

NOVABANK S.A.

Simulation Optimization Loan Product Policy

⁰¹ Description of business

NOVABANK S.A.

- is a **modern** and **medium-sized commercial bank** in Warsaw.
- **provides** a variety of **financial products** for individual customers and small businesses, including: **payment accounts, credit cards, savings, and consumer loan packages**.
- needs to **develop new, smarter loan products, combining data and simulation to ensure:**
 - **Growth in lending revenue**
 - **Minimizing credit risk** by applying predictive and optimization models
 - **Maintaining a competitive position** in the rapidly changing Polish banking industry

01

NOVARATE

a **smart loan product** designed to **optimize profitability** while maintaining a disciplined approach to credit risk.

NovaRate is structured as a fixed-term installment loan, offering borrowers a principal amount of 50 000 PLN over a period of 5 years (60 months).

The product targets financially stable individuals who seek medium-term financing for purposes such as home renovation, business expansion, or asset acquisition.

02 Description of the problem

Objective: Maximize expected profit while controlling portfolio risk, within the business constraints provided by internal stakeholders, by selecting the optimal:

- Interest rate (r)
- Maximum probability of default threshold (PD threshold, t)

Variable	Range	Department	Reason
Interest Rate	Minimum 6%, maximum 12%	Finance & Sales	Ensures profitability while remaining competitive in the market
PD threshold	Approve only customers with $PD \leq 15\%$	Risk Management	Controls credit risk and prevents approving overly risky clients
Acceptance rate	At least 30%	Sales/ Business Development	Ensures marketing effectiveness and customer acquisition
Total risk exposure	Maximum 4 000 000 PLN	Risk Management	Limits total portfolio risk exposure
Expected profit	Minimum expected profit of 2 000 000 PLN	Finance	Guarantees the product is profitable after cost of capital and credit losses

$$Max \left(\sum_{i=1}^N (1 - PD_i) * A * r * y - PD_i * LGD rate * A - c_{op} \right) - \lambda * \left(\sum_{i=1}^N PD_i * LGD rate * A \right)$$

with:

- PDi: probability of customer i being default
- A: loan amount
- r: interest rate
- y: duration of loan in year
- LGD rate: loss given default rate
- c_op: cost of operation per loan
- λ : risk aversion of the bank

Objective function

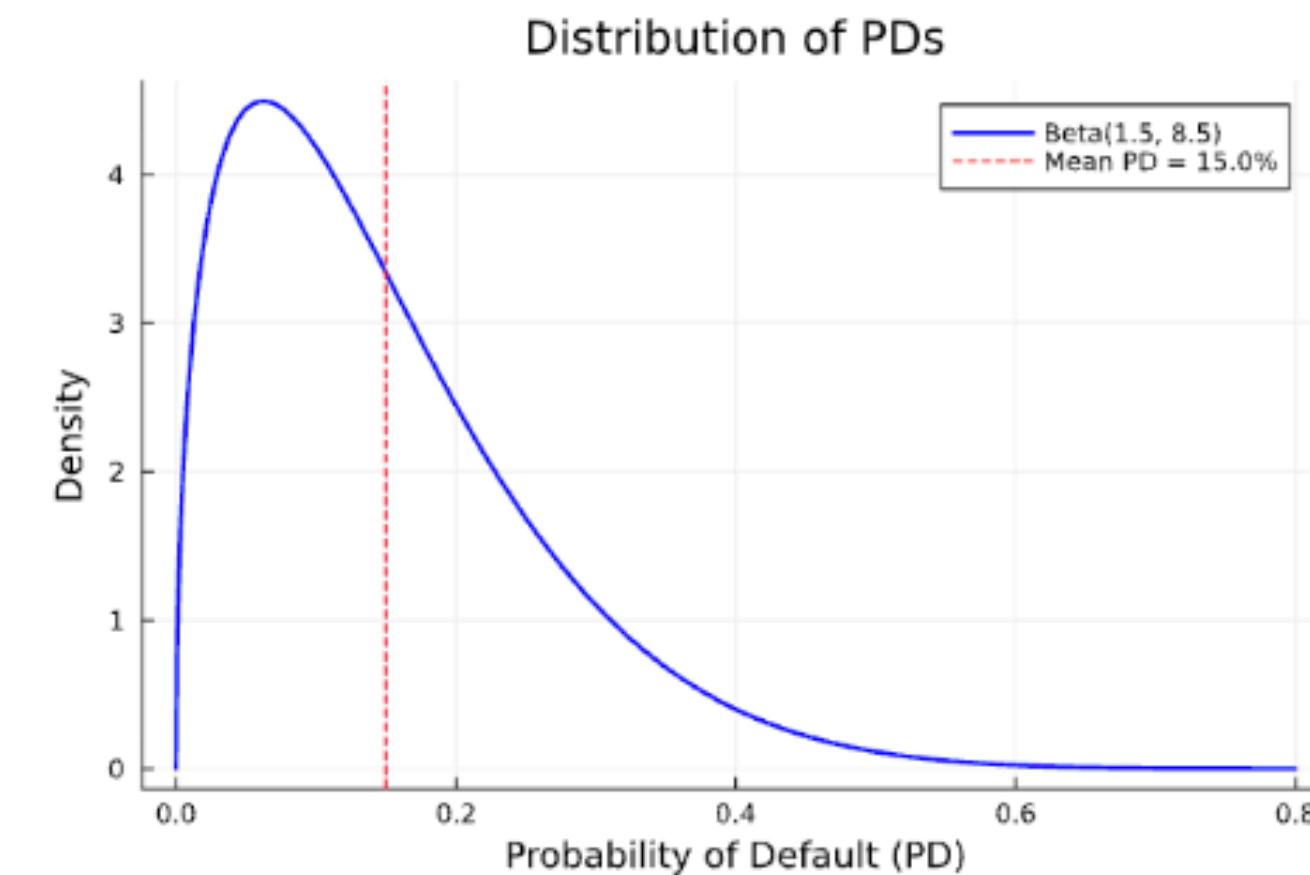


Figure 1: The assumed Distribution of Customers Probability of Default

04

Results and analysis

Opt. Interest rate	Opt. PD threshold	Exp. Profit	Exp. Acceptance rate	Exp. Total risk exposure	Exp. Objective value
12%	8%	83 276	30%	3 765	82 146

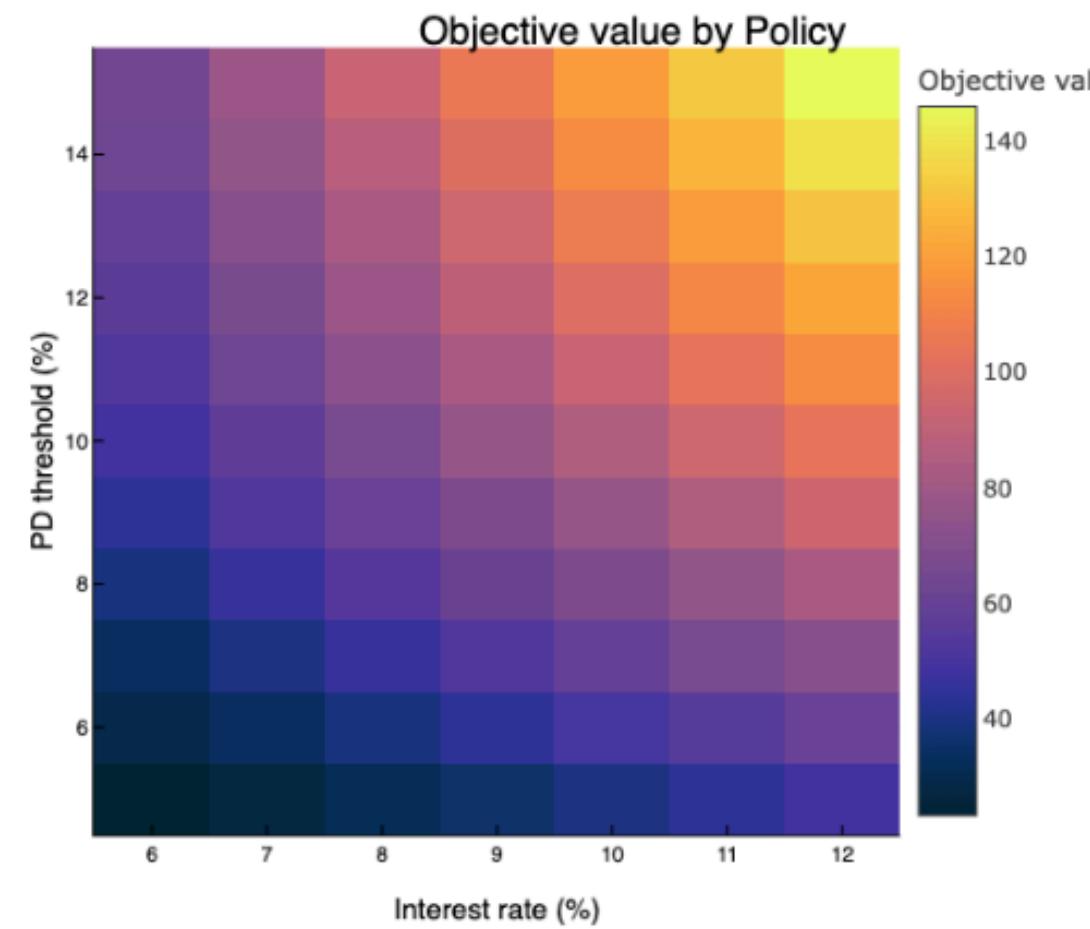


Figure 2: Objective value by different policies

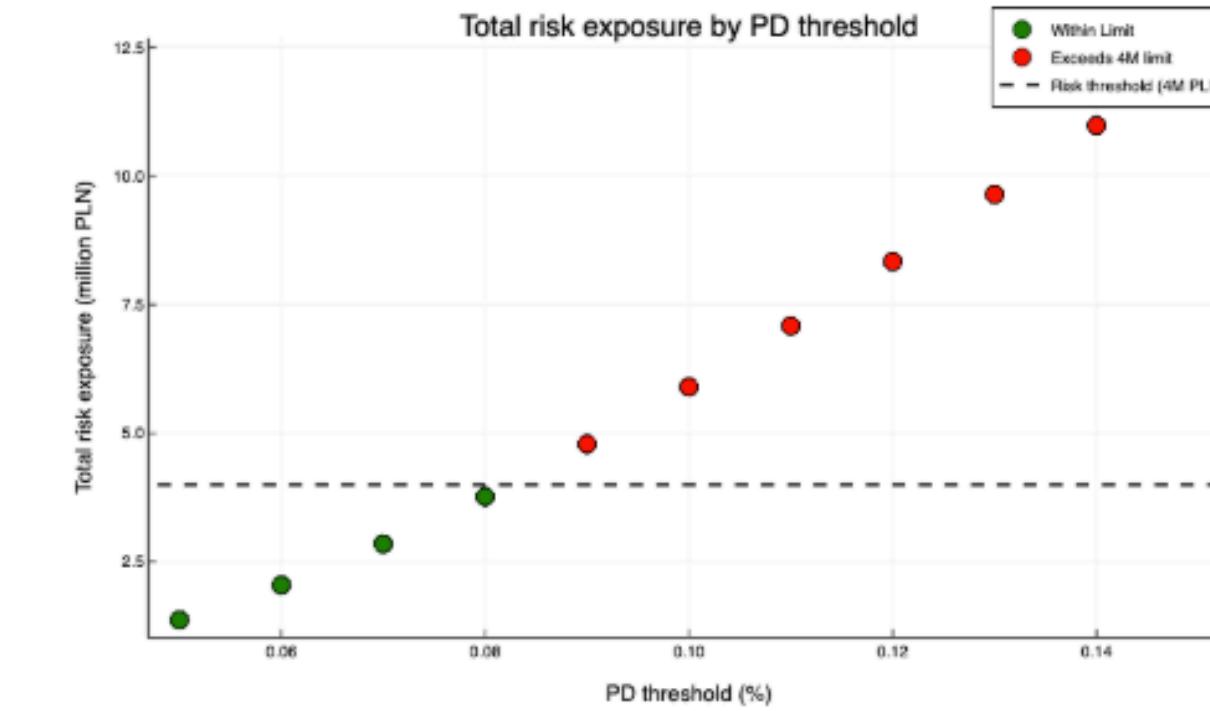


Figure 3: Expected total risk exposure by different PD threshold

Sensitivity analyses

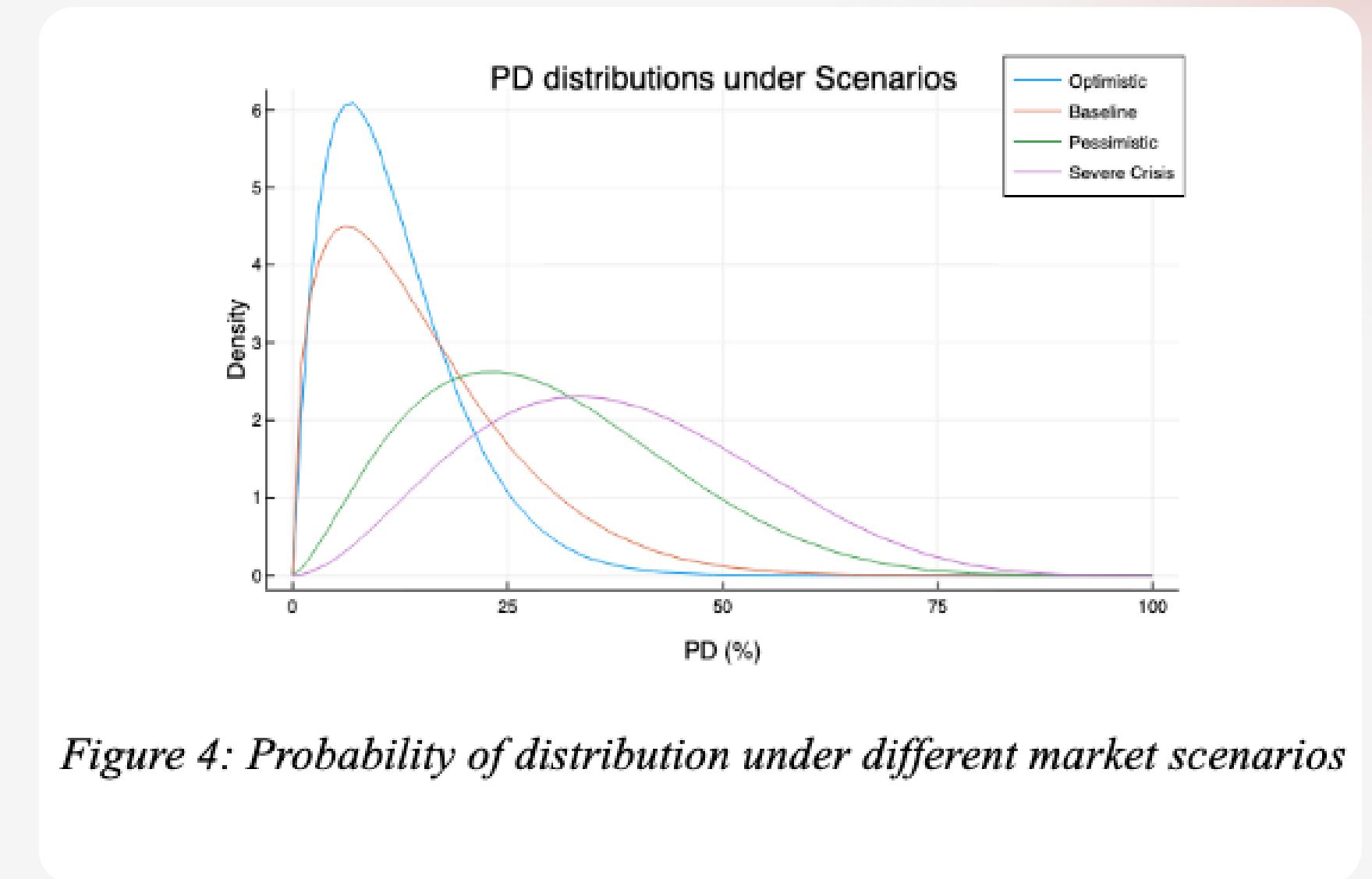
Parameter	Impact on optimal policy (r, t)
Risk Aversion (λ)	Higher risk aversion leads to stricter thresholds and potentially lower interest rates to retain low-risk customers → t may be increased, r may be decreased or unchanged
Loss Given Default (LGD)	Higher LGD leads to higher compensation via increased rates and tighter approval policies → t may be increased, r may be increased
PD distribution (β_a, β_b)	Riskier population means tighter approval and higher interest to mitigate default exposure → t may be increased, r may be increased
Loan amount (A)	Larger loans increase returns and may allow more flexibility in approval → t may be decreased or unchanged, r may be increased
Operation cost per loan (c_{op})	Larger loans increase returns and may allow more flexibility in approval → t may be decreased or unchanged, r may be increased

05 Sensitivity analyses

Distribution of Probability of Default (beta_a, beta_b)

To explore the best-performing credit approval strategies under varying market conditions, we conducted an unconstrained optimization using the same grid search over interest rates and PD thresholds.

Scenario	Opt. interest rate	Opt. PD threshold	Exp. Profit (M PLN)
Optimistic	12%	7%	84 099
Baseline	12%	8%	83 276
Pessimistic	12%	12%	28 136
Severe Crisis	12%	12%	10 228



05 Sensitivity analyses

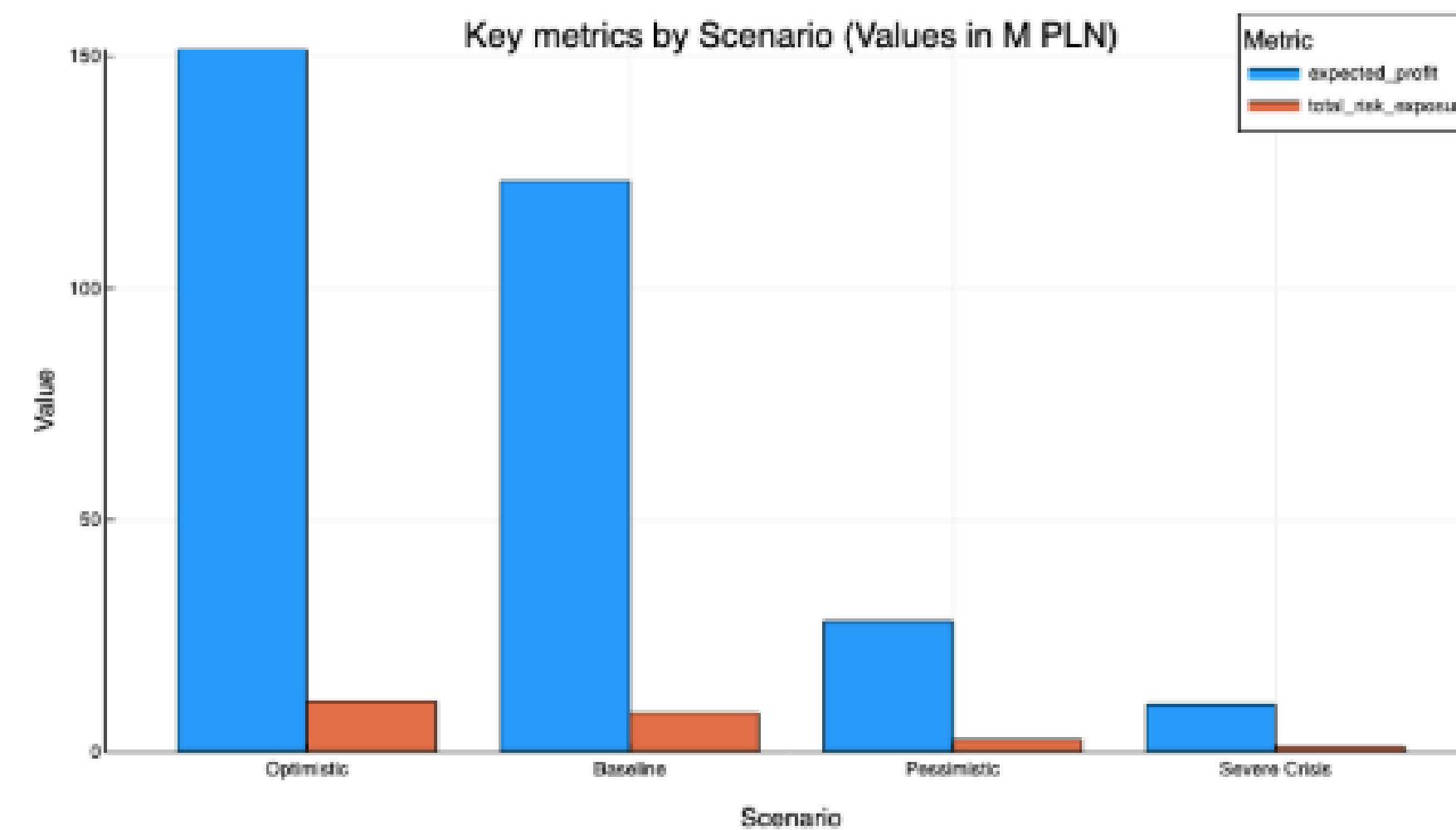


Figure 5: Expected profit and Expected total risk exposure under different market scenarios

⁰⁵ Sensitivity analyses

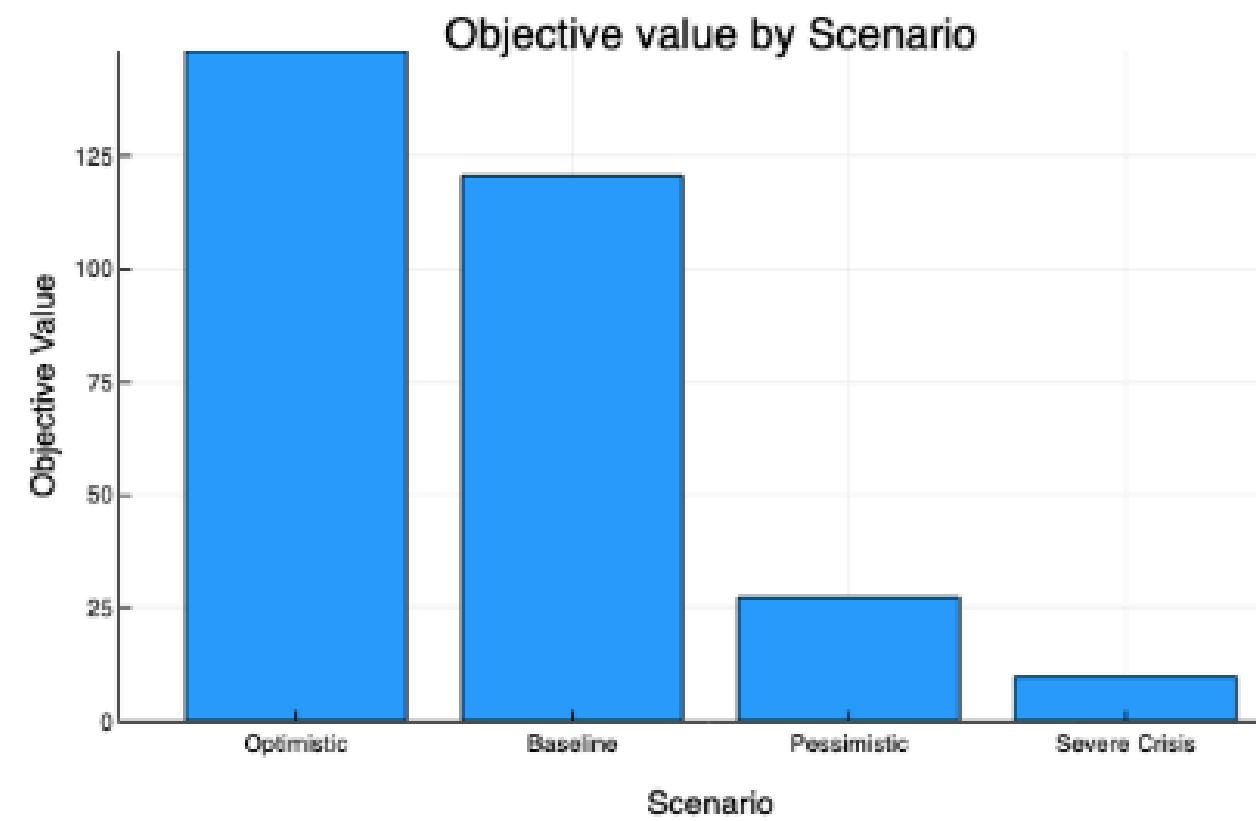


Figure 6: Expected Objective value in different market scenarios

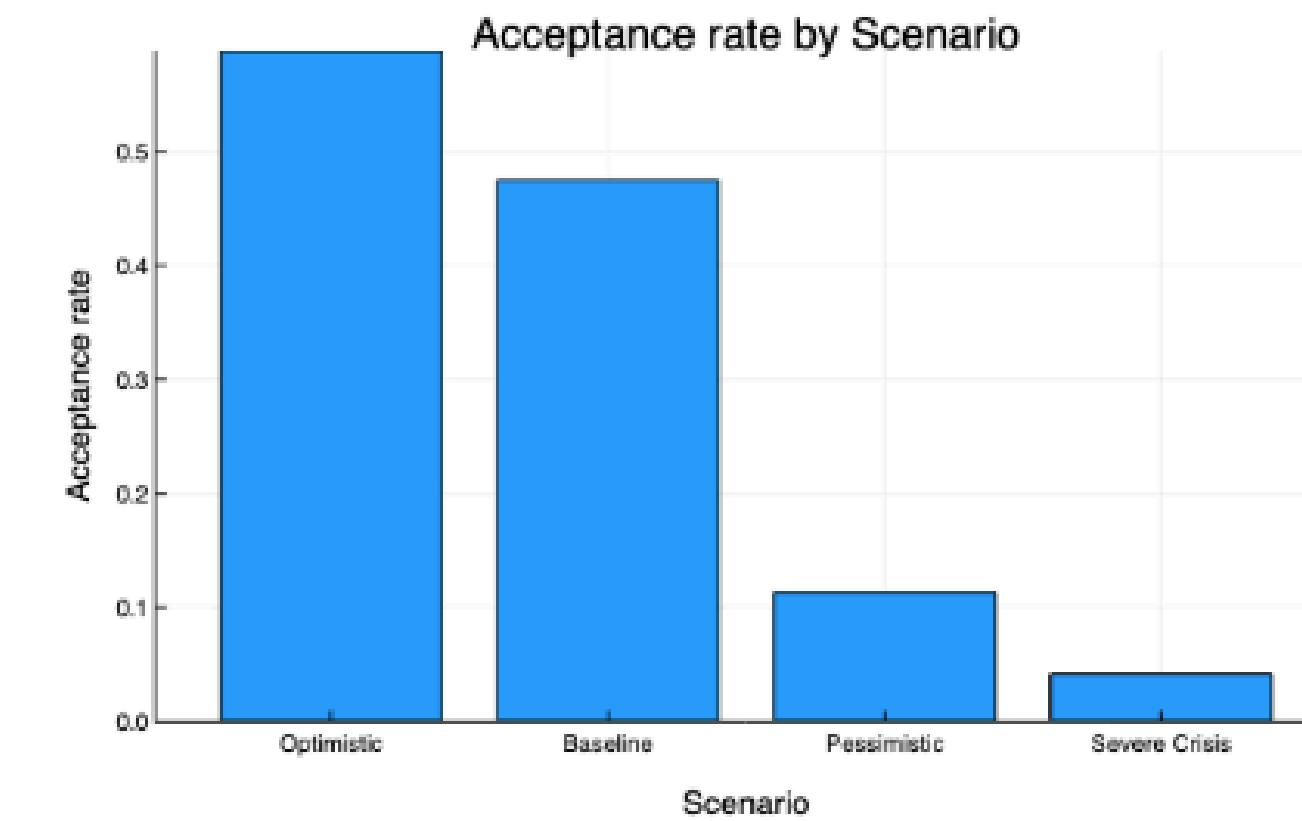


Figure 7: Expected Acceptance rate in different market scenarios

05 Sensitivity analyses

Bank's risk aversion (λ - lambda)

Risk-neutral	$\lambda = 0.0$
Low aversion	$\lambda = 0.1$
Moderate aversion	$\lambda = 0.3$
High aversion	$\lambda = 0.6$
Extreme aversion	$\lambda = 1.0$
Stress testing	$\lambda = 3.0$

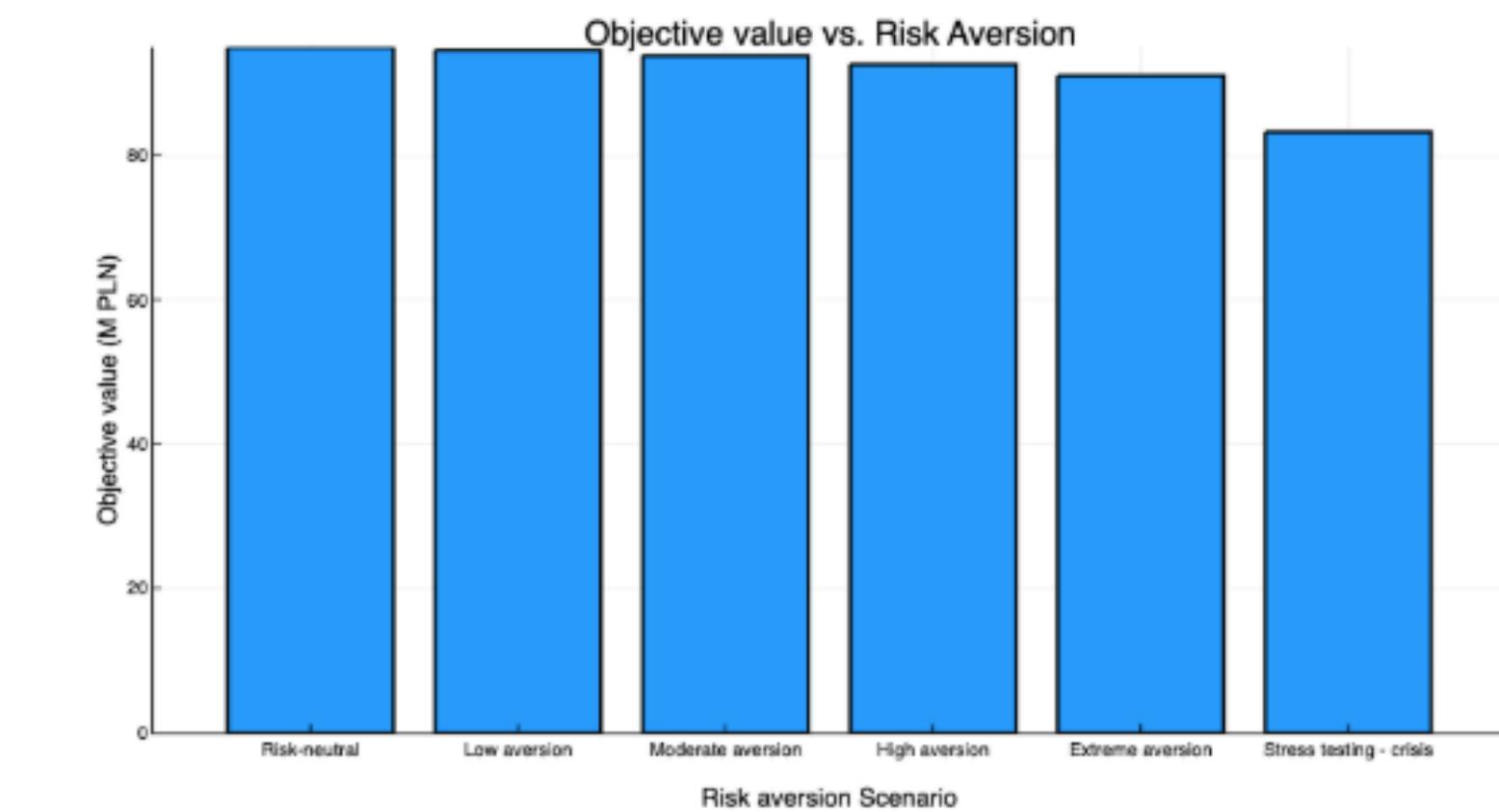


Figure 8: Objective value under different bank's risk aversion scenarios

05 Overall recommendation

The optimization framework, driven by simulation-based modeling, offers a robust and practical decision support tool.

- The proposed policy (12% interest rate, PD threshold $\leq 8\%$) maximizes profit (PLN 83M) while maintaining risk within acceptable bounds.
- The solution is resilient to market shifts, enabling NovaBank to adapt without reengineering the entire process.
- It aligns with NovaBank's long-term goals of:
 - Product innovation
 - Credit process automation
 - Integrated enterprise risk management

Recommendation: Integrate this model into NovaBank's credit risk infrastructure to enhance future readiness and decision making across credit products.

**Thank
You!**