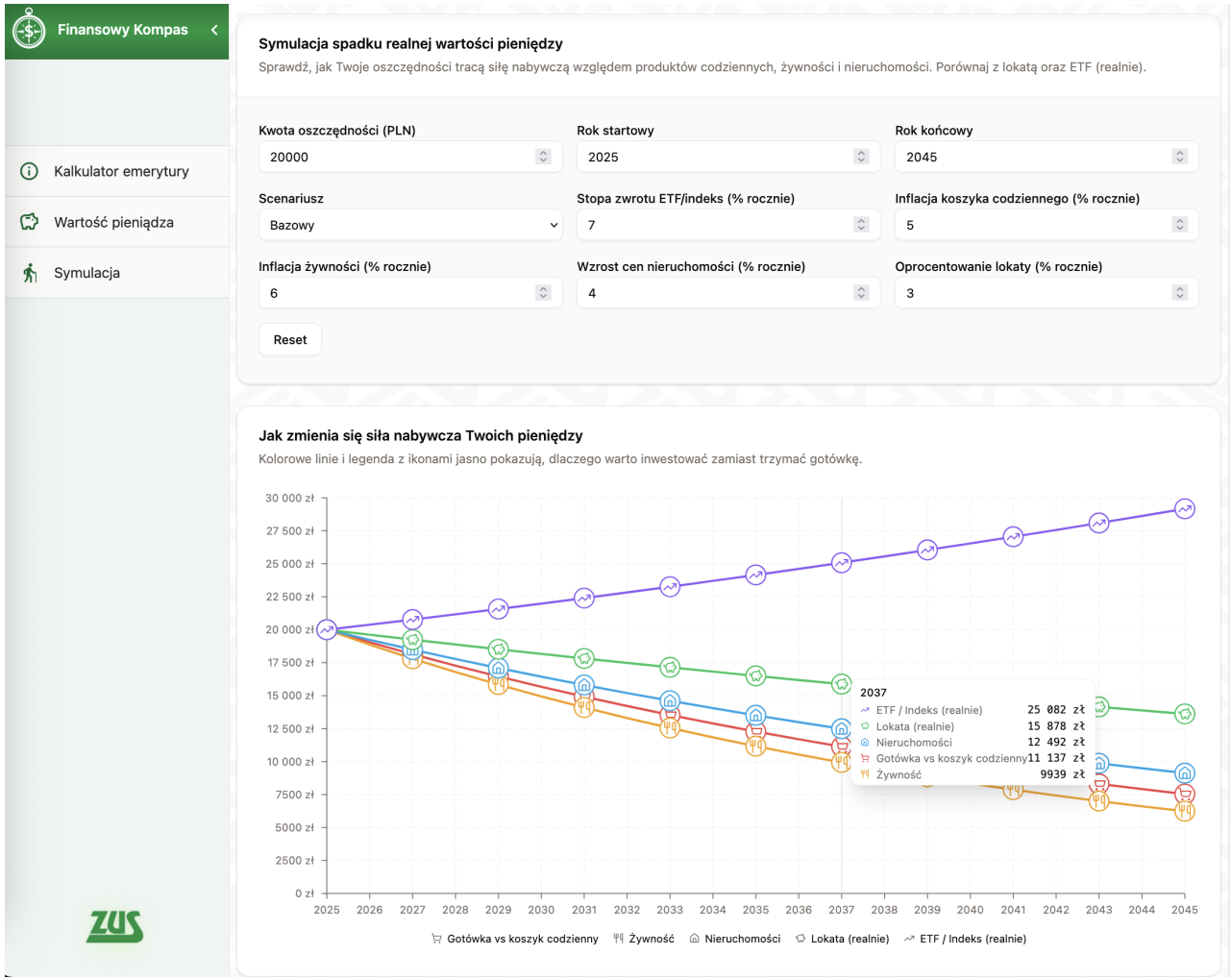
- average earnings,
- length of work experience,
- employment fraction (full-time, part-time, etc.)

The module also compares the pension of a person employed under an employment contract with that of a sole proprietor (B2B), assuming the minimal legally required ZUS contribution.

The module also presents contextual tidbits — subtly educating young users about key elements of the pension system.

Additionally: a chart presenting the median pension for ten random occupations.





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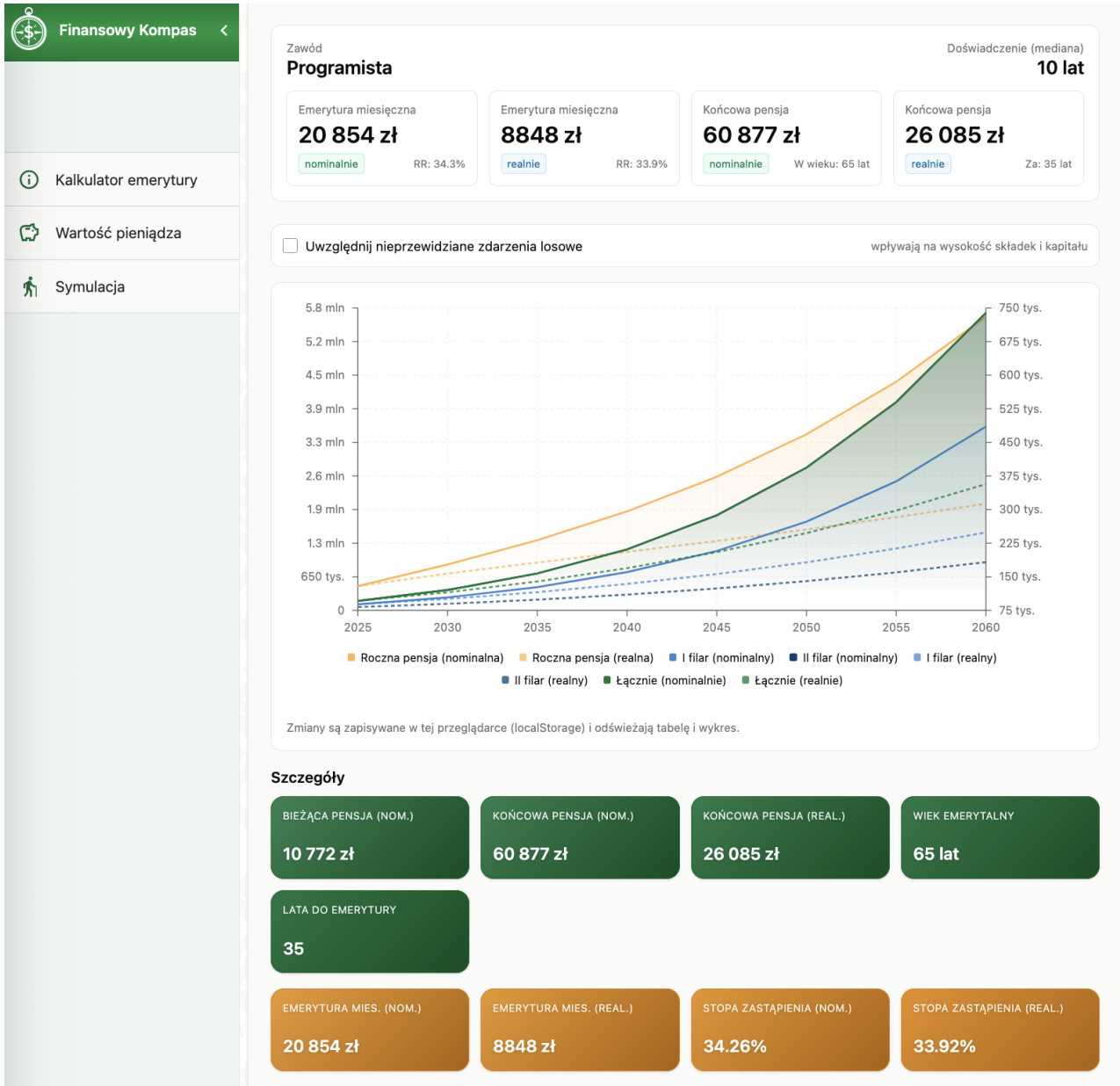

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- funds accumulated in the ZUS account and sub-account until the end of working life,
- earnings trajectory, forecast pension value and the replacement rate — the real, percentage change in income at the moment of retirement.

Unlike Module II, Module IV not only uses the full set of user data (entered manually or computed from our models and sensible defaults) but also illustrates all important pension parameters:

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- a chart showing money accumulated in the ZUS account and sub-account over the remaining working years

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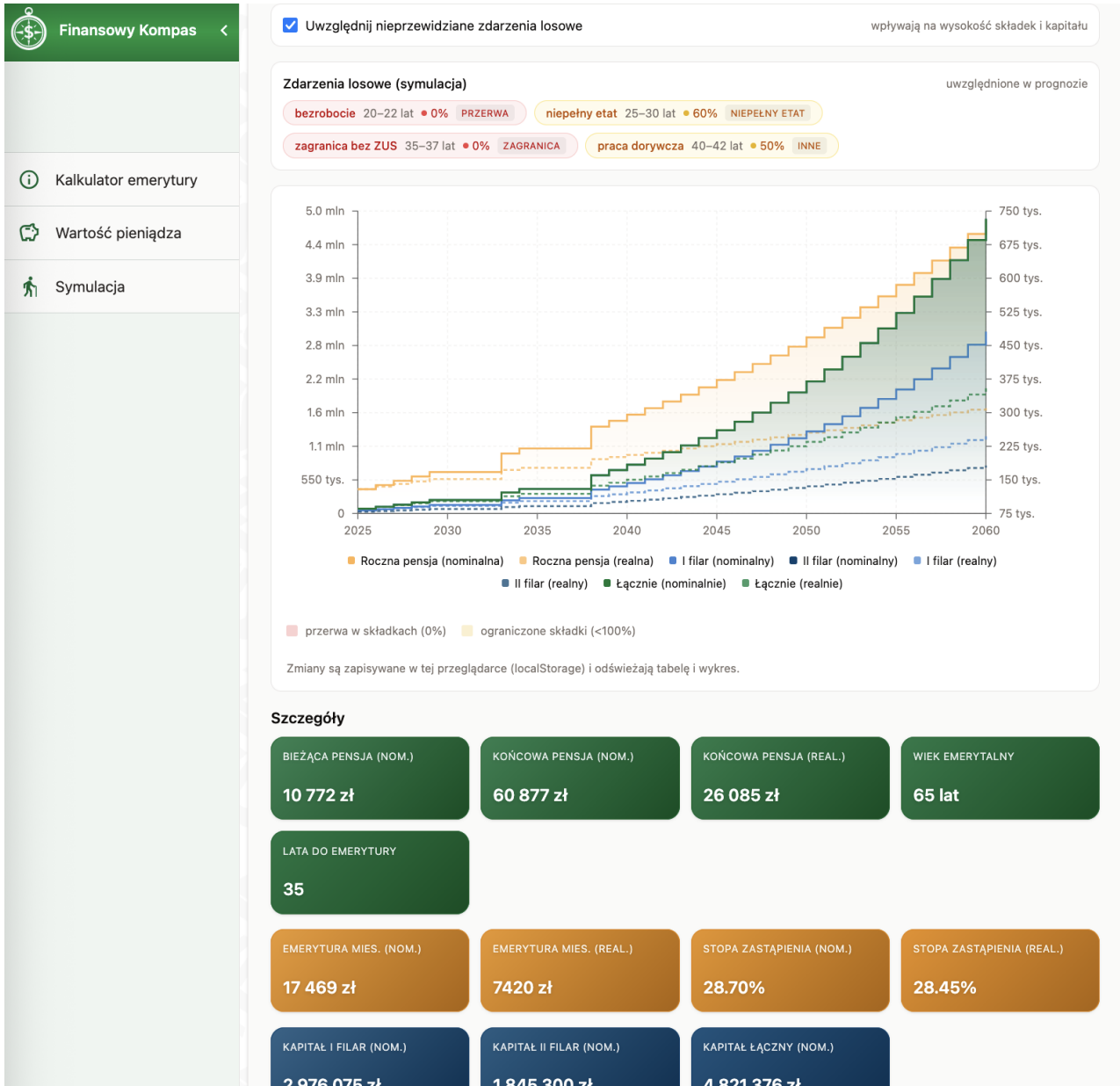
- a chart showing money accumulated in the ZUS account and sub-account over the remaining working years
- earnings progression, pension levels and the so-called replacement rate — the real percentage change in income the user will experience at retirement.



An optional module that factors random events (job loss, illness, parental leave, etc.) into the calculations of Module IV.

An optional module that factors random events (job loss, illness, parental leave, etc.) into the calculations of Module IV. It helps users understand how strongly early breaks in employment and contributions can affect the final pension amount.

At the hackathon stage we did not introduce authentication or a database, but we implemented a module for collecting anonymous statistics, available as an Excel (.xlsx) report to the site administrator, in line with the task requirements.

Using models in the application

Our model transforms a simple pension contributions calculator into an intelligent guide to financial dependencies that proactively suggests credible default values for key parameters.

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Collecting these data by hand would be time-consuming for the user and error-prone.

→ The current solution (MVP) demonstrates the usefulness of credible defaults.

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- Evolve into a fully featured application: gradually expand the set of user-editable parameters. Ultimately, every parameter will be adjustable manually for more realistic forecasts.

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- Evolve into a fully featured application: gradually expand the set of user-editable parameters. Ultimately, every parameter will be adjustable manually for more realistic forecasts.
- Improve models and the breadth and quality of data (public and industry sources), leading to higher accuracy and auditable results.

Thank you for your attention!

Team Kwarta