

ARPM Certificate

Level 2

Example

This is an example of examination sheet for the Certificate in Advanced Risk and Portfolio Management (ARPM Certificate) - Level 2.

The exercises below test the following modules from the body of knowledge:

- Financial engineering
- Quantitative risk management
- Quantitative portfolio management.

The exam is graded according to the breakdown policy specified on the examination sheet. The grade for the exam is a number L_2 in the interval $[0, 1]$, computed via an increasing function $L_2(p)$, where p is the total number of points that you collect by solving the exercises below. The minimum score to pass is 0.65.

Exercise 1 True or false? Justify your answers

Note: 1 point is assigned to correct True/False; 4 points are assigned to a correct motivation.

1. *[5 points]* According to the law of one price, if two European call options on the same underlying have the same strike, they should have the same value.
2. *[5 points]* Given a large sample of weekly observations of the price of a stock, the sample standard deviation provides a good estimate for the volatility of the stock value over a one-week horizon.
3. *[5 points]* The duration of a bond is the average time it takes to receive all the cash flows of a bond, weighted by the present value of each of the cash flows.
4. *[5 points]* Consider two normal random variables $X_1 \sim N(1, 1)$ and $X_2 \sim N(0, 5)$. The random variable X_1 strongly dominates X_2 .
5. *[5 points]* If we consider the P&L as measure of performance, the information ratio is a positive homogeneous (of order one) measure of satisfaction.
6. *[5 points]* The function $f(x) = 3(x - 1)^2$ can be used as a spectrum to define a coherent spectral measure of satisfaction/risk.
7. *[5 points]* The ex-ante return of a portfolio can be attributed linearly to a set of risk factors by means of the Euler decomposition.
8. *[5 points]* The allocation obtained with the resampling approach may not satisfy the investment constraints.
9. *[5 points]* In the context of cross-sectional strategies, signal characteristics are the regression loadings of the risk drivers \mathbf{X}_{t+1} on the signals \mathbf{S}_t .
10. *[5 points]* Constant proportion portfolio insurance is a time series strategy that guarantees the value stays above a minimum target.

Exercise 2 The Checklist: historical projection and pricing at the horizon

1. [7 points] Assume that the log-value of an equity share $X_t \equiv \ln V_t^{stock}$ follows a random walk $X_{t+1} = X_t + \varepsilon_{t+1}$ and that the shock ε_t is modeled via its historical distribution with flexible probabilities $\{\varepsilon_t, p_t\}_{t=1}^{\bar{t}}$.
Write the scenario-probability distribution of the P&L $\Pi_{t_{now} \rightarrow t_{hor}}^{stock}$ at the horizon $t_{hor} = t_{now} + 1$ day, as function of the realizations $\{\varepsilon_t\}_{t=1}^{\bar{t}}$.
2. [7 points] Assume now that $X_t \equiv \ln V_t^{stock}$ follows a GARCH(1,1) model, where the residual ε_t is modeled via its historical distribution with flexible probabilities $\{\varepsilon_t, p_t\}_{t=1}^{\bar{t}}$.
Write the scenario-probability distribution of the P&L $\Pi_{t_{now} \rightarrow t_{hor}}^{stock}$ at the horizon $t_{hor} = t_{now} + 1$ day, as function of the realizations $\{\varepsilon_t\}_{t=1}^{\bar{t}}$.

Exercise 3 The Checklist: risk and portfolio management steps

[20 points] Assume that, by applying the steps of the Checklist, you obtained the scenario-probability distribution of the ex-ante P&Ls of 500 stocks over the investment horizon

$$\mathbf{\Pi} \sim \{\boldsymbol{\pi}^{(j)}, p^{(j)}\}_{j=1}^{\bar{j}}. \quad (1)$$

Using pseudo-code, write the steps that you would use to set up and solve a mean-variance optimization problem, where:

- the investment constraints are the full investment of the budget and no short selling;
- the risk/satisfaction is measured by the expected shortfall of the portfolio *return* distribution at confidence level 90% (you can assume to have a function that computes spectral measures of satisfaction given the spectrum and the distribution of the ex-ante performance).

Exercise 4 Market buy/sell liquidity curve.

[16 points] Define the market buy and market sell liquidity curves and briefly summarize their interpretation.