



Faculty of computer science

Data Science and
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Risk calculator development for SPFI MOEX

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Subject area

OTC derivatives are bilateral contracts on prices, rates, FX or volatility. Custom terms, no exchange standard.

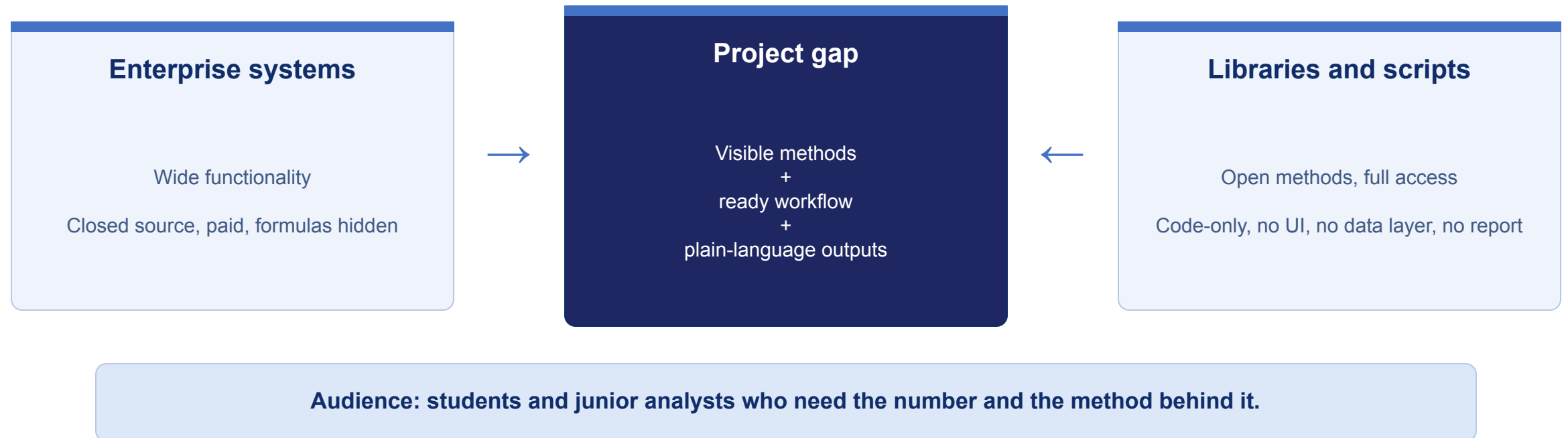
Risk is harder to measure than for stocks: payoffs are non-linear, prices are not continuous, sensitivity to several factors.





Existing solutions

Risk models are well known. Ready-to-use tools that combine them with a workflow are not.





Goal and objectives

Goal

Build a web service that computes market risk metrics on SPFI MOEX instruments. Method shown for every result, PDF export, deployed online.

Quantitative analytics

- Single-asset risk (VaR, ES, LVaR)
- Portfolio risk and efficient frontier
- Options: pricing, Greeks, option VaR
 - Stress scenarios and backtests

Data and application

- MOEX and Tinkoff market data
 - Excel / CSV upload
 - Basic and Pro user modes
- Modular backend, isolated math

Delivery and interpretation

- Interactive charts for every metric
- Risk Copilot - guided interpretation
- PDF reports with method and result
- Containerized, one-command deployment



Where our project fits

Enterprise tools hide the math. Open libraries have no workflow. Our project fills the gap.

Enterprise platforms

Bloomberg MARS · MSCI RiskManager ·
LSEG Workspace

Wide asset coverage
Closed source, paid

Open-source tools

QuantLib · OpenGamma · PyPortfolioOpt

Open methods, free to use
No UI, no data, no reports

Our platform

Open methods, ready workflow
MOEX and Tinkoff data built in
Interpretation and PDF output

Not a library, not a terminal. A web service where the method is open.



What the platform actually does

Portfolio Risk Calculator

Risk Calculator Workspace

Basic mode keeps only the fastest workflows. Pro mode opens the full quant toolkit and deeper detail.

Workspace

Methodology

Selected asset: MOEX - Московская Биржа

source: Tinkoff · spot: 176.7600 · prices: 334 · mu: -0.000167 · sigma: 0.012440

Options

Futures

Option Risk

Model Check

Stress

One Asset

Portfolio

MOEX

Options

Futures & SPFI

Option Risk

Model Check

Factor Breakdown

Bond & Swap

Stress Scenarios

Calculation Inputs

API

Manual

Random

Instrument

MOEX

Enter a ticker or part of an instrument name. Search is used to load price history from Tinkoff.

Search

API

Default search uses the local cache file. If the instrument is missing, click the small "API" button for live search and cache refresh.

MOEX - Московская Биржа

Start

End

05.06.2025

06.06.2026

LOSS IN A BAD DAY (VaR)

Methodology

3,67 ₺

Historical: 2,91 ₺ [how it works](#)

AVERAGE LOSS IN VERY BAD DAYS (ES)

Methodology

4,91 ₺

Tail risk measure

LOSS WITH FAST EXIT COSTS (LVAR)

Methodology

3,67 ₺

Stressed: 3,83 ₺

Moderate risk. This is about 2.07% of position size.

The position is sensitive to a bad day. Keep an eye on size and liquidity.

Moderate risk

The position is sensitive to a bad day. Keep an eye on size and liquidity.

Key takeaways

- Parametric VaR is about 2.07% of the current position size.
- Expected Shortfall is 4.91, which represents the average loss across the worst scenarios.
- Liquidity meaningfully worsens the result: exiting the position under stress is more expensive than the base market-risk estimate.

What the user does

1. Load prices from MOEX/Tinkoff or upload a file
2. Pick the module: single asset, portfolio, option
3. See numbers and a chart
4. Read the interpretation
5. Download the PDF

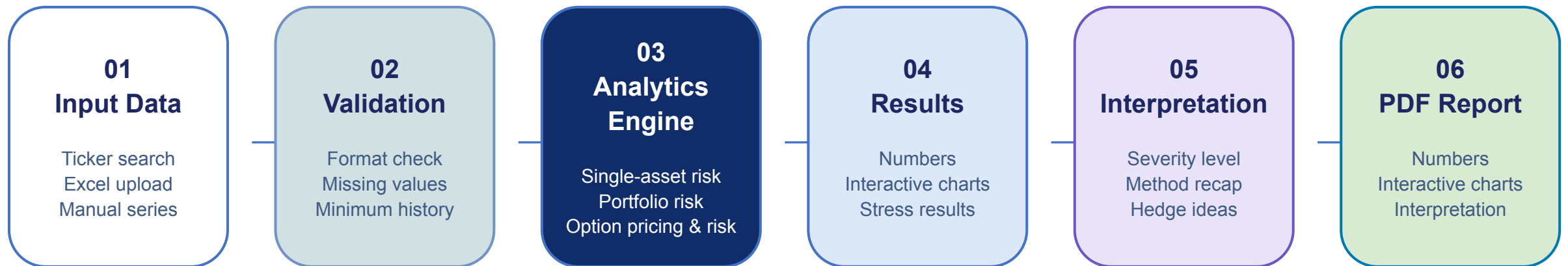
One service. From price source to PDF.

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User Workflow

Six steps. The same path in every module.



All modules use the same six steps. The user learns the flow once.



Architecture

Design principles

Separated layers

UI, services, math and reporting do not mix.

Independent engines

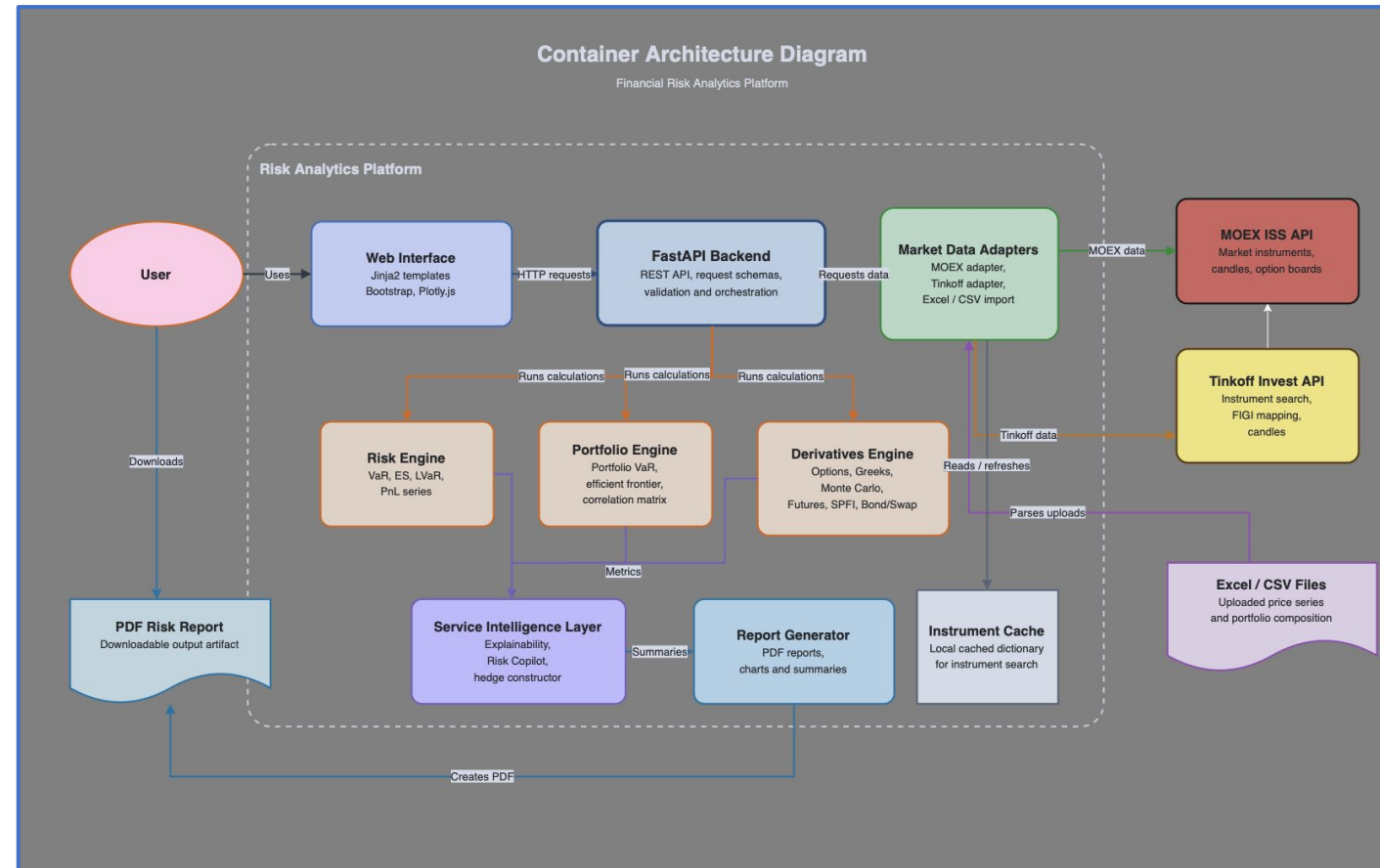
Single-asset, portfolio and options change without affecting each other.

Single data interface

Tinkoff, MOEX and uploads come through the same adapter.

Reusable outputs

Same result feeds the chart, the interpretation and the PDF.



The math part has no UI or network code. Every method can be tested on its own.



Deployment

Delivery flow

Push to deploy

A commit to main triggers a Render rebuild automatically.

Same environment everywhere

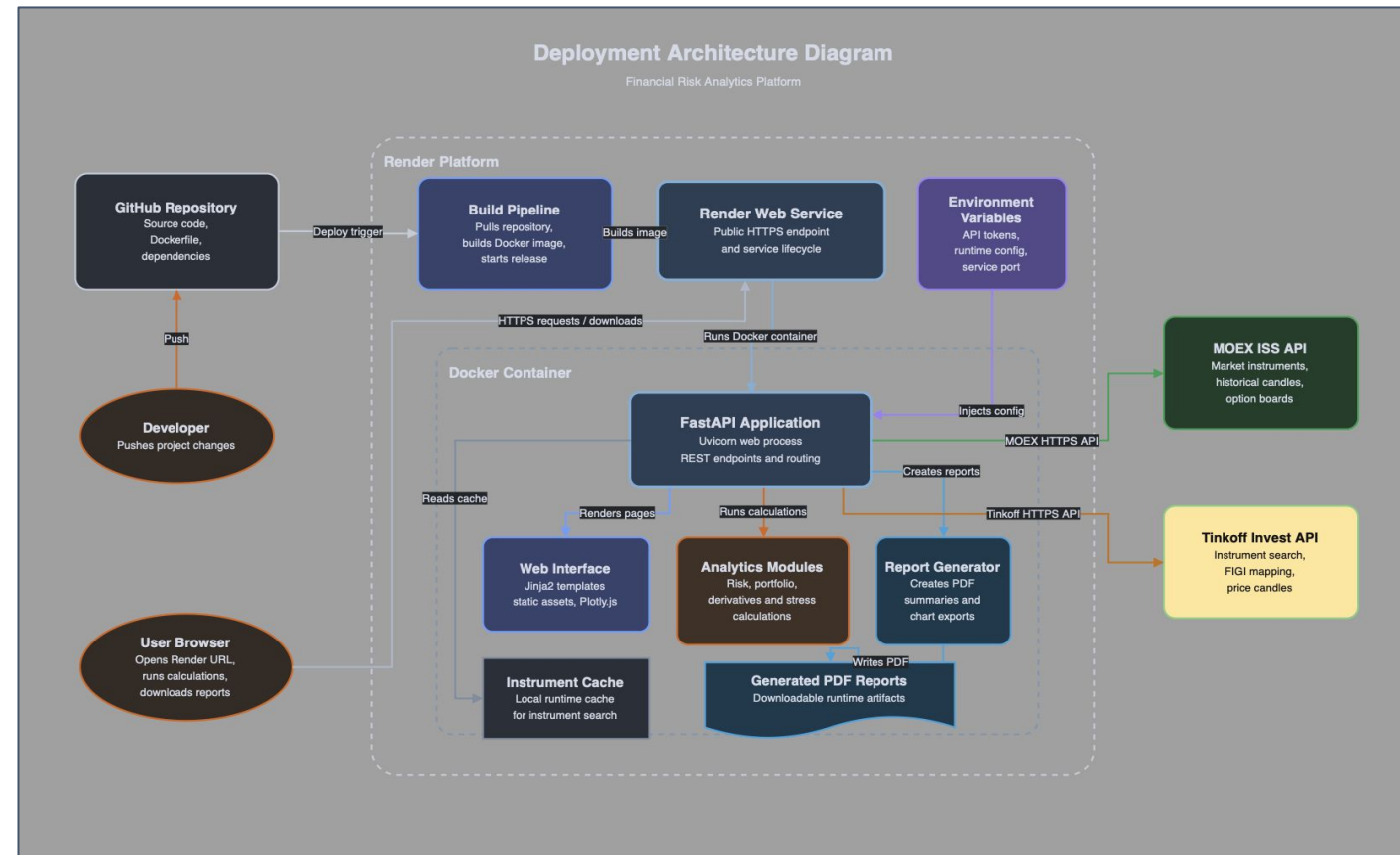
The Docker image runs identically on a laptop and on the cloud.

Public endpoint

The service is reachable over HTTPS - no local setup for the user.

Live data and reports

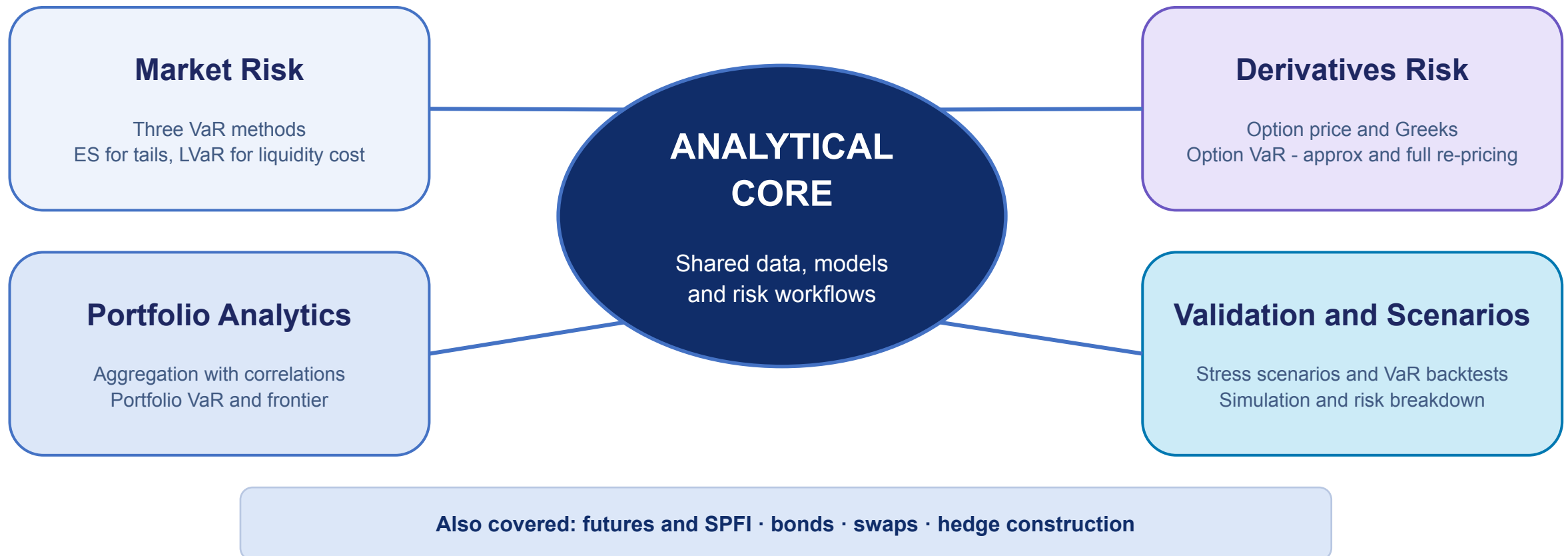
Market keys are injected at runtime; PDFs are built inside the running service.



The user opens a URL, not a script. The project is a running service.



Methods covered



Several methods run on the same data. The user can compare them.



What the user can do inside the platform

Ten modules with shared data and one menu

One Asset

Risk metrics for a single instrument

Portfolio risk

Portfolio risk and optimization

Options

Option price and sensitivities

Option Risk

Option VaR - fast and accurate

Stress Scenarios

Loss under user-defined shocks

Futures & SPFI

Forwards and SPFI exposures

Bond & Swap

Bond pricing and rate sensitivity

Model Check

Checks whether VaR matches reality

Factor Breakdown

Which asset drives the risk

MOEX / Tinkoff Data

Live market data lookup

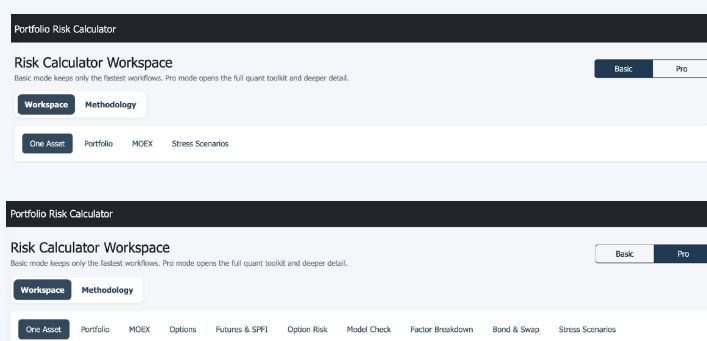
Pick a module, get a result. No setup in between.



How the user moves through the interface

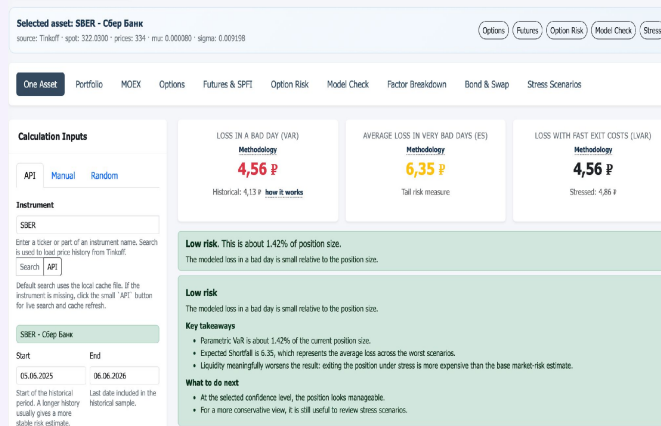
Three decisions: how deep, what to compute, what it means

01 CHOOSE MODE



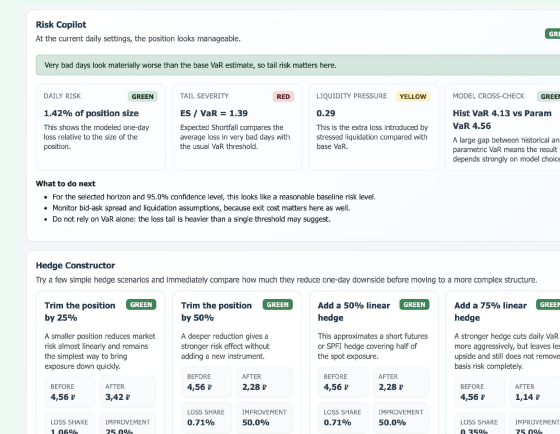
Basic shows the four most-used modules. Pro opens all of them with extra parameters.

02 CALCULATE



Inputs, numbers and interpretation on one page. No tab switching.

03 INTERPRET



Risk Copilot shows severity, explains the method and suggests a hedge. Fixed rules, not free-form text.

The user does not see formulas on screen. Only the result and what it means.



Validation

Three checks: history, hypothetical shocks, risk drivers

01 VALIDATE

One Asset Portfolio MOEX Options Futures & SPFI Option Risk **Model Check** Factor Breakdown Bond & Swap Stress Scenarios

Model Check. This tab checks how the risk model behaved on historical data. It shows how often realized losses broke through VaR and whether those exceptions were too frequent.

Model Check Inputs

When to use it
If you already have a historical PnL series, this screen helps you see whether the model understates risk or looks overly optimistic.

Use PnL from Selected Asset

Comma-separated PnL Series
-4.820000, 1.520000, 0.300000, 3.180000, -2.400000, 3.320000, -1.800000, 0.950000, -0.200000, 1.410000, 2.360000, -0.100000, -0.500000, 2.700000, 0.600000, 1.200000, 2.400000, -0.800000, 2.300000, 0.120000, 0.640000, 0.200000, 2.270000, 1.650000, 0.200000, 0.270000, 0.110000, -0.180000, 5.870000,
Historical daily PnL series used to check how well the VaR model worked on history.

Confidence Level
90%
Success level of the VaR being tested.

Window Size
167
Testing window size for the rolling VaR.

Results

The model looks too conservative
Realized breaches: 5 out of 167. Expected: about 16.70 at a tail probability of 10.0%.

How to read the result

VaR COVERAGE
2.99% vs 10.00%
There are undetectable losses breaches than expected. This usually means VaR is too strict: the model is more likely overestimating risk than underestimating it.

BREACH DEPENDENCE
OK
Breaches do not look clustered. That is a good sign: bad days are not arriving in suspicious bursts.

EXPECTED SHORTFALL
Tail ratio 0.81
Realized tail losses are below predicted ES. This looks like a conservative estimate of tail severity.

What to do next: For a demo this is not a critical flaw because risk is not underestimated. Still, you can reduce the confidence intervals or rerun the rolling window so the model is not overly cautious. Window: 166. A larger window makes the estimate more stable, but it also makes the model slower to react to a new market regime.

Rolling Backtest Summary methodology

BACKTEST OBSERVATIONS	OBSERVED EXCEPTIONS	EXPECTED EXCEPTIONS	EXCEPTION RATE
167	5 / 167	16.70	0.0299

► Show details

VaR Exception Check

Backtesting compares past VaR predictions with what actually happened.

02 CHALLENGE

One Asset Portfolio MOEX Options Futures & SPFI Option Risk Model Check **Factor Breakdown** Bond & Swap Stress Scenarios

Stress Scenarios. Basic mode offers ready-made presets for a quick single-position check. Pro mode keeps the full workflow with a position list and custom shocks. methodology

Advanced Stress Builder

What a stress scenario means
You define what happened to the market: how much the underlying moved, how volatility shifted, and how rates changed. The service then replicates each position and shows the possible portfolio outcome.

Use Selected Asset

1. POSITIONS
Each card below represents one option in your portfolio. No BSCN input is required.

The portfolio is built manually with cards

Position 1
One card equals one option included in the portfolio stress test.

Option Type: Call Underlying ID: U1
A Call gives value when the underlying rises, while a Put benefits from a decline.
Group positions by the same underlying so they can share one common shock.

Spot: 322.03 Strike: 322.03

Results

Stress shows a potential loss
Worst scenario: Market: -20%, PnL: -17.2016.

WORST PnL: -17.2016
This is the key stress number: how much is lost in the selected scenario.

LOSSES VS BASE: -98.56%
Stress PnL as a share of the base position value.

POSITIONS: 1
How many positions were included in the worst scenario.

What to do next: Compare the stress loss with VaR and ES: stress is usually the answer to "what happens if the market breaks sharply?".

Stress Scenario Ranking

Rate: +100 bps
Rate: -100 bps
Credit: -10% + 104 +10bps
Market: -10%
Market: -20%

Total PnL

Exception rate needed for total that will meet adverse outcome to achieve immutability.

Stress tests use hand-picked shocks. They show what history alone does not.

03 DECOMPOSE

One Asset Portfolio MOEX Options Futures & SPFI Option Risk Model Check **Factor Breakdown** Bond & Swap Stress Scenarios

Factor Breakdown. This screen decomposes total VaR by risk factor. It is useful when you need to understand what loads the risk limit most heavily.

Factor Breakdown Inputs

What matters here
This is an advanced quant block. If you do not have a factor model, you can skip it. If you do, this screen shows which factors contribute the most to VaR.

Factor Names (comma-separated):
Factor1, Factor2

Names of the risk factors used to decompose total VaR.

Delta Cash Values (comma-separated):
100000, 50000

Cash sensitivity of the portfolio to each factor.

Key Horizon Values (comma-separated):
0.001, 0.005

Expected move of each factor over the chosen horizon.

Covariance Horizon (BSCN array of arrays):
[[0.0004, 0.0001], [0.0001, 0.0009]]

Results

Main risk factor: Factor1
Portfolio VaR: 3,694.1685, sum of component VaR: 3,694.1685.

TOP FACTOR SHARE: 65.31%
Risk is spread across factors without extreme concentration.

PORTFOLIO SIGMA: 2,291.2878
Aggregated factor volatility after applying the covariance matrix.

FACTOR COUNT: 2
The more factors you track, the more important correlations and component VaR signs become.

What to do next: Use the table below to explain which factors contribute the most to VaR.

Risk Attribution Details

PORTFOLIO VaR	PORTFOLIO SIGMA	PORTFOLIO VaR	COMPONENT SUM
75.0000	2,291.2878	3,694.1685	3,694.1685

Factor	Delta Cash	Marginal VaR	Component VaR	Share %
Factor1	100,000.00	0.0241	2,432.7790	65.31
Factor2	-50,000.00	-0.0235	1,261.3895	34.69

► Show details

Factor attribution points to the assets that account for most of the risk.

The user does not have to trust the number. The platform shows how it was checked.



Methods used in the platform

Single-asset risk

Three VaR methods: historical, parametric, Monte Carlo. Plus Expected Shortfall for the loss in the tail and Liquidity-adjusted VaR for the cost of exiting the position.

Portfolio

Covariance aggregation, correlations, efficient frontier with random portfolios, Sharpe ratio.

Options

Black-Scholes pricing, all five Greeks, option VaR by delta-gamma and by full revaluation under simulated paths.

Other instruments

Bonds, swaps, futures, SPFI forwards. Hedge constructor for chosen positions.



Backtesting and internal checks

Backtesting

We take a historical price series, predict VaR for each day in the past, and count how many days the actual loss exceeded the prediction. The count should match the chosen confidence level.

Two standard tests

Kupiec checks if the number of exceptions matches the expected one. Christoffersen adds a check that exceptions are not clustered in time. Both run inside the Model Check module.

Internal checks

VaR_99 must be greater than VaR_95. ES must be greater than VaR. Portfolio risk must be less than the weighted sum of single risks. Greeks must have the correct sign. The platform checks these on every run.

Method comparison

Three VaR methods on the same data should give close numbers. A wide gap signals non-normal returns. We show this to the user, not hide it.



Metrics shown to the user

Risk numbers

VaR (three methods), ES, LVaR, daily PnL, position size, ratio of VaR to position. For portfolios: portfolio VaR, asset weights, contribution per asset, correlations.

Option metrics

Price, delta, gamma, vega, theta, rho. Option VaR by two methods. Profit and loss diagram.

Validation metrics

Exception count, exception ratio, Kupiec p-value, Christoffersen p-value, verdict (passed or failed).

Severity tag

Risk Copilot classifies the result as Low, Moderate or High based on VaR to position ratio. The tag is shown next to the number with the same color in the PDF.



What we delivered

A working web service with ten analytical modules, data integrations and a PDF report

End-to-end

From ticker search to PDF. No external tools needed.

Wide method coverage

Single-asset risk, portfolio, options, stress and backtests in one place.

Deployed, not a notebook

Containerized and hosted - the project is reachable via a URL.

Plain-language outputs

Every result is paired with method, severity and a PDF the user can keep.

Separate methods became one service with one workflow.

Ten modules. Two data sources. One platform. PDF on every result.

From input to decision

Market data and user inputs



Calculated risk metrics



Interpretation and hedge ideas

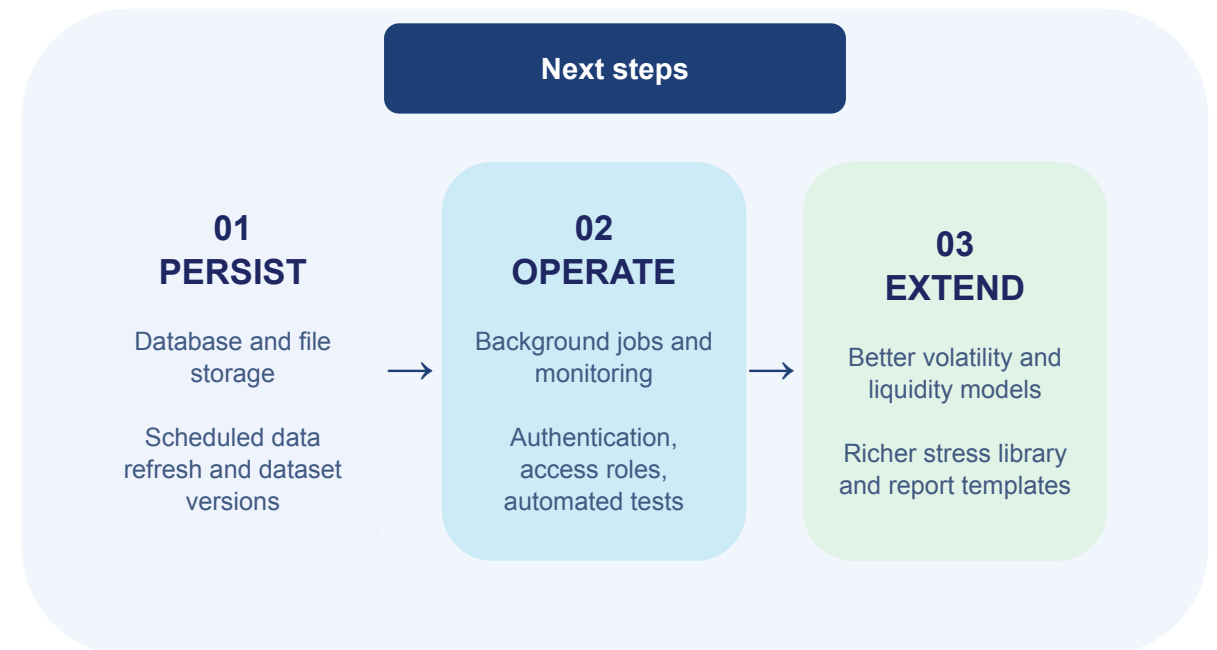
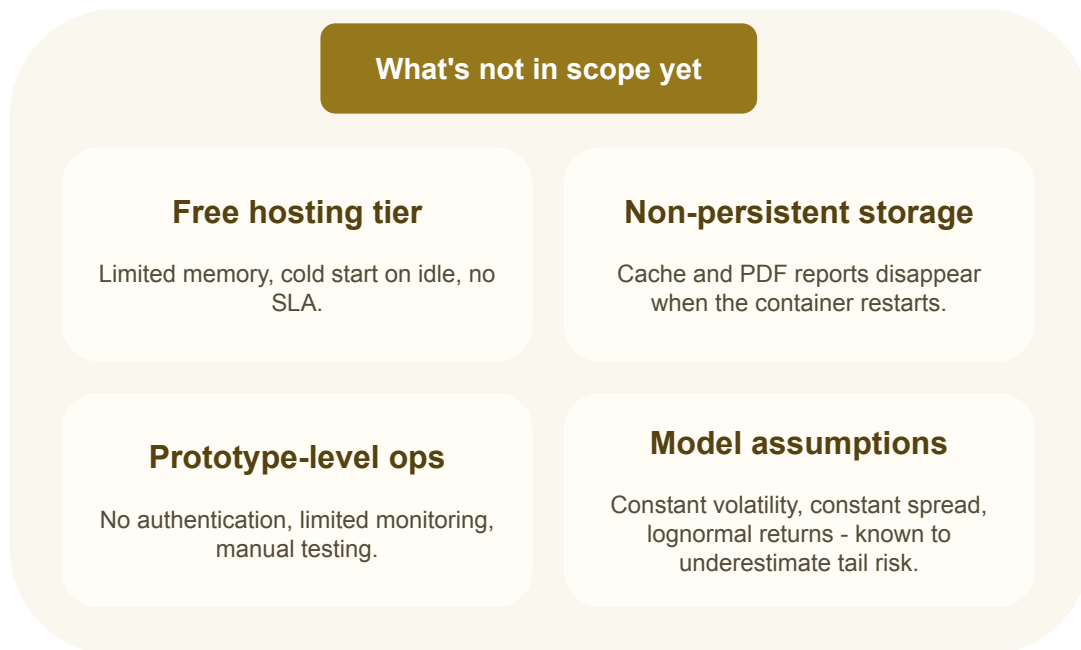


Final PDF report



Limitations and next steps

What the prototype does not have, and what comes next



The architecture can grow in stages. Each step is independent.



Financial effect and applicability

Direct financial effect: none

This is a coursework prototype. It is not sold, not licensed, and does not target commercial use in its current form. We do not claim revenue or cost savings.

Indirect effect: time and access

A risk analyst writing ad-hoc Python scripts spends roughly 30-60 minutes per single-asset or portfolio report. Our service produces the same numbers, charts and a PDF in under 2 seconds. For routine reports this is real saved time.

Educational applicability

The platform covers methods from the standard risk-management syllabus (VaR, ES, LVaR, portfolio risk, Greeks, backtesting). It can be used as a teaching tool without the cost of Bloomberg or MSCI access.

Path to commercial use

Production work listed in Future Work (database, authentication, monitoring, advanced volatility models) is what would be required before any commercial deployment. We do not claim the prototype is production-ready.



Live prototype

Open the live prototype:

<https://risk-calculator-ffol.onrender.com/>

What to try (not all at once, please):

1. Search a ticker on MOEX (e.g. SBER)
2. Run single-asset risk
3. Switch to Portfolio - add 2-3 instruments
4. Download the PDF report



