Lesson 2.3 Exercises: Democratizing Investment and Lending

Module 2: The Access Problem

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Digital Finance — BSc Course

Exercise 1: Sharpe Ratio Calculation

Scenario: The risk-free rate is 2.0%. You are evaluating three investment options:

Investment	Expected Return	Std. Deviation
Government Bond Fund	3.5%	3.0%
Balanced ETF Portfolio	7.0%	11.0%
Growth Equity Fund	11.0%	22.0%

Tasks:

a. Calculate the Sharpe ratio for each investment.

b. Rank the three investments by risk-adjusted performance (best to worst).

c. An investor says: "The Growth Equity Fund is the best because it has the highest return." Is this correct? Explain using the Sharpe ratio.

d. Under what circumstances might an investor rationally choose the Growth Equity Fund despite its lower Sharpe ratio?

Difficulty: Introductory — tests Sharpe ratio computation and interpretation.

Exercise 2: The Compounding Cost of Fees

Scenario: Three investors each deposit $25,000 today. All portfolios earn 7.0% gross return annually. The only difference is fees:

Investor / Product	Annual Fee
Alice — DIY index fund	0.05%
Bob — Robo-advisor	0.25%
Carol — Traditional advisor + active fund	1.50%

Tasks:

a. Calculate each investor's portfolio value after 10, 20, and 30 years. Use: $V = P \times (1 + r - f)^t$.

b. Calculate the total dollar fees "lost" by each investor after 30 years, relative to a zero-fee benchmark $V_0 = 25{,}000 \times (1.07)^{30}$.

c. Carol's advisor claims: "My expertise adds at least 1% of value annually." What gross return must Carol's advisor achieve to match Alice's net outcome after 30 years?

d. Create a one-paragraph argument **for** and **against** paying 1.50% for a human advisor.

Difficulty: Intermediate — requires compounding and financial reasoning.

Exercise 3: Rebalancing Decision

Scenario: A robo-advisor manages a portfolio with a target allocation of 60% equity / 40% bonds and a ± 5 percentage point threshold band. The portfolio started the year at target with \$100,000.

After market movements:

Asset Class	Start Value	Return	End Value
Equity	\$60,000	+15%	\$69,000
Bonds	\$40,000	+2%	\$40,800
Total	\$100,000		\$109,800

Tasks:

a. Calculate the new portfolio weights (equity % and bond %).

b. Has the threshold been breached? Show the calculation.

c. If rebalancing is triggered, calculate the dollar amounts to sell/buy to restore 60/40.

d. What is the Sharpe ratio of the portfolio if the standard deviation is 9% and the risk-free rate is 2%? (Use the actual return earned this year as r_p.)

Difficulty: Intermediate — combines rebalancing mechanics with Sharpe ratio.

Exercise 4: P2P Lending Portfolio Returns

Scenario: An investor allocates \$5,000 across 200 P2P loans (\$25 each) on a marketplace lending platform. The loans are distributed across risk grades:

Grade	Loans	Interest Rate	Default Rate	Recovery Rate
A (low risk)	80	5.0%	2%	50%
B (medium)	80	9.0%	6%	30%
C (high risk)	40	14.0%	12%	20%

Tasks:

a. Calculate the gross interest income from each grade (assume 1-year loans, interest on performing loans only).

b. Calculate the loss from defaults for each grade (principal lost minus recovery).

c. Calculate the net return for the entire portfolio (total interest − total losses) as a dollar amount and as a percentage.

d. The platform charges a 1% annual servicing fee on the total invested amount. What is the investor's net return after the platform fee?

Difficulty: Intermediate–Advanced — multi-step P2P return calculation.

Exercise 5: Loan Default Waterfall Analysis

Scenario: A P2P platform publishes the following loan pool statistics after 24 months (1,000 original loans, $10 average principal each):

Status	Number of Loans
Performing (current)	870
Late 30 days	45
Late 60+ days	25
Defaulted (charged off)	60
Of defaulted: recovered	18
Of defaulted: total loss	42

Tasks:

a. What is the cumulative default rate after 24 months?

b. What is the recovery rate on defaulted loans?

c. Calculate the total dollar loss (net of recovery) for an investor who funded the entire pool.

d. If the average interest rate was 8% annually, was the investor's net return positive or negative after 24 months? Show the calculation.

Difficulty: Intermediate — applies the waterfall framework with real-world-style data.

Exercise 6: Robo-Advisory Value Proposition

Scenario: A 30-year-old professional with $15,000 to invest compares two options:

	Robo-Advisor	**Traditional Advisor**
Minimum investment	$0	$50,000
Annual fee	0.25%	1.00%
Portfolio	5 ETFs (MPT-optimized)	8 mutual funds
Rebalancing	Threshold (automated)	Quarterly (manual review)
Tax-loss harvesting	Automated (daily scan)	Manual (annual review)
Human contact	Chat/email only	Quarterly meetings

Tasks:

a) Can this investor use the traditional advisor? Why or why not?

b) Estimate the value of tax-loss harvesting at 0.5% per year. Over 30 years with a 7% gross return, how much extra wealth does TLH generate on $15,000?

c) Identify two scenarios where the **traditional advisor** provides value that the robo-advisor cannot.

d) Write a recommendation for this investor, considering both quantitative and qualitative factors.

Difficulty: Advanced — requires multi-dimensional comparison and judgment.

Exercise 7: Microfinance Cost Analysis

Scenario: A microfinance institution (MFI) makes loans with the following cost structure (all values synthetic and annual):

Cost Component	Amount per Loan
Loan origination (fixed)	\$15
Credit assessment (fixed)	\$8
Disbursement and collection (fixed)	\$12
Cost of funds (variable, 6% of principal)	Variable
Expected credit losses (8% of principal)	Variable
Target profit margin (3% of principal)	Variable

Tasks:

a. Calculate the break-even interest rate for a \$100 loan (fixed costs + variable costs as % of principal).

b. Calculate the break-even interest rate for a \$500 loan.

c. Calculate the break-even interest rate for a \$5,000 loan.

d. Explain why microfinance rates are high and what technological innovation could reduce them.

Difficulty: Intermediate — combines fixed/variable cost analysis with access implications.

Exercise 8: Building a Democratized Investment Strategy

Scenario: Maria, a university graduate earning $35,000/year, wants to start investing. She has $2,000 saved and can add $200/month. She has a 30-year time horizon (retirement) and moderate risk tolerance.

Tasks:

a. A traditional advisor requires $50,000 minimum. How many months would Maria need to save $200/month to meet this requirement (ignore interest)?

b. Using a robo-advisor at 0.25% fee with a 60/40 portfolio (expected return 6.5%, $\sigma = 10\%$, $r_f = 2\%$), calculate the Sharpe ratio.

c. If Maria invests $2,000 now plus $200/month at 6.25% net return (6.5% − 0.25%) for 30 years, what is her projected portfolio value? Use: $V = P(1+r)^n + \text{PMT} \times \frac{(1+r)^n - 1}{r}$ where r is the monthly rate.

d. Maria considers allocating 10% of her portfolio to P2P loans at 7% expected net return (after defaults). Discuss the trade-offs: diversification benefit vs. added risks.

e. Write a three-sentence investment plan for Maria, covering platform choice, allocation, and risk management.

Difficulty: Advanced–Integrative — combines all lesson concepts into a realistic scenario.