



# AIFMD ESMA/CSSF Reporting Handbook

AIFMD  
ANNEX IV  
REPORTING

A Practical Guide to Annex IV  
Reporting, Risk Data, XML Validation,  
Python Workflows, and Control Design



● SYNTHETIC DATA. REALISTIC WORKFLOW. PROFESSIONAL CONTROL LOGIC.

# AIFMD Annex IV ESMA/CSSF Reporting Handbook

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Theory, definitions, equations, calculations, controls, Python automation, XML generation, validation, filing evidence, and production operation

Get the full package files here: [AIFMD Annex IV Reporting Automation Package](#)

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## Legal And Operating Boundary

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This handbook teaches an AIFMD Annex IV reporting workflow and the implementation pattern used in the local automation package. It is not legal advice, regulatory advice, or permission to submit a filing. A real filing requires a real authorised or registered AIFM, real fund data, current official regulatory templates and schemas, current CSSF identifiers, authorised submission access, and internal sign-off.

The package used here is deliberately marked synthetic. Do not submit its example identifiers, XML files, or filing zip to a regulator.

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## How To Use This Handbook

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This handbook is meant to stand alone. A reader can study it from zero background and learn:

- what AIFMD Annex IV reporting is;
- what DATMAN and DATAIF reports represent;
- what NAV, AUM, exposure, leverage, liquidity, DV01, CS01, VaR, and concentration mean;
- how to structure source data;
- how to calculate reporting metrics;
- how to implement the workflow in Python;
- how to generate XML;
- how to validate XML against XSD schemas;
- how to build control packs and evidence packs;
- how to prepare a CSSF-style filing layer;
- how to operate, test, govern, and harden the process.

Recommended path:

1. Study Parts 0-4 to build the prerequisite knowledge base.
  2. Study Parts 5-11 to learn professional finance, risk, valuation, liquidity, governance, and reporting quality.
  3. Use Parts 12-15 to practise the analyst workflow and connect the added books to AIFMD reporting.
  4. Use the Applied Modules and appendices as the implementation manual for the local automation package.
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# Before AIFMD: The Knowledge Map

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This book is not only about filling a template. AIFMD reporting sits at the intersection of finance, accounting, portfolio data, risk, regulation, data engineering, Python automation, XML validation, and operational controls.

A person starting from zero should learn the subjects in this order:

Stage	Subject	Why it matters for AIFMD reporting
1	Basic arithmetic and percentages	Almost every reported measure is a ratio, percentage, total, or reconciliation
2	Time periods and dates	Reporting periods, quarters, valuation dates, maturities, and submission deadlines
3	Accounting basics	NAV, assets, liabilities, valuation, income, and fund books
4	Investment fund basics	AIFM, AIF, investors, subscriptions, redemptions, strategies
5	Financial instruments	Loans, bonds, equities, derivatives, cash, financing, collateral
6	Market value and exposure	Difference between accounting value and risk exposure
7	Leverage	Gross and commitment methods, borrowing, derivatives, netting, hedging
8	Risk measures	DV01, CS01, VaR, stress tests, concentration, counterparty risk
9	Liquidity	How quickly assets can be sold and investors can redeem
10	Data analysis	Cleaning, validating, aggregating, grouping, reconciling
11	Excel	Source templates, validation workbooks, sign-off packs
12	Python	Reproducible calculations and automation
13	XML and XSD	Regulatory machine-readable submission files
14	Controls and governance	Evidence, sign-off, audit trail, maker/checker, exception handling
15	AIFMD Annex IV workflow	Turning raw AIFM/AIF data into validated reports and filing evidence

The key idea is this:

AIFMD reporting is a controlled transformation of source data into regulator-readable structured data, with evidence that the transformation is complete, correct, approved, and reproducible.

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# Part 0 - Mathematical And Data Foundations

## 0.1 Numbers, Units, And Sign Conventions

Financial reporting fails when people mix units or signs. Before doing anything with AIFMD data, identify:

- currency, such as EUR, USD, GBP;
- scale, such as units, thousands, or millions;
- sign, such as positive asset value and negative liability value;
- date, such as trade date, settlement date, valuation date, or reporting date;
- source, such as administrator, portfolio accounting system, risk system, or manual override.

Example:

Raw value	Possible meaning	Risk
248750000	EUR 248.75 million	Clear if currency is known
248.75	EUR 248.75 or EUR 248.75 million	Dangerous without scale
-1750000	Negative derivative market value	Must not be treated as positive asset NAV without context
42,000,000	Gross derivative exposure	Not the same as market value

## 0.2 Percentages

A percentage means "per 100".

If a fund has AUM of EUR 312,400,000 and exposure to one sector of EUR 111,000,000, then:

$$\text{Sector exposure \% AUM} = \frac{\text{Sector exposure}}{\text{AUM}} \times 100 = \frac{111,000,000}{312,400,000} \times 100 = 35.53\%$$

The general formula is:

$$\text{Percentage} = \frac{\text{Part}}{\text{Whole}} \times 100$$

In Python:

$$\text{pct} = \text{part} / \text{whole} * 100$$

Control:

$$\text{Whole} \neq 0$$

Never divide by zero. If a denominator can be zero, define a rule before calculating.

## 0.3 Totals And Reconciliations

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A reconciliation proves that two independent views of the same fact agree.

Example:

$$\text{Difference} = \text{Source A value} - \text{Source B value}$$

$$\text{Difference \%} = \frac{\text{Difference}}{\text{Source B value}} \times 100$$

A pass/fail control can be:

$$|\text{Difference}| \leq \text{Tolerance}$$

Example:

$$|\text{Administrator NAV} - \text{Pipeline NAV}| \leq 1$$

This means the values must agree within EUR 1.

## 0.4 Weighted Averages

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Many portfolio metrics are weighted by exposure or market value.

If each position  $i$  has value  $x_i$  and weight  $w_i$ , then:

$$\text{Weighted average} = \frac{\sum_{i=1}^n w_i x_i}{\sum_{i=1}^n w_i}$$

Example uses:

- weighted average maturity;
- weighted average coupon;
- weighted average liquidity days;

- weighted average credit spread;
- weighted average duration.

## 0.5 Bucketing

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Bucketing means assigning each data row to a category based on a rule.

For liquidity:

$$\text{Bucket}(d) = \begin{cases} 0-1 \text{ days,} & d \leq 1 \\ 2-7 \text{ days,} & 1 < d \leq 7 \\ 8-30 \text{ days,} & 7 < d \leq 30 \\ 31-90 \text{ days,} & 30 < d \leq 90 \\ 91-180 \text{ days,} & 90 < d \leq 180 \\ 181-365 \text{ days,} & 180 < d \leq 365 \\ >365 \text{ days,} & d > 365 \end{cases}$$

Then:

$$\text{Liquidity bucket \%} = \frac{\sum \text{Market value in bucket}}{\sum \text{Market value in all buckets}} \times 100$$

## 0.6 Basic Statistics For Risk

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Risk reporting often uses statistical concepts.

### Mean

The mean is the average:

$$\bar{x} = \frac{1}{n} \sum_{i=1}^n x_i$$

### Variance

Variance measures dispersion:

$$\sigma^2 = \frac{1}{n-1} \sum_{i=1}^n (x_i - \bar{x})^2$$

## Standard Deviation

Standard deviation is the square root of variance:

$$\sigma = \sqrt{\sigma^2}$$

In finance, volatility is often standard deviation of returns.

## Return

Simple return:

$$R_t = \frac{P_t - P_{t-1}}{P_{t-1}}$$

Log return:

$$r_t = \ln \left( \frac{P_t}{P_{t-1}} \right)$$

For AIFMD operations, you do not always calculate VaR from scratch, but you must understand whether a risk system output is plausible.

## 0.7 Data Quality Rules

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Every source field should have:

- owner;
- definition;
- data type;
- allowed values;
- unit;
- sign convention;
- source system;
- reconciliation rule;
- exception process.

Example:

Field	Data type	Unit	Rule
NAV	Decimal	Base currency	Must be positive
AUM	Decimal	Base currency	Must be greater than or equal to NAV unless documented
LEI	Text	20 characters	Must be alphanumeric
Country	Text	ISO country code	Must be valid ISO 3166 code
Currency	Text	ISO currency code	Must be valid ISO 4217 code
Percentage	Decimal	Percent	Allocation totals must equal 100

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# Part 1 - Finance Foundations For AIFMD Reporting

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## 1.1 What A Fund Is

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An investment fund pools capital from investors and invests that capital according to a strategy.

Basic structure:

```
Investors -> Fund -> Assets
                -> Liabilities
                -> Service providers
                -> Manager/AIFM
```

The fund owns assets and owes liabilities. The net value belongs economically to investors.

## 1.2 Balance Sheet Logic

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The basic accounting equation is:

$$\text{Assets} = \text{Liabilities} + \text{Equity}$$

For a fund, equity is usually investor net assets:

$$\text{NAV} = \text{Assets} - \text{Liabilities}$$

If:

- assets = EUR 300,000,000;
- liabilities = EUR 51,250,000;

then:

$$\text{NAV} = 300,000,000 - 51,250,000 = 248,750,000$$

## 1.3 NAV

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NAV means net asset value.

$$\text{NAV} = \sum \text{Asset values} - \sum \text{Liabilities}$$

NAV is usually calculated by the fund administrator and is one of the most important values in reporting.

Controls:

$$NAV > 0$$

$$\text{Pipeline NAV} = \text{Administrator NAV}$$

within tolerance.

## 1.4 AUM

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AUM means assets under management. It is not always identical to NAV. AUM may include gross assets, regulatory adjustments, or other scope-specific treatments.

In the synthetic package:

$$AUM = 312,400,000$$

$$NAV = 248,750,000$$

Control:

$$AUM \geq NAV$$

This is implemented as:

```
passed = aum >= nav
```

## 1.5 Market Value

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Market value is the current value of a position.

For a loan, market value might be close to principal adjusted for credit quality.

For a derivative, market value can be much smaller than exposure and can be negative.

Example:

Instrument	Market value	Gross exposure
Senior loan	58,200,000	58,200,000
Interest rate swap	-1,750,000	42,000,000

The swap has negative market value but large risk exposure.

## 1.6 Exposure

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Exposure measures economic sensitivity or footprint. It is not always the same as market value.

For AIFMD reporting, exposure matters for:

- leverage;
- concentration;
- principal markets;
- principal instruments;
- counterparty risk;
- risk monitoring.

Gross exposure often uses absolute values:

$$\text{Gross exposure} = \sum_{i=1}^n |\text{Gross exposure}_i|$$

Commitment exposure uses a regulatory commitment method:

$$\text{Commitment exposure} = \sum_{i=1}^n |\text{Commitment exposure}_i|$$

## 1.7 Investors

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Investor data describes who owns the fund economically.

Example:

Investor type	Percentage
Insurance undertakings	41
Pension funds	33
Family offices	16
Other professional investors	10

Control:

$$\sum_{i=1}^n \text{Investor percentage}_i = 100\%$$

## 1.8 Strategy

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Strategy explains how the fund invests.

Example:

Strategy	Percentage
Senior secured corporate loans	72.5
Unitranche lending	14.0
Cash and liquidity	8.5
Other private credit	5.0

Control:

$$\sum_{i=1}^n \text{Strategy percentage}_i = 100\%$$

## 1.9 Common Asset Classes

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Asset class	Plain-English meaning	AIFMD reporting concern
Cash	Bank deposits or money market cash	Liquidity, counterparty concentration
Equity	Ownership in a company	Market risk, issuer concentration
Bond	Tradable debt security	Interest-rate risk, credit risk
Loan	Bilateral/private debt instrument	Credit risk, liquidity, sector concentration
Derivative	Contract whose value depends on another variable	Leverage, counterparty risk, exposure
Fund interest	Investment in another fund	Look-through, strategy, liquidity
Real estate	Property assets	Valuation, liquidity, leverage

## 1.10 Private Credit Example

The synthetic fund is a private credit style fund. It holds:

- senior secured loans;
- a unitranche loan;
- a revolving credit facility;
- an interest rate swap hedge;
- cash.

Key risks:

- borrowers may default;
- sectors may become concentrated;
- private loans may be illiquid;
- leverage may increase through facilities or derivatives;
- interest rates and credit spreads may move;
- cash may be concentrated at one bank.

# Part 2 - Risk Foundations

## 2.1 What Risk Means

Risk is the possibility that future outcomes differ from expectations. In fund reporting, risk is made visible through numbers.

Key risk types:

Risk type	Meaning	Example metric
Market risk	Loss from market price movement	VaR, stress loss
Credit risk	Loss from borrower/issuer default or spread widening	CS01, sector exposure
Interest-rate risk	Sensitivity to interest rates	DV01
Liquidity risk	Inability to sell assets or meet redemptions	Liquidity buckets
Counterparty risk	Loss from counterparty failure	Counterparty exposure
Concentration risk	Too much exposure to one area	Largest sector % AUM
Leverage risk	Exposure larger than capital base	Gross leverage % NAV
Operational risk	Error in process, system, or people	Failed control

## 2.2 DV01

DV01 means dollar value of one basis point. In EUR portfolios, people may still say DV01 even when the amount is in EUR.

It measures approximate value change for a 0.01% interest-rate move.

If a portfolio has:

$$DV01 = 50,000$$

then a one basis point move changes value by about EUR 50,000, depending on sign convention.

Aggregate:

$$\text{Total DV01} = \sum_{i=1}^n \text{DV01}_i$$

## 2.3 CS01

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CS01 means credit spread value of one basis point.

It measures approximate value change for a 0.01% change in credit spreads.

Aggregate:

$$\text{Total CS01} = \sum_{i=1}^n \text{CS01}_i$$

## 2.4 VaR

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VaR means Value-at-Risk.

A 99% 10-day VaR answers:

Under the model assumptions, what loss threshold should not be exceeded with 99% confidence over 10 days?

Simplified normal VaR:

$$\text{VaR}_\alpha = z_\alpha \sigma V$$

where:

- $z_\alpha$  is the confidence-level z-score;
- $\sigma$  is volatility;
- $V$  is portfolio value.

For 10-day scaling from 1-day volatility:

$$\sigma_{10d} = \sigma_{1d} \sqrt{10}$$

In production, VaR normally comes from a risk system, not from a simple formula in the reporting script. The reporting process must still reconcile and validate it.

## 2.5 Stress Testing

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Stress testing estimates losses under severe scenarios.

Example:

$$\text{Stress P\&L} = \sum_{i=1}^n \text{Position sensitivity}_i \times \text{Scenario shock}_i$$

Stress examples:

- credit spreads widen by 300 bps;
- rates rise by 100 bps;
- liquidity haircut increases;
- top borrower defaults;
- sector valuation falls by 20%.

## 2.6 Concentration Risk

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Concentration risk asks: is too much exposure in one place?

Largest counterparty:

$$\text{Largest counterparty \% AUM} = \frac{\max_c(\text{Exposure}_c)}{\text{AUM}} \times 100$$

Largest sector:

$$\text{Largest sector \% AUM} = \frac{\max_s(\text{Exposure}_s)}{\text{AUM}} \times 100$$

Country concentration:

$$\text{Country \% AUM} = \frac{\text{Exposure by country}}{\text{AUM}} \times 100$$

Controls in the synthetic package:

$$\text{Largest counterparty \% AUM} \leq 10\%$$

$$\text{Largest sector \% AUM} \leq 35\%$$

## 2.7 Leverage Risk

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Leverage means exposure is larger than the capital base.

Gross leverage:

$$\text{Gross leverage \% NAV} = \frac{\text{Gross exposure}}{\text{NAV}} \times 100$$

Commitment leverage:

$$\text{Commitment leverage \% NAV} = \frac{\text{Commitment exposure}}{\text{NAV}} \times 100$$

Control:

$$\text{Gross leverage \% NAV} \leq 150\%$$

unless reviewed.

## 2.8 Liquidity Risk

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Liquidity risk asks whether assets can be sold or realised in time to meet obligations.

Asset liquidity profile:

$$\text{Bucket value}_b = \sum_{i \in b} \max(\text{Market value}_i, 0)$$

$$\text{Bucket percentage}_b = \frac{\text{Bucket value}_b}{\sum_b \text{Bucket value}_b} \times 100$$

Investor liquidity must also be understood:

- redemption frequency;
- notice period;
- lock-up;
- gates;
- side pockets;
- suspension powers.

The reporting analyst must compare asset liquidity and investor liquidity. A fund with illiquid loans and frequent investor redemptions requires careful review.

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# Part 3 - Data Analysis From Raw AIFM Data

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## 3.1 What Opening The Raw Data Means

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When you open raw AIFM/AIF data, do not start calculating immediately. First classify the data.

Ask:

1. What entity does this file describe: AIFM, AIF, portfolio, investor, risk, liquidity, or static data?
2. What date does it belong to?
3. What currency is it in?
4. What system produced it?
5. Who owns it?
6. Is it final or draft?
7. Does it reconcile to an official source?
8. Are there missing or duplicate identifiers?
9. Are signs and scales documented?
10. Which AIFMD sections does it feed?

## 3.2 Raw Data Intake Checklist

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- Confirm reporting period.
- Confirm AIFM name, identifier, and LEI.
- Confirm AIF name, identifier, and LEI.
- Confirm base currency.
- Confirm NAV source.
- Confirm AUM source.
- Confirm portfolio source.
- Confirm risk metric source.
- Confirm investor allocation source.
- Confirm strategy allocation source.
- Confirm funding/borrowing source.
- Confirm official static data source.
- Check for missing mandatory fields.
- Check for duplicate positions.

- Check for stale dates.
- Check for invalid country/currency codes.
- Check for synthetic/test values.

### 3.3 Data Types

Data type	Examples	Validation
Text	AIF name, counterparty, strategy	Not blank when mandatory
Identifier	LEI, AIF code, ISIN	Format and register check
Date	valuation date, maturity date	Valid date and correct period
Decimal	NAV, AUM, exposure	Numeric and correct scale
Percentage	investor percentage	Between 0 and 100 where appropriate
Category	country, sector, asset class	In allowed list
Boolean/status	pass/fail/review	In allowed values

### 3.4 Data Cleaning

Common cleaning tasks:

- trim extra spaces;
- standardise case;
- convert text numbers to numeric values;
- parse dates;
- remove thousands separators;
- convert percentages consistently;
- map country names to ISO codes;
- map currency names to ISO codes;
- remove duplicate rows;
- flag missing identifiers;
- preserve the original raw file unchanged.

Production rule:

Never overwrite raw source data. Create a transformed copy and keep evidence of the transformation.

## 3.5 Grouping And Aggregation

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Most AIFMD analysis uses group-by logic:

$$\text{Exposure by group } g = \sum_{i:\text{group}(i)=g} \text{Exposure}_i$$

Examples:

- exposure by sector;
- exposure by country;
- exposure by asset class;
- exposure by counterparty;
- market value by liquidity bucket.

Python pattern:

```
from collections import defaultdict

by_sector = defaultdict(float)
for row in portfolio:
    by_sector[row["Sector"]] += abs(row["GrossExposure"])
```

## 3.6 From Raw Data To AIFMD Outputs

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Raw data	Transformation	Output
AIFM static	Validate identity	DATMAN identity fields
AIF static	Validate identity, NAV, AUM	DATAIF identity and principal info
Portfolio	Aggregate exposure	Principal exposures
Portfolio	Group by country	Geographical exposure
Portfolio	Group by sector	Concentration and credit exposure
Portfolio	Group by counterparty	Counterparty risk
Portfolio	Bucket liquidity days	Liquidity profile
Strategy	Sum percentages	Investment strategy section
Investors	Sum percentages	Investor profile section
Risk system	Reconcile metrics	Risk metric section
XML templates	Populate and validate	DATMAN/DATAIF XML

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# Part 4 - Excel, Python, XML, And Automation Foundations

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## 4.1 Why Excel Still Matters

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Excel is common in regulatory reporting because it is easy to review, annotate, and sign off. In this workflow, Excel is used for:

- source templates;
- validation outputs;
- calculation evidence;
- control packs;
- submission trackers;
- sign-off workbooks.

But Excel alone is weak for reproducibility. Python makes the workflow repeatable.

## 4.2 Python Mental Model

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Python automates a sequence:

```
read data -> transform data -> validate data -> write outputs
```

Core Python concepts:

Concept	Meaning	AIFMD use
variable	Named value	<code>nav</code> , <code>aum</code> , <code>gross_exposure</code>
list	Ordered collection	portfolio rows
dictionary	Key/value mapping	calculation outputs
function	Reusable block	<code>calculate_outputs()</code>
loop	Repeat logic	iterate through positions
condition	if/else decision	assign liquidity bucket
module	Python file	<code>run_full_pipeline.py</code>
package	organised code folder	<code>src/aifmd_pipeline</code>

## 4.3 XML Mental Model

XML is structured text with tags.

Example:

```
<AIF>
  <AIFName>LuxBridge Senior Credit Fund SCSp</AIFName>
  <AIFNationalCode>LBSCF01</AIFNationalCode>
</AIF>
```

An XML schema, or XSD, defines what tags and values are allowed.

XSD validation answers:

XML file  $\in$  Language allowed by XSD

In plain English:

Does this XML obey the official structural rules?

## 4.4 Automation Design Principle

A good reporting automation must be:

- deterministic: same input gives same output;
- transparent: calculations can be explained;

- testable: controls can be run repeatedly;
  - auditable: evidence is stored;
  - recoverable: failures are clear;
  - governed: changes are approved.
-

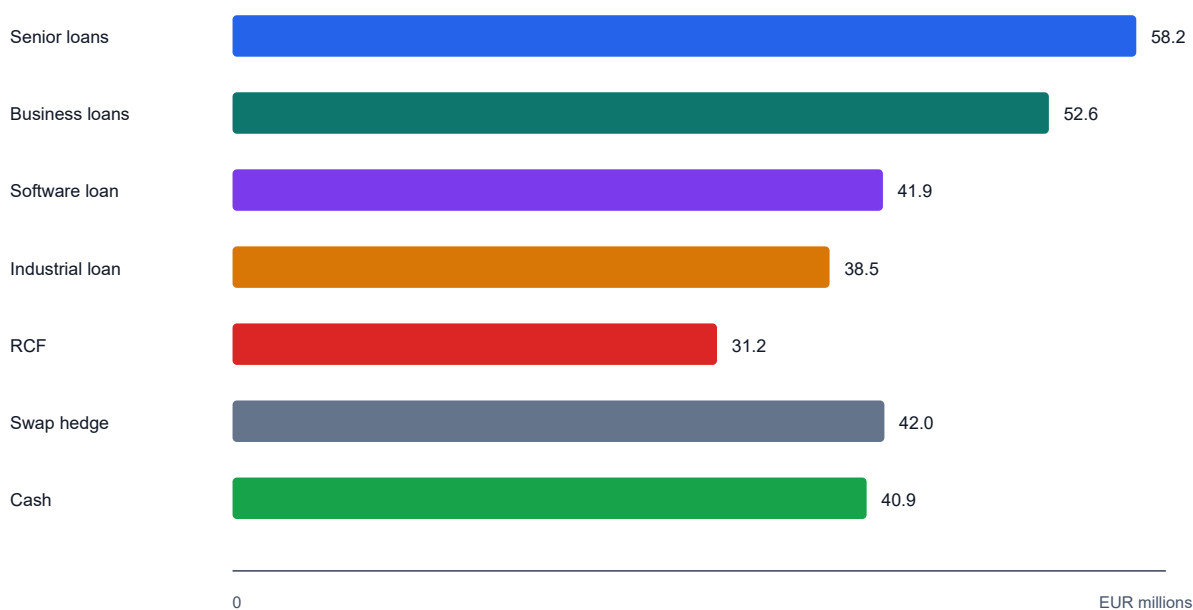
# Part 5 - Financial Markets And Products For AIFMD Analysts

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This section turns market-product knowledge into reporting judgment. The aim is not to become a trader. The aim is to recognise what a raw portfolio row means, what risks it creates, and how it should flow into AIFMD calculations.

## Illustrative AIF Gross Exposure By Position

Synthetic private credit portfolio; EUR millions. Gross exposure can differ from market value.



## 5.1 Financial Institutions And Why AIFMD Cares

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Financial markets contain many institution types:

Institution	Core function	AIFMD relevance
Bank	Lending, deposits, market-making, financing	Counterparty, cash, borrowing, derivatives, collateral
Fund manager	Manages pooled capital	AIFM reporting entity
Pension fund	Long-term investor	Investor profile
Insurance company	Invests premiums and reserves	Investor profile and institutional concentration
Broker/dealer	Executes and finances trades	Counterparty and collateral risk
Central counterparty	Clears standardised trades	Derivative counterparty structure
Administrator	Calculates NAV and accounting books	NAV source and reconciliation owner
Depository/custodian	Safekeeping and oversight	Asset existence and operational controls

An AIFMD analyst must know where each data feed comes from. A NAV file from an administrator has a different control meaning from a risk file produced by an internal model.

## 5.2 Cash And Deposits

Cash looks simple but creates concentration and liquidity questions.

Key fields:

- bank/counterparty;
- currency;
- balance;
- unrestricted or restricted status;
- interest rate;
- account owner;
- valuation date.

AIFMD relevance:

$$\text{Cash \% AUM} = \frac{\text{Cash balance}}{\text{AUM}} \times 100$$

Counterparty concentration:

$$\text{Bank exposure \% AUM} = \frac{\text{Cash at bank} + \text{Other exposure to bank}}{\text{AUM}} \times 100$$

## 5.3 Loans And Private Credit

Private credit funds often hold loans rather than exchange-traded securities. A loan row may contain:

Field	Meaning
borrower	entity that owes money
principal	amount outstanding
market value	accounting valuation
coupon	interest paid
maturity	final repayment date
seniority	priority in default
collateral	security package
sector	borrower industry
country	borrower or asset jurisdiction
rating/internal grade	credit quality

Important private credit risks:

- default;
- recovery uncertainty;
- illiquidity;
- valuation uncertainty;
- covenant breach;
- sector concentration;
- borrower concentration.

Expected credit loss concept:

$$\text{Expected Loss} = \text{PD} \times \text{LGD} \times \text{EAD}$$

where:

- PD is probability of default;
- LGD is loss given default;
- EAD is exposure at default.

## 5.4 Bonds

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A bond is a tradable debt instrument.

Plain bond price:

$$P = \sum_{t=1}^T \frac{C_t}{(1+y)^t} + \frac{F}{(1+y)^T}$$

where:

- $P$  is price;
- $C_t$  is coupon cash flow at time  $t$ ;
- $F$  is face value;
- $y$  is yield;
- $T$  is maturity.

Bond AIFMD relevance:

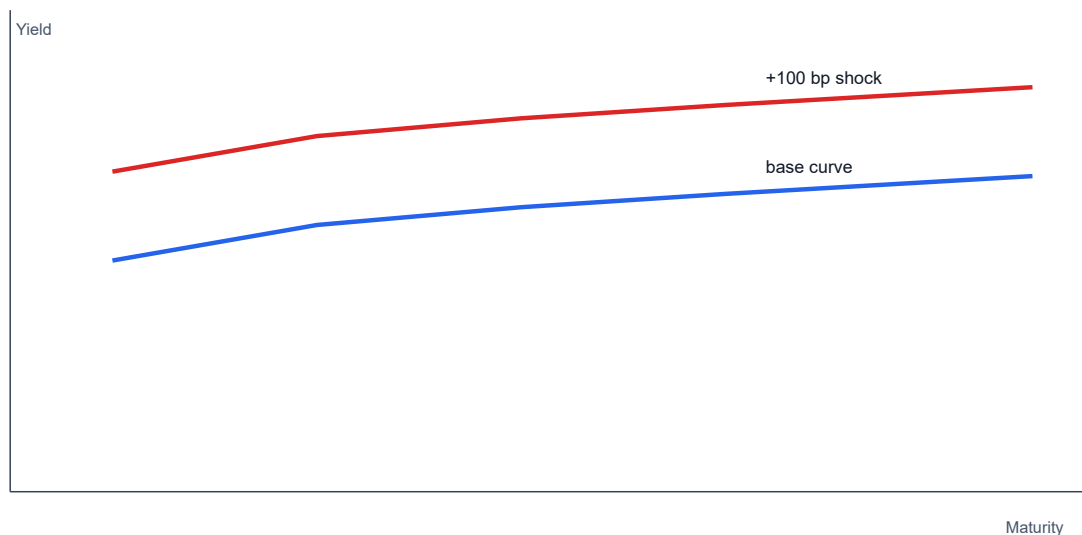
- market value;
- issuer exposure;
- country exposure;
- interest-rate risk;
- credit spread risk;
- maturity and liquidity profile.

## 5.5 Interest Rates, Duration, And DV01

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## Interest Rate Shock And Bond Price Sensitivity

Duration and DV01 approximate the price effect of small yield changes.



Approximation:  $\Delta\text{Price} \approx -\text{Duration} \times \text{Price} \times \Delta\text{Yield}$

Duration approximates price sensitivity to yield changes:

$$\frac{\Delta P}{P} \approx -D_{\text{mod}} \Delta y$$

DV01 converts this into value change for one basis point:

$$\text{DV01} \approx D_{\text{mod}} \times P \times 0.0001$$

If a bond portfolio has modified duration 4.5 and value EUR 20,000,000:

$$\text{DV01} \approx 4.5 \times 20,000,000 \times 0.0001 = 9,000$$

Interpretation: a one basis point yield move changes value by approximately EUR 9,000, subject to sign convention.

## 5.6 Derivatives

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A derivative is a contract whose value depends on an underlying.

Common derivatives:

Derivative	Underlying	AIFMD risk issue
Forward	FX, equity, commodity, rate	exposure can exceed market value
Future	standardised exchange contract	margin, leverage, market risk
Swap	rates, credit, inflation, total return	counterparty and leverage
Option	right but not obligation	nonlinear payoff and Greeks
CDS	credit event protection	credit exposure and counterparty risk

Derivative market value can be small or negative while gross exposure is large.

That is why:

$$\text{Market value} \neq \text{Exposure}$$

## 5.7 Forwards And Futures

---

Forward payoff for a long position:

$$\text{Payoff}_{\text{long}} = S_T - K$$

Futures are similar economically but exchange-traded and marked to market.

AIFMD relevance:

- notional;
- market value;
- counterparty or clearing broker;
- margin;
- underlying exposure;
- maturity;
- hedging purpose.

## 5.8 Options And Greeks

---

Option payoff:

$$\text{Call payoff} = \max(S_T - K, 0)$$

$$\text{Put payoff} = \max(K - S_T, 0)$$

Key Greeks:

Greek	Meaning
Delta	sensitivity to underlying price
Gamma	sensitivity of delta
Vega	sensitivity to volatility
Theta	sensitivity to time decay
Rho	sensitivity to rates

AIFMD analyst takeaway:

Options can create nonlinear exposure. A simple market value column is not enough to understand risk.

## 5.9 FX Risk

If assets are in a currency different from the fund base currency, the fund has FX exposure.

Base-currency value:

$$\text{Value}_{\text{base}} = \text{Value}_{\text{foreign}} \times \text{FX rate}$$

FX return approximation:

$$R_{\text{base}} \approx R_{\text{local}} + R_{\text{FX}}$$

Controls:

- all currencies valid;
  - FX rates sourced and timestamped;
  - hedges linked to exposures;
  - unhedged exposure reviewed.
-

# Part 6 - Quantitative Analysis Toolkit

---

## 6.1 Probability

---

Probability measures uncertainty.

For event  $A$ :

$$0 \leq P(A) \leq 1$$

Complement:

$$P(A^c) = 1 - P(A)$$

Joint probability:

$$P(A \cap B)$$

Conditional probability:

$$P(A|B) = \frac{P(A \cap B)}{P(B)}$$

In risk reporting, conditional thinking matters. Example: probability of loss given a sector downturn is not the same as unconditional probability of loss.

## 6.2 Random Variables And Distributions

---

A random variable is a numerical uncertain outcome, such as a return, loss, default event, or spread change.

Important distributions:

Distribution	Use
Bernoulli	default/no default
Binomial	number of defaults
Normal	simplified return model
Lognormal	positive asset prices
Student t	fat-tailed returns
Empirical	historical simulation

## 6.3 Expected Value

$$E[X] = \sum_i p_i x_i$$

For continuous variables:

$$E[X] = \int_{-\infty}^{\infty} x f(x) dx$$

Expected loss:

$$E[L] = PD \times LGD \times EAD$$

## 6.4 Variance And Volatility

$$\text{Var}(X) = E[(X - E[X])^2]$$

$$\sigma = \sqrt{\text{Var}(X)}$$

Annualised volatility from daily volatility:

$$\sigma_{\text{annual}} = \sigma_{\text{daily}} \sqrt{252}$$

Ten-day volatility:

$$\sigma_{10d} = \sigma_{1d} \sqrt{10}$$

## 6.5 Covariance And Correlation

Covariance:

$$\text{Cov}(X, Y) = E[(X - E[X])(Y - E[Y])]$$

Correlation:

$$\rho_{X,Y} = \frac{\text{Cov}(X, Y)}{\sigma_X \sigma_Y}$$

Correlation matters because diversification depends on imperfect correlation.

Portfolio variance for two assets:

$$\sigma_p^2 = w_1^2 \sigma_1^2 + w_2^2 \sigma_2^2 + 2w_1 w_2 \rho_{1,2} \sigma_1 \sigma_2$$

## 6.6 Regression

---

Regression explains one variable using another.

Simple linear regression:

$$y_i = \alpha + \beta x_i + \varepsilon_i$$

In finance:

- $y_i$  can be fund return;
- $x_i$  can be market return;
- $\beta$  measures market sensitivity;
- $\alpha$  is unexplained average return after market exposure.

CAPM regression:

$$R_i - R_f = \alpha_i + \beta_i (R_m - R_f) + \varepsilon_i$$

## 6.7 Time Series

---

Financial observations arrive over time.

Return:

$$R_t = \frac{P_t - P_{t-1}}{P_{t-1}}$$

Log return:

$$r_t = \ln \left( \frac{P_t}{P_{t-1}} \right)$$

Rolling volatility over window  $k$ :

$$\sigma_{t,k} = \sqrt{\frac{1}{k-1} \sum_{j=t-k+1}^t (r_j - \bar{r})^2}$$

## 6.8 Simulation

---

Simulation creates many possible future scenarios.

Generic Monte Carlo process:

1. choose model;
2. estimate parameters;
3. generate random shocks;
4. revalue portfolio;
5. sort losses;
6. compute risk measures.

Monte Carlo VaR:

$$\text{VaR}_\alpha = \text{Quantile}_\alpha(\text{Loss distribution})$$

---

# Part 7 - Valuation And Risk Models

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## 7.1 Present Value

---

Present value discounts future cash flows:

$$PV = \frac{CF_t}{(1+r)^t}$$

For multiple cash flows:

$$PV = \sum_{t=1}^T \frac{CF_t}{(1+r)^t}$$

In AIFMD work, valuation source matters. The analyst usually does not independently value every asset but must understand whether valuation inputs are plausible and reconciled.

## 7.2 No-Arbitrage Intuition

---

No-arbitrage pricing means two portfolios with identical cash flows should have the same price.

If:

$$\text{Cash flows of A} = \text{Cash flows of B}$$

then:

$$\text{Price of A} = \text{Price of B}$$

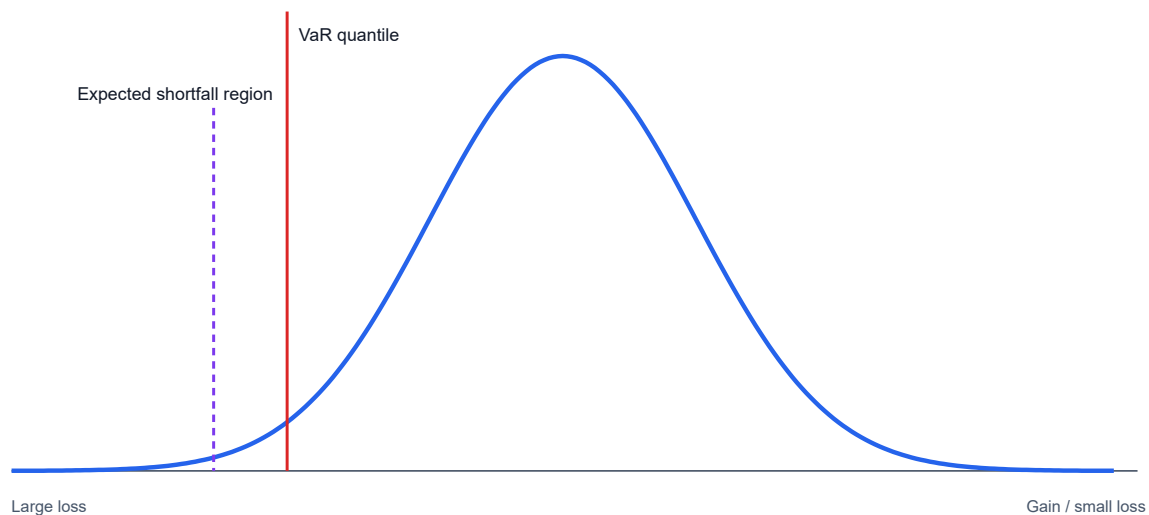
otherwise an arbitrage opportunity exists.

## 7.3 VaR

---

## Loss Distribution, VaR, And Expected Shortfall

A teaching diagram: VaR is a quantile; expected shortfall is the average loss beyond that quantile.



VaR at confidence level  $\alpha$  is the loss quantile:

$$P(L > \text{VaR}_\alpha) = 1 - \alpha$$

Historical VaR:

$$\text{VaR}_\alpha = \text{empirical quantile of historical losses}$$

Parametric normal VaR:

$$\text{VaR}_\alpha = z_\alpha \sigma V$$

Monte Carlo VaR:

$$\text{VaR}_\alpha = \text{quantile of simulated losses}$$

## 7.4 Expected Shortfall

---

Expected shortfall is average loss beyond VaR:

$$\text{ES}_\alpha = E[L \mid L \geq \text{VaR}_\alpha]$$

Expected shortfall is often more informative than VaR because it says something about tail severity.

## 7.5 Backtesting VaR

---

Backtesting compares predicted VaR with realised losses.

Exception indicator:

$$I_t = \begin{cases} 1, & L_t > \text{VaR}_t \\ 0, & L_t \leq \text{VaR}_t \end{cases}$$

Exception count:

$$N = \sum_{t=1}^T I_t$$

If a 99% VaR model is correct, exceptions should be rare. Too many exceptions indicate the model may underestimate risk.

## 7.6 Stress Testing

---

Stress tests are scenario-based.

Linear sensitivity approximation:

$$\Delta V \approx \Delta r \times \text{DV01}_{\text{scaled}} + \Delta s \times \text{CS01}_{\text{scaled}} + \Delta \text{FX} \times \text{FX sensitivity}$$

Private credit stress examples:

- default top borrower;
- widen all loan spreads by 300 bps;
- haircut illiquid assets by 10%;
- assume exit liquidity doubles;
- draw subscription line fully;
- freeze redemption liquidity.

## 7.7 Model Risk

---

Model risk is the risk that a model is wrong or misused.

Controls:

- model owner;
- methodology document;

- input validation;
- independent review;
- parameter governance;
- change log;
- backtesting;
- limitations disclosure.

For AIFMD reporting, any model-fed field such as VaR, stress loss, liquidity days, or fair value hierarchy should be traceable.

---

# Part 8 - Credit And Counterparty Risk

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## 8.1 Credit Risk Basics

---

Credit risk is the risk that a borrower, issuer, or counterparty fails to perform.

Core variables:

Variable	Meaning
PD	probability of default
LGD	loss given default
EAD	exposure at default
EL	expected loss
UL	unexpected loss

Expected loss:

$$EL = PD \times LGD \times EAD$$

If  $PD = 2\%$ ,  $LGD = 45\%$ , and  $EAD = 10,000,000$ :

$$EL = 0.02 \times 0.45 \times 10,000,000 = 90,000$$

## 8.2 Ratings And Migration

---

Ratings classify credit quality.

Migration means a borrower moves from one rating grade to another.

Expected rating transition:

$$P_{ij} = P(\text{rating moves from grade } i \text{ to grade } j)$$

Credit deterioration can affect:

- valuation;
- CS01;
- liquidity;

- concentration review;
- stress tests.

## 8.3 Portfolio Credit Risk

---

Portfolio credit risk depends on default correlation.

Two loans with independent default risk diversify better than two loans likely to default together.

For default indicators  $D_1$  and  $D_2$ :

$$\rho_D = \frac{\text{Cov}(D_1, D_2)}{\sigma_{D_1} \sigma_{D_2}}$$

Sector concentration is a practical proxy for correlated credit risk.

## 8.4 Counterparty Risk

---

Counterparty risk applies especially to derivatives, financing, deposits, and unsettled trades.

Future exposure:

Potential Future Exposure = high quantile of future positive exposure

Current exposure:

$$\text{Current Exposure} = \max(\text{Market Value}, 0)$$

Counterparty exposure after collateral:

$$\text{Net Exposure} = \max(\text{Exposure} - \text{Collateral}, 0)$$

## 8.5 Netting And Collateral

---

Netting reduces exposure across transactions with the same counterparty under a legal agreement.

Collateral reduces loss if the counterparty defaults.

Simplified net exposure:

$$\text{Net Exposure} = \max\left(\sum \text{Positive MTM} - \sum \text{Collateral}, 0\right)$$

## Production control:

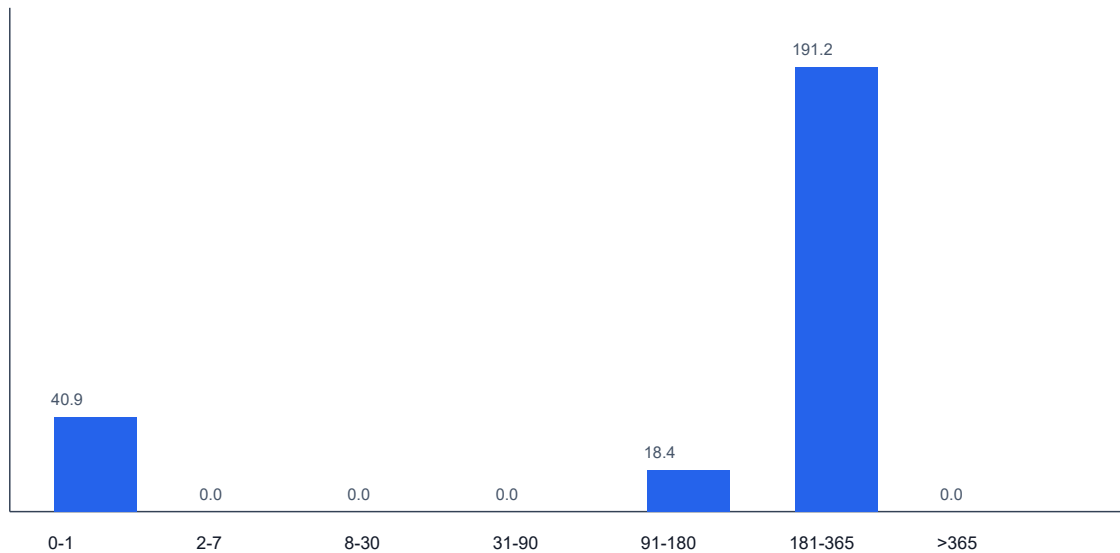
Do not assume netting or collateral is eligible unless legal documentation and operational data support it.

---

# Part 9 - Liquidity And Treasury Risk

## Liquidity Bucket Profile

Positive market value assigned by estimated days to liquidate.



## 9.1 Market Liquidity Vs Funding Liquidity

Market liquidity:

Can the fund sell or realise assets without large price impact?

Funding liquidity:

Can the fund meet cash obligations when due?

A private credit AIF may have poor market liquidity but acceptable funding liquidity if investor redemptions are restricted and financing is stable.

## 9.2 Liquidity Gap

Liquidity gap by time bucket:

$$\text{Liquidity Gap}_b = \text{Cash Inflows}_b - \text{Cash Outflows}_b$$

Cumulative liquidity gap:

$$\text{Cumulative Gap}_k = \sum_{b=1}^k \text{Liquidity Gap}_b$$

Negative cumulative gap indicates potential funding pressure.

## 9.3 Liquidity Stress Testing

---

Stress testing combines assumptions:

- asset sale haircuts;
- longer liquidation times;
- investor redemption shock;
- margin calls;
- drawdowns on facilities;
- FX stress;
- blocked cash.

Stress liquidity coverage:

$$\text{Stress Coverage Ratio} = \frac{\text{Available Liquidity Under Stress}}{\text{Required Liquidity Under Stress}}$$

Control:

$$\text{Stress Coverage Ratio} \geq 1$$

unless escalated.

## 9.4 Illiquid Assets

---

Illiquid assets require special care:

- stale prices;
- model valuation;
- valuation committee review;
- wide bid/ask spreads;
- uncertain exit date;
- side pockets;
- redemption gates;
- stress haircuts.

AIFMD reporting should not present illiquid assets as short-term liquid simply because they have a modelled fair value.

---

# Part 10 - Investment Management And Portfolio Risk

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## 10.1 Modern Portfolio Theory

---

Portfolio expected return:

$$E[R_p] = \sum_{i=1}^n w_i E[R_i]$$

Portfolio variance:

$$\sigma_p^2 = \sum_{i=1}^n \sum_{j=1}^n w_i w_j \sigma_{ij}$$

where  $\sigma_{ij}$  is covariance between asset  $i$  and asset  $j$ .

## 10.2 CAPM

---

CAPM expected return:

$$E[R_i] = R_f + \beta_i (E[R_m] - R_f)$$

Beta:

$$\beta_i = \frac{\text{Cov}(R_i, R_m)}{\text{Var}(R_m)}$$

In AIFMD reporting, CAPM is not usually a required direct calculation, but factor exposure and systematic risk thinking help analysts understand portfolio risk.

## 10.3 Factor Risk

---

A factor is a common driver of returns.

Examples:

- equity market;
- interest rates;
- credit spreads;

- inflation;
- liquidity;
- value/growth;
- size;
- sector;
- country.

Factor model:

$$R_p = \alpha + \beta_1 F_1 + \beta_2 F_2 + \dots + \beta_k F_k + \varepsilon$$

## 10.4 Performance Measures

---

Sharpe ratio:

$$\text{Sharpe} = \frac{R_p - R_f}{\sigma_p}$$

Information ratio:

$$\text{Information Ratio} = \frac{R_p - R_b}{\sigma_{p-b}}$$

Maximum drawdown:

$$\text{Drawdown}_t = \frac{\text{Portfolio Value}_t - \max_{s \leq t} \text{Portfolio Value}_s}{\max_{s \leq t} \text{Portfolio Value}_s}$$

These are not always AIFMD fields, but they help professionals interpret risk and investment quality.

## 10.5 Due Diligence And Fraud Warning Signs

---

Operational risk matters. Warning signs:

- one person controls valuation, trading, and reconciliation;
- unexplained returns;
- late NAVs;
- frequent manual overrides;
- missing administrator confirmation;
- inconsistent position identifiers;

- stale prices;
- unclear strategy;
- weak service provider controls.

AIFMD reporting analysts should escalate suspicious or inconsistent source data.

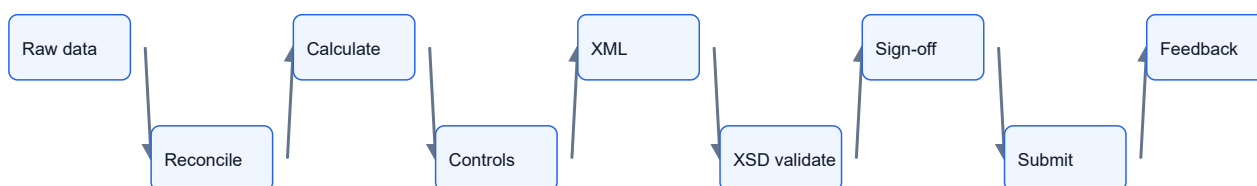
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# Part 11 - Governance, Data Aggregation, And Reporting Quality

---

## AIFMD Reporting Data Pipeline

From raw AIFM/AIF data to regulator-facing XML and retained evidence.



## 11.1 Data Aggregation Principles

---

High-quality risk reporting requires:

- accuracy;
- completeness;
- timeliness;
- adaptability;
- traceability;
- governance;
- clear ownership.

Every reported number should answer:

1. Where did it come from?
2. Who owns it?
3. How was it transformed?

4. What controls were applied?
5. What evidence proves it?
6. Who approved it?

## 11.2 Three Lines Of Defence

---

Line	Role in reporting
First line	Produces data, runs process, owns business controls
Second line	Risk/compliance review, challenge, policy
Third line	Internal audit independent assurance

## 11.3 Maker-Checker Control

---

Maker-checker means one person prepares and another independently reviews.

Control evidence should show:

- preparer;
- reviewer;
- timestamp;
- version;
- issues found;
- resolution;
- approval.

## 11.4 Change Governance

---

Changes requiring governance:

- new data source;
- formula change;
- threshold change;
- XML mapping change;
- XSD version change;
- new fund strategy;
- new instrument type;

- code refactor;
- submission channel change.

Minimum change record:

Field	Description
Change ID	Unique identifier
Description	What changed
Reason	Why it changed
Impact	Data, calculations, XML, controls
Approver	Named owner
Test evidence	Proof it works
Effective date	Filing cycle from which it applies

---

# Part 12 - AIFMD Analyst Practicum

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This practicum explains exactly what a new analyst should do after receiving raw AIFM/AIF data.

## 12.1 First 30 Minutes With A Raw Data Pack

---

Do this before calculating:

1. Identify the reporting period.
2. Identify the AIFM.
3. Identify each AIF.
4. Confirm whether the file is final.
5. Confirm the valuation date.
6. Confirm base currency.
7. Create a source inventory.
8. Check file names against expected sources.
9. Check that NAV and AUM are present.
10. Check that position-level data exists.
11. Check that identifiers are present.
12. Check for obvious test values.

## 12.2 Source Inventory Template

---

Source file	Owner	System	Date	Final?	AIFMD use	Con
NAV file	Fund accounting	Administrator	quarter-end	yes/no	NAV/AUM	recor to ad
Position file	Operations	Accounting system	quarter-end	yes/no	exposures	positi coun check
Risk file	Risk	Risk system	quarter-end	yes/no	DV01/CS01/VaR	recor to ris repor
Investor file	Investor relations	Transfer agent	quarter-end	yes/no	investor profile	totals equa 100
Strategy file	Portfolio management	internal	quarter-end	yes/no	strategy profile	totals equa 100
Static data	Operations	master data	current	yes/no	identifiers	LEI/cc valida

## 12.3 Position-Level Checklist

For each position row:

- instrument name exists;
- unique identifier exists if applicable;
- asset class is mapped;
- sector is mapped;
- country is mapped;
- currency is mapped;
- market value is numeric;
- gross exposure is numeric;
- commitment exposure is numeric;
- counterparty is present where relevant;
- liquidity days are present;
- risk sensitivities are present or explicitly not applicable.

## 12.4 Calculation Walkthrough Using The Synthetic Pack

---

The package portfolio contains loans, a credit facility, a swap hedge, and cash.

Gross exposure:

$$\text{GrossExposure} = 58.2 + 52.6 + 41.9 + 38.5 + 31.2 + 42.0 + 40.9 = 305.3$$

where values are EUR millions.

Gross leverage:

$$\text{GrossLeveragePctNAV} = \frac{305.3}{248.75} \times 100 = 122.73\%$$

Largest counterparty concentration:

$$\text{LargestCounterpartyPctAUM} = \frac{\max(\text{Counterparty exposures})}{312.4} \times 100$$

The analyst must then compare this to the threshold:

$$\text{LargestCounterpartyPctAUM} \leq 10\%$$

If not, the result is not automatically wrong. It becomes a review item requiring explanation, approval, and evidence.

## 12.5 How To Write A Professional Review Note

---

Weak note:

Counterparty is high.

Professional note:

BR-002 generated REVIEW because the largest counterparty exposure is above the configured 10% AUM threshold. The exposure relates to [counterparty/instrument], is supported by [source file], and was reviewed by Risk on [date]. No XML correction is required because the value is source-consistent; the issue is retained as a documented concentration review.

## 12.6 Final Analyst Skill Checklist

---

By the end of this handbook, the analyst should be able to:

- explain AIFM and AIF roles;
  - define NAV and AUM;
  - distinguish market value from exposure;
  - calculate percentages and reconciliations;
  - calculate gross and commitment leverage;
  - aggregate exposures by category;
  - bucket liquidity;
  - explain DV01, CS01, VaR, stress testing, and concentration;
  - read raw Excel source data;
  - identify data quality problems;
  - run Python scripts;
  - understand XML and XSD validation;
  - build a control pack;
  - prepare a filing evidence pack;
  - explain why XSD validation is not business validation;
  - operate a maker-checker reporting workflow.
-

# Part 13 - Professional Study Plan And Practice Problems

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## 13.1 Twelve-Day Study Plan

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This plan is designed for a junior analyst, student, or professional moving into regulatory reporting.

Day	Focus	Outcome
1	Arithmetic, percentages, dates, units, signs	Can read financial data without confusing scale, sign, or period
2	Accounting basics and NAV	Can explain assets, liabilities, NAV, AUM, and reconciliation
3	Funds and AIFMD entities	Can distinguish AIFM, AIF, investor, administrator, depositary, regulator
4	Products: cash, loans, bonds, derivatives	Can classify portfolio rows and identify risk implications
5	Exposure and leverage	Can calculate gross exposure, commitment exposure, and leverage ratios
6	Probability/statistics	Can explain mean, variance, volatility, correlation, quantiles
7	Market risk	Can explain VaR, expected shortfall, stress testing, DV01, CS01
8	Credit and counterparty risk	Can explain PD, LGD, EAD, expected loss, netting, collateral
9	Liquidity risk	Can bucket liquidity, calculate gaps, and design stress assumptions
10	Data analysis and Python	Can read Excel, group data, calculate metrics, write outputs
11	XML/XSD and controls	Can generate, validate, profile, and evidence XML outputs
12	End-to-end AIFMD practicum	Can run the workflow and explain every output to a reviewer

## 13.2 Competency Matrix

Competency	Beginner	Professional
NAV/AUM	Knows definitions	Reconciles sources and explains differences
Exposure	Sums positions	Distinguishes market value, gross exposure, commitment exposure, notional
Leverage	Calculates ratio	Explains method, drivers, thresholds, exceptions
Liquidity	Buckets assets	Compares asset liquidity to investor terms and stress assumptions
Risk metrics	Defines DV01/CS01/VaR	Reconciles risk system outputs and challenges plausibility
Data quality	Checks blanks	Builds validation rules, exception logs, and audit trail
Python	Runs scripts	Reads, modifies, tests, and documents calculations
XML	Runs validation	Understands schema errors, red flags, and mapping defects
Controls	Marks pass/fail	Designs maker-checker workflow and evidence pack
Filing	Prepares zip	Understands submission channel, feedback, remediation, retention

## 13.3 Practice Problems

### Problem 1 - Percent Of AUM

An AIF has AUM of EUR 500,000,000. Exposure to healthcare loans is EUR 85,000,000. Calculate healthcare exposure as a percentage of AUM.

Answer:

$$\frac{85,000,000}{500,000,000} \times 100 = 17\%$$

### Problem 2 - NAV

Assets are EUR 310,000,000 and liabilities are EUR 42,000,000. Calculate NAV.

Answer:

$$\text{NAV} = 310,000,000 - 42,000,000 = 268,000,000$$

### Problem 3 - Gross Leverage

NAV is EUR 250,000,000. Gross exposure is EUR 330,000,000. Calculate gross leverage as percent of NAV.

Answer:

$$\text{Gross leverage} = \frac{330,000,000}{250,000,000} \times 100 = 132\%$$

### Problem 4 - Strategy Total

Strategy percentages are 55%, 30%, and 14%. Does the control pass?

Answer:

$$55 + 30 + 14 = 99$$

The control fails unless there is a documented tolerance or missing 1% category.

### Problem 5 - Investor Total

Investor percentages are 40%, 35%, 15%, and 10%. Does the control pass?

Answer:

$$40 + 35 + 15 + 10 = 100$$

The control passes.

### Problem 6 - DV01 Approximation

A bond portfolio has modified duration 5.2 and value EUR 12,000,000. Approximate DV01.

Answer:

$$\text{DV01} = 5.2 \times 12,000,000 \times 0.0001 = 6,240$$

### Problem 7 - Expected Loss

PD is 3%, LGD is 40%, EAD is EUR 8,000,000. Calculate expected loss.

Answer:

$$EL = 0.03 \times 0.40 \times 8,000,000 = 96,000$$

## Problem 8 - Liquidity Bucket

A position has liquidity days of 120. Which bucket does it enter?

Answer: 91-180 days .

## Problem 9 - XSD Validation

An XML file passes XSD validation. Does that prove NAV is correct?

Answer: no. XSD validation proves structural schema conformity, not business correctness.

## Problem 10 - Review Item

Largest counterparty exposure is 12% of AUM and the threshold is 10%. Is the report automatically wrong?

Answer: no. It becomes a REVIEW or escalation item. The analyst must document source consistency, explanation, owner review, and approval.

## 13.4 Capstone Assignment

---

Use the synthetic package and produce a one-page filing readiness note answering:

1. What reporting period is covered?
  2. Who is the AIFM?
  3. Who is the AIF?
  4. What are NAV and AUM?
  5. What are gross and commitment leverage?
  6. Which controls passed?
  7. Which controls require review?
  8. Did XML validation pass?
  9. What evidence files support the filing?
  10. Why is this still not a real filing?
-

# Part 14 - Raw Data Field Playbook

This playbook tells a new analyst what to do with each major field family.

## 14.1 Identity Fields

Field	What it means	What to do
AIFM name	Legal manager name	Compare to authorised records and prior filing
AIFM identifier	Local regulator identifier	Validate against current CSSF source
AIFM LEI	Legal Entity Identifier	Check 20-character alphanumeric format and source
AIF name	Fund legal name	Compare to fund documents and prior filing
AIF national code	Fund local code	Validate against regulator/static data
AIF LEI	Fund LEI	Check format and source

Control formula for LEI format:

$$\text{Length(LEI)} = 20$$

and:

LEI contains only uppercase letters and digits

## 14.2 Valuation Fields

Field	What it means	What to do
NAV	Net asset value	Reconcile to administrator
AUM	Assets under management	Reconcile to official AUM source
Market value	Position valuation	Reconcile total to portfolio accounting
Price	Unit valuation	Check stale or zero prices
FX rate	Currency conversion	Validate date and source

Core checks:

$$NAV > 0$$

$$AUM \geq NAV$$

$$\sum \text{Position market values} \approx \text{Portfolio market value total}$$

## 14.3 Exposure Fields

Field	What it means	What to do
Notional	Contract/reference amount	Do not confuse with market value
Gross exposure	Absolute economic footprint	Use in gross leverage
Commitment exposure	Regulatory adjusted exposure	Use in commitment leverage
Delta-adjusted exposure	Option-like adjusted exposure	Review mapping methodology
Counterparty exposure	Exposure to entity	Use in concentration review

Exposure sanity check:

$$\text{GrossExposure} \geq 0$$

For many instruments:

$$\text{GrossExposure} \geq |\text{Market Value}|$$

but this is not universal. Investigate exceptions; do not blindly fail them.

## 14.4 Risk Fields

Field	Meaning	Analyst action
DV01	interest-rate sensitivity	reconcile to risk system
CS01	credit spread sensitivity	reconcile to risk system
VaR	modelled loss quantile	confirm model date/confidence/horizon
Stress loss	scenario result	confirm scenario definition
Rating	credit quality	map to approved scale
PD/LGD/EAD	credit model inputs	check source and model governance

Risk-system reconciliation:

$$\text{Pipeline metric} - \text{Risk system metric} = \text{Difference}$$

Control:

$$|\text{Difference}| \leq \text{Approved tolerance}$$

## 14.5 Liquidity Fields

Field	Meaning	Analyst action
Liquidity days	estimated liquidation horizon	bucket and review
Redemption frequency	investor dealing frequency	compare with asset liquidity
Notice period	investor advance notice	compare with liquidity
Lock-up	period investor cannot redeem	document restrictions
Gate	limit on redemption amount	include in liquidity analysis

Liquidity mismatch concept:

$$\text{Mismatch}_b = \text{Investor liquidity demand}_b - \text{Asset liquidity supply}_b$$

Positive mismatch means investor cash demand exceeds expected liquid asset supply in bucket  $b$ .

## 14.6 Classification Fields

Field	Use
Asset class	principal instruments and exposure grouping
Sector	concentration and credit risk
Country	geographical exposure
Currency	FX exposure and base currency conversion
Strategy	investment strategy reporting
Investor type	investor profile reporting

Mapping rule:

Every raw category must map to one approved reporting category or to a documented exception bucket.

---

# Part 15 - Further Reading

For more detailed and in-depth learning you can consult these references:

Book	Topic areas reflected in this handbook
2024 FRM Exam Part I - Quantitative Analysis	probability, random variables, moments, regression, time series, volatility, simulation
2024 FRM Exam Part I - Financial Markets and Products	banks, funds, derivatives, futures, forwards, options, rates, bonds
2024 FRM Exam Part I - Foundations of Risk Management	governance, risk frameworks, portfolio theory, data aggregation, risk reporting
2024 FRM Exam Part I - Valuation and Risk Models	VaR, volatility, credit ratings, stress testing, discounting, duration, convexity, DV01, option Greeks
2024 FRM Exam Part II - Market Risk Measurement and Management	VaR methods, backtesting, correlations, term structure, volatility, trading book concepts
2024 FRM Exam Part II - Credit Risk Measurement and Management	PD/LGD/EAD, credit scoring, credit VaR, portfolio credit risk, counterparty risk, collateral
2024 FRM Exam Part II - Liquidity and Treasury Risk Measurement and Management	liquidity risk, leverage, early warning indicators, stress testing, contingency planning, illiquid assets
2024 FRM Exam Part II - Risk Management and Investment Management	factor theory, portfolio construction, risk budgeting, performance evaluation, hedge funds, due diligence
Risk Management and Financial Institutions by John C. Hull	risk-return foundations, financial institutions, regulation, credit ratings, derivatives, risk management architecture

How to use those books alongside this handbook:

1. Read this handbook first to understand the AIFMD workflow and why each subject matters.
2. Use the books to deepen the underlying finance/risk theory.
3. Return to the package implementation and connect each theory topic to a data field, formula, control, or evidence file.

The professional target is not memorisation. The target is judgment:

Given raw AIFM/AIF data, can you identify what each field means, what can go wrong, what calculation is needed, what control proves it, and what evidence must be retained?

---

# Applied Module A - Regulatory Foundations

---

## 1. What AIFMD Annex IV Reporting Is

---

AIFMD stands for Alternative Investment Fund Managers Directive. Annex IV reporting is the structured periodic reporting that an AIFM makes about itself and the AIFs it manages.

The report gives regulators a standard view of:

- the manager;
- the funds under management;
- strategy;
- principal exposures;
- market and instrument concentration;
- leverage;
- liquidity;
- investor profile;
- counterparty exposure;
- risk metrics;
- stress testing and other supervisory information.

The report is not a narrative essay. It is primarily a structured data submission, normally implemented through XML files that conform to official schemas.

## 2. Core Reporting Objects

---

Object	Meaning	Practical role
AIFM	Alternative Investment Fund Manager	The manager-level reporting entity
AIF	Alternative Investment Fund	The fund-level reporting object
DATMAN	Manager-level XML report	Contains AIFM information
DATAIF	Fund-level XML report	Contains AIF information, exposures, leverage, liquidity, and risk
XML	Extensible Markup Language	Machine-readable reporting payload
XSD	XML Schema Definition	Defines permitted XML structure, tags, data types, and constraints
ESMA	European Securities and Markets Authority	Provides common AIFMD reporting technical material
CSSF	Luxembourg regulator	Receives Luxembourg AIFM reporting via accepted filing channels

### 3. DATMAN And DATAIF

In the package:

- `DATMAN_A00018427_2026Q1_SYNTHETIC_LU.xml` is the manager report.
- `DATAIF_A00018427_LBSCF01_2026Q1_SYNTHETIC_LU.xml` is the fund report.

Conceptually:

```
AIFM static data -> DATMAN
AIF static data + portfolio + risk + investor + liquidity data -> DATAIF
```

The manager report and fund report are linked by reporting period, jurisdiction, identifiers, and the relationship between the AIFM and the AIF.

### 4. Reporting Period

A reporting period defines the time window covered by the filing.

The synthetic example uses:

Field	Value
Label	Q1 2026
Start date	2026-01-01
End date	2026-03-31
Period type	Q1
Reporting member state	LU
Regulator	CSSF

For production, all period fields must be consistent across source data, XML tags, file names, control packs, and evidence manifests.

## 5. Reporting Frequency And Scope

---

AIFMD reporting frequency depends on the manager and fund characteristics, such as AUM, leverage, and fund type. This handbook does not try to replace legal classification analysis. Operationally, the automation assumes that the reporting obligation has already been determined and focuses on producing a controlled filing for the selected reporting period.

Production rule:

Determine reportability and frequency before building data. Never let a script infer legal filing obligations without governance.

---

# Applied Module B - Data And Quantitative Foundations

## 6. Essential Data Definitions

Term	Definition	Source in the package
NAV	Net asset value of the fund after liabilities	<code>AIF_Static.NAV</code>
AUM	Assets under management	<code>AIF_Static.AUM</code>
Market value	Current value of a position	<code>Portfolio.MarketValue</code>
Gross exposure	Absolute economic exposure used in gross leverage	<code>Portfolio.GrossExposure</code>
Commitment exposure	Exposure under commitment method treatment	<code>Portfolio.CommitmentExposure</code>
DV01	Change in value for a 1 bp interest-rate move	<code>Portfolio.DV01</code>
CS01	Change in value for a 1 bp credit-spread move	<code>Portfolio.CS01</code>
VaR	Value-at-Risk, a modelled loss threshold over confidence and horizon	Risk model output
Liquidity days	Estimated days needed to liquidate or realise a position	<code>Portfolio.LiquidityDays</code>
Counterparty	Entity to which the fund has exposure	<code>Portfolio.Counterparty</code>

## 7. Source Workbook Data Model

The raw input workbook contains these sheets:

Sheet	Purpose	Required fields
AIFM_Static	Manager identity	AIFMName , AIFMIdentifier , AIFMLEI , HomeMemberState , BaseCurrency
AIF_Static	Fund identity and headline values	AIFName , AIFNationalCode , AIFLEI , AIFDomicile , NAV , AUM , BaseCurrency
Portfolio	Position-level market/risk data	Instrument , AssetClass , Sector , Country , MarketValue , GrossExposure , CommitmentExposure , DV01 , CS01 , LiquidityDays , Counterparty
Funding	Borrowings and capital sources	Source , Provider , Amount , Currency , Maturity
Investors	Investor type allocation	InvestorType , Percentage
Strategy	Investment strategy allocation	Strategy , Percentage
Thresholds	Visible control thresholds	RuleID , Metric , Threshold

## 8. Core Equations

### 8.1 Gross Exposure

$$\text{GrossExposure} = \sum_{i=1}^n |\text{PositionGrossExposure}_i|$$

Use absolute values because gross leverage measures the total footprint of positions rather than their net P&L sign.

### 8.2 Commitment Exposure

$$\text{CommitmentExposure} = \sum_{i=1}^n |\text{PositionCommitmentExposure}_i|$$

Commitment exposure reflects the commitment method after eligible netting, hedging, or conversion treatment in the source process.

### 8.3 Gross Leverage

$$\text{GrossLeveragePctNAV} = \frac{\text{GrossExposure}}{\text{NAV}} \times 100$$

The result is expressed as a percentage of NAV.

### 8.4 Commitment Leverage

$$\text{CommitmentLeveragePctNAV} = \frac{\text{CommitmentExposure}}{\text{NAV}} \times 100$$

The result is also expressed as a percentage of NAV.

### 8.5 Category Exposure Percentage

$$\text{PctAUM}_c = \frac{\text{Exposure}_c}{\text{AUM}} \times 100$$

This applies to:

- asset class exposure;
- sector exposure;
- country exposure;
- counterparty exposure.

### 8.6 Liquidity Bucket Percentage

$$\text{LiquidityPct}_b = \frac{\text{PositiveMarketValue}_b}{\sum_{j=1}^m \text{PositiveMarketValue}_j} \times 100$$

The package assigns positions to buckets by `LiquidityDays` :

Days	Bucket
<= 1	0-1 days
<= 7	2-7 days
<= 30	8-30 days
<= 90	31-90 days
<= 180	91-180 days
<= 365	181-365 days
> 365	>365 days

## 8.7 Investor Total

$$\text{InvestorTotal} = \sum_{i=1}^n \text{InvestorPercentage}_i$$

Control:

$$|\text{InvestorTotal} - 100| < \text{Tolerance}$$

## 8.8 Strategy Total

$$\text{StrategyTotal} = \sum_{i=1}^n \text{StrategyPercentage}_i$$

Control:

$$|\text{StrategyTotal} - 100| < \text{Tolerance}$$

## 8.9 DV01

$$\text{DV01}_{\text{total}} = \sum_{i=1}^n \text{DV01}_i$$

DV01 is interest-rate sensitivity. A positive DV01 means the portfolio value changes by that amount for a one basis point move, according to the sign convention of the risk system.

## 8.10 CS01

$$CS01_{\text{total}} = \sum_{i=1}^n CS01_i$$

CS01 is credit-spread sensitivity.

## 9. Business Controls

---

The reporting process needs both technical and business controls.

Technical validation answers:

| Does the XML conform to the schema?

Business validation answers:

| Are the numbers, identifiers, mappings, and reconciliations correct enough to file?

Rule	Area	Description	Expression	Owner
BR-001	NAV/AUM	AUM must be greater than or equal to NAV	<code>aum &gt;= nav</code>	Finance
BR-002	Counterparty	Largest counterparty exposure should not exceed threshold without review	<code>largest_counterparty_pct_aum &lt;= threshold</code>	Risk
BR-003	Leverage	Gross leverage should not exceed threshold without review	<code>gross_leverage_pct_nav &lt;= threshold</code>	Risk
BR-004	Strategy	Strategy percentages must total 100	<code>abs(strategy_total - 100) &lt; 0.01</code>	Portfolio Management
BR-005	Investor profile	Investor percentages must total 100	<code>abs(investor_total - 100) &lt; 0.01</code>	Investor Relations
DQ-LEI-001	Identifier validation	LEI should be 20 characters and alphanumeric	<code>len(lei) == 20 and lei.isalnum()</code>	Static Data
DQ-ISO-001	Country/currency validation	Country and currency codes should be valid	<code>country in iso_3166 and currency in iso_4217</code>	Static Data

## 10. Reconciliation Controls

Before filing, reconcile:

- NAV to fund administrator official NAV;
- AUM to official AUM source;
- position count to portfolio accounting;
- market value by position and currency;
- risk metrics to risk system output;
- static identifiers to master data;
- country and currency codes to official reference tables;
- current filing to previous filing.

Expected production reconciliation outputs:

Source	Control	Expected output
fund administrator NAV file	NAV reconciliation	runs/<run_id>/reconciliation/NAV_reconciliation.xlsx
portfolio accounting system	Market value and position count reconciliation	runs/<run_id>/reconciliation/position_count_reconciliati
risk system output	DV01, CS01, VaR, stress metric reconciliation	runs/<run_id>/reconciliation/risk_metric_reconciliation.
static data master	LEI, ISIN, country, currency, AIF/AIFM validation	runs/<run_id>/reconciliation/static_data_validation.xlsx
previous filing	Period-on-period movement analysis	runs/<run_id>/reconciliation/previous_submission_compari



# Applied Module C - Operating Model

---

## 11. End-To-End Workflow

---

```
source templates
-> raw input data
-> Python calculations
-> risk/control checks
-> DATMAN/DATAIF XML generation
-> ESMA XSD validation
-> Excel control pack
-> HTML/PDF management report
-> CSSF-style filing pack
-> evidence ZIP
-> run manifest
```

The process separates:

- source data creation;
- calculations;
- business controls;
- XML generation;
- XML schema validation;
- human review outputs;
- filing evidence;
- audit evidence.

## 12. Package Folder Roles

---

Folder	Purpose
00_config	Reporting configuration and thresholds
00_source_templates	Reusable Excel source-data templates
01_input_data	Generated raw input workbook
02_calculations	Risk/exposure/leverage/liquidity calculations
03_control_checks	Business validation and breach monitoring
04_xml_generation	DATMAN and DATAIF XML outputs
05_xsd_validation	XSD validation logs
06_excel_control_pack	Excel review/control pack
07_html_pdf_management_report	Readable management report
08_python_scripts	Main runnable workflow scripts
08_evidence_pack	Evidence ZIP
09_xml_mapping	XML field mapping and section explanations
10_process_readme	Process readme
11_python_scripts	Proof scripts for calculations and validation
12_cssf_filing_pack	CSSF-style filing pack
13_official_sources	Official ESMA/CSSF downloads and indexes
official_xsd	XSDs used by validation
official_xml_templates	XML sample templates
runs	Run manifests and file hashes
tests	Test scaffold

## 13. XML Mapping

AIFMD section	Source	Field	XML area	Val
AIFM record information	AIFM_Static	AIFMName	AIFMRecordInfo	Mandatory field
AIFM record information	AIFM_Static	AIFMIdentifier	AIFMRecordInfo	CSSF/local check
AIF report information	AIF_Static	AIFName	AIFRecordInfo	Mandatory field
AIF report information	AIF_Static	NAV	AIFPrincipalInfo	NAV > 0
AIF report information	AIF_Static	AUM	AIFPrincipalInfo	AUM >= 1
Investment strategies	Strategy	Percentage	InvestmentStrategies	Strategy t
Principal exposures	Portfolio	GrossExposure	PrincipalExposures	Exposure asset/geo
Liquidity profile	Portfolio	LiquidityDays	LiquidityProfile	Liquidity k = 100
Leverage	Portfolio	GrossExposure / CommitmentExposure	LeverageAIF	Gross and leverage c
Counterparty risk	Portfolio	Counterparty	CounterpartyExposure	Largest cc threshold
Credit exposure	Portfolio	CS01 / Sector	PrincipalExposures	Sector and sensitivity

## 14. Evidence Chain

Evidence	Purpose
Raw input workbook	Shows source data used by the pipeline
Calculation workbook	Shows formulas and outputs
Control checks workbook	Shows business validation
XML files	Regulatory payloads
XSD validation logs	Schema validation evidence
Excel control pack	Reviewer and sign-off pack
HTML/PDF management report	Human-readable management report
CSSF filing pack	Submission-layer evidence
Run manifest	Timestamp and file hash evidence

## 15. Important Validation Distinction

XSD validation confirms XML structure and data types. It does not prove:

- NAV is correct;
- AUM is correct;
- leverage is economically correct;
- liquidity bucketing is reasonable;
- identifiers are real;
- reporting frequency is legally correct;
- strategy or investor totals are sourced correctly;
- the file has been submitted.

Business correctness is evidenced through:

- reconciliations;
- calculation workbooks;
- Python calculation scripts;
- business validation scripts;
- breach monitoring;
- sign-off;
- feedback retention.



# Applied Module D - Python Implementation

---

## 16. Environment Setup

---

Run from the package folder:

```
cd AIFMD_ESMA_CSSF_AUTOMATION_PACKAGE
python -m pip install -r requirements.txt
```

Main commands:

```
python 08_python_scripts/run_full_pipeline.py
python 08_python_scripts/audit_package.py
python 08_python_scripts/run_production_like_pipeline.py
```

Identifier validation:

```
python 11_python_scripts/validate_identifiers.py
```

Tests:

```
python 08_python_scripts/run_tests.py
```

## 17. Workflow Architecture

---

The implementation should start from controlled source files that already exist in the reporting folder. Those files normally come from fund accounting, portfolio accounting, risk systems, investor services, static-data teams, and previous regulatory submissions.

The pipeline should validate, transform, and evidence those inputs. It should not invent the portfolio, investor base, identifiers, or filing facts inside Python.

Stage	Responsibility
<code>validate_input_files</code>	Confirms all required source workbooks and templates are present
<code>load_source_data</code>	Reads approved Excel/CSV/XML source files
<code>reconcile_sources</code>	Reconciles NAV, AUM, positions, identifiers, and previous filing data
<code>calculate_outputs</code>	Calculates exposures, leverage, liquidity, concentrations, DV01, CS01
<code>write_calculation_evidence</code>	Writes calculation evidence
<code>run_control_checks</code>	Applies business validation rules
<code>write_control_evidence</code>	Writes control evidence
<code>write_mapping_evidence</code>	Writes XML mapping evidence
<code>generate_xml_files</code>	Writes DATMAN and DATAIF XML from the mapping layer
<code>validate_xml</code>	Validates XML against XSD
<code>write_validation_outputs</code>	Writes validation logs
<code>build_cssf_filing_pack</code>	Builds CSSF-style filing evidence
<code>profile_xml</code>	Profiles XML and scans for red flags
<code>build_control_pack</code>	Builds Excel control pack
<code>build_management_report</code>	Builds readable management evidence
<code>package_evidence</code>	Creates the archived evidence ZIP

## 18. Calculation Pattern

The core Python calculation pattern is:

```

portfolio = RAW_DATA["Portfolio"]
nav = next(row["Value"] for row in RAW_DATA["AIF_Static"] if row["Field"] == "NAV")
aum = next(row["Value"] for row in RAW_DATA["AIF_Static"] if row["Field"] == "AUM")

gross_exposure = sum(abs(row["GrossExposure"]) for row in portfolio)
commitment_exposure = sum(abs(row["CommitmentExposure"]) for row in portfolio)
market_value = sum(row["MarketValue"] for row in portfolio)
dv01 = sum(row["DV01"] for row in portfolio)
cs01 = sum(row["CS01"] for row in portfolio)

gross_leverage_pct_nav = round(gross_exposure / nav * 100, 2)
commitment_leverage_pct_nav = round(commitment_exposure / nav * 100, 2)

```

Concentration uses grouped dictionaries:

```

by_asset = defaultdict(float)
by_country = defaultdict(float)
by_sector = defaultdict(float)
by_counterparty = defaultdict(float)

for row in portfolio:
    exposure = abs(row["GrossExposure"])
    by_asset[row["AssetClass"]] += exposure
    by_country[row["Country"]] += exposure
    by_sector[row["Sector"]] += exposure
    by_counterparty[row["Counterparty"]] += exposure

```

## 19. XML Generation Pattern

The training implementation starts from local XML templates and updates:

- reporting dates;
- reporting period type;
- AIFM name;
- AIFM national code;
- AIFM LEI;
- AIF name;
- AIF national code;
- AIF LEI;
- country codes;
- BICs;

- entity names;
- old sample values;
- known red flags.

Simplified pattern:

```
parser = etree.XMLParser(remove_blank_text=False, remove_comments=True)
document = etree.parse(str(template_path), parser)

for element in document.getroot().iter():
    tag = etree.QName(element).localname
    if tag == "AIFMName":
        element.text = REPORTING["aifm_name"]
    if tag == "AIFMNationalCode":
        element.text = REPORTING["aifm_id"]
    if tag == "ReportingPeriodType":
        element.text = "Q1"

document.write(str(output_path), pretty_print=True, xml_declaration=True,
encoding="UTF-8")
```

Production recommendation:

For a real filing, build schema-aware XML generation from a controlled mapping layer rather than relying on broad template text replacement.

## 20. XSD Validation Pattern

```
document = etree.parse(str(xml_path))
schema = etree.XMLSchema(etree.parse(str(xsd_path)))
valid = schema.validate(document)
errors = [str(error) for error in schema.error_log]
```

Validation output records:

- XML file;
- XSD file;
- PASS/FAIL/ERROR;
- error count;
- error text.

## 21. Red Flag Scan

---

The package scans generated XML for old sample values:

```
2014
XMLSpy
TESTGB
TESTFR
AIFM 1
474286
969500AA77L4ZJXJ0T02
Id2
```

In production, red flag scans should include:

- old reporting dates;
  - sample names;
  - dummy identifiers;
  - test LEIs;
  - test BICs;
  - old country codes;
  - placeholder text;
  - previous filing period values.
-

# Applied Module E - Filing Operation

## 22. Safe Step-By-Step Runbook

Run the numbered scripts from the package folder after the source files have been placed in `01_input_data/` :

```
python 08_python_scripts/01_validate_input_files.py
python 08_python_scripts/02_calculate_risk_metrics.py
python 08_python_scripts/03_run_control_checks.py
python 08_python_scripts/04_generate_xml.py
python 08_python_scripts/05_validate_xsd.py
python 08_python_scripts/06_generate_excel_pack.py
python 08_python_scripts/07_generate_management_report.py
```

Meaning of each step:

Step	Script	Output
1	<code>01_validate_input_files.py</code>	Input completeness check
2	<code>02_calculate_risk_metrics.py</code>	Calculation workbook
3	<code>03_run_control_checks.py</code>	Control checks workbook
4	<code>04_generate_xml.py</code>	DATMAN and DATAIF XML
5	<code>05_validate_xsd.py</code>	XSD validation logs
6	<code>06_generate_excel_pack.py</code>	Excel control pack
7	<code>07_generate_management_report.py</code>	HTML/PDF management report

## 23. Full Run

```
python 08_python_scripts/run_full_pipeline.py
```

This executes the numbered workflow against the existing source files and templates.

## 24. Production-Like Run

```
python 08_python_scripts/run_production_like_pipeline.py
```

This runs:

1. full pipeline;
2. run manifest creation;
3. transient cleanup;
4. package audit.

## 25. CSSF Filing Pack

---

The CSSF-style filing folder is:

```
12_cssf_filing_pack/  
  01_submission_xml/  
  02_submission_zip/  
  03_cssf_identifier_check/  
  04_xsd_validation/  
  05_business_control_signoff/  
  06_edesk_s3_submission_checklist/  
  07_cssf_feedback_examples/  
  README_CSSF_FILING_PROCESS.md
```

Practical filing flow:

```
Final DATMAN/DATAIF XML  
-> CSSF-style submission ZIP  
-> CSSF identifier check  
-> XSD validation evidence  
-> business control sign-off  
-> eDesk/S3 submission checklist  
-> CSSF feedback retention
```

## 26. CSSF eDesk/S3 Layer

---

CSSF public material states that AIFM reporting submissions use CSSF eDesk or API/S3 channels from 1 July 2024. A real process must therefore control:

- sender registration and access;
- credential governance;

- submission channel;
- file naming;
- packaging;
- evidence capture;
- feedback retention.

The synthetic package does not submit anything and contains no credentials.

## 27. Feedback Handling

Feedback state	Operational response
Accepted	Retain feedback, update tracker, close filing
Warning	Assess warning, correct if needed, document owner approval
Rejected	Stop cycle, remediate source/mapping/XML, rerun full pipeline, revalidate, reapprove, resubmit
No feedback	Escalate to filing owner and transmission support

Never manually edit final XML after approval. Corrections should flow from source data or controlled mapping logic.

---

# Applied Module F - Production Hardening

---

## 28. Production Minimum Controls

---

A production-grade AIFMD reporting process needs:

- governed source systems;
- formal data lineage;
- controlled mapping;
- maker/checker review;
- versioned schemas;
- current official source downloads;
- checksum evidence;
- deterministic runs;
- test coverage;
- run manifests;
- exception handling;
- access controls;
- credential separation;
- evidence retention;
- sign-off workflow;
- feedback parsing and remediation.

## 29. Testing Strategy

---

Layer	Tests
Config	JSON/YAML parse, required keys, thresholds, owners
Source data	Required columns, data types, no missing identifiers
Calculations	Known input/output tests for leverage, liquidity, concentrations
Business rules	PASS/FAIL/REVIEW behavior
XML	Root, namespaces, mandatory tags, XSD validation
Red flags	No old dates, sample identifiers, test names
Evidence	Required outputs exist, zip contents correct, hashes recorded
Run scripts	Pipeline exits non-zero on critical failure

## 30. Production Readiness Checklist

- Reporting obligation and frequency confirmed.
- Current official ESMA/CSSF sources downloaded.
- XSD checksums recorded.
- Source data reconciled.
- NAV and AUM reconciled.
- Position count reconciled.
- Static identifiers validated.
- Country and currency codes validated.
- Risk metrics reconciled to risk system.
- Strategy percentages total 100.
- Investor percentages total 100.
- Liquidity buckets reviewed.
- Leverage reviewed.
- Counterparty concentration reviewed.
- Sector concentration reviewed.
- DATMAN generated.
- DATAIF generated.
- XSD validation passed.
- Red flag scan passed.
- Control pack reviewed.

- Filing zip reviewed.
  - Approval workflow completed.
  - Submission made through authorised CSSF channel.
  - Official feedback retained.
  - Any warnings or rejections remediated.
  - Filing cycle archived.
-

# Appendix A - File Structure

---

```
AIFMD_ESMA_CSSF_AUTOMATION_PACKAGE/  
  00_config/  
    reporting_config.json  
    business_rules.json  
    business_rules.yml  
    schema_register.json  
    source_reconciliation_register.json  
  00_source_templates/  
    aif_source_data_template.xlsx  
    aifm_source_data_template.xlsx  
    cssf_submission_tracker.xlsx  
    mapping_matrix.xlsx  
    validation_rule_catalogue.xlsx  
  01_input_data/  
    aifm_static.xlsx  
    aif_static.xlsx  
    portfolio_positions.xlsx  
    investor_profile.xlsx  
    liquidity_profile.xlsx  
    counterparty_exposures.xlsx  
    financing_and_leverage.xlsx  
  02_calculations/  
    calculation_outputs.xlsx  
    reconciliation_outputs.xlsx  
  03_control_checks/  
    business_validation.xlsx  
    control_checks_and_breach_monitoring.xlsx  
    identifier_validation_results.xlsx  
    reconciliation_report.json  
    reconciliation_report.xlsx  
  04_xml_generation/  
    DATMAN_<AIFM_CODE>_<PERIOD>.xml  
    DATAIF_<AIFM_CODE>_<AIF_CODE>_<PERIOD>.xml  
  05_xsd_validation/  
    xsd_validation_log.txt  
    xsd_validation_log.xlsx  
    xml_validation_and_red_flag_scan.xlsx  
  06_excel_control_pack/  
    AIFMD_Control_Pack.xlsx  
  07_html_pdf_management_report/  
    AIFMD_Q1_2026_Management_Report.html  
    AIFMD_Q1_2026_Management_Report.pdf  
  08_python_scripts/  
    01_validate_input_files.py  
    02_calculate_risk_metrics.py  
    03_run_control_checks.py  
    04_generate_xml.py  
    05_validate_xsd.py  
    06_generate_excel_pack.py  
    07_generate_management_report.py
```

```
run_full_pipeline.py
run_production_like_pipeline.py
audit_package.py
create_run_manifest.py
run_tests.py
09_xml_mapping/
  aifmd_field_mapping_matrix.xlsx
  xml_field_mapping_and_section_explanations_Q1_2026.xlsx
10_process_readme/
  README_PROCESS.md
11_python_scripts/
  calculate_risk_exposures.py
  run_business_validation.py
  validate_identifiers.py
  validate_xml_and_scan_red_flags.py
12_cssf_filing_pack/
13_official_sources/
official_xsd/
official_xml_templates/
runs/
tests/
run_pipeline.py
requirements.txt
```

---

# Appendix B - Configuration Files

---

## 00\_config/reporting\_config.json

```
{
  "reporting_period": {
    "label": "Q1 2026",
    "start_date": "2026-01-01",
    "end_date": "2026-03-31",
    "period_type": "Q1"
  },
  "jurisdiction": {
    "reporting_member_state": "LU",
    "regulator": "CSSF",
    "framework": "AIFMD Annex IV"
  },
  "aifm": {
    "name": "<legal AIFM name from source file>",
    "national_code": "<CSSF AIFM national code>",
    "lei": "<AIFM LEI>"
  },
  "aif": {
    "name": "<legal AIF name from source file>",
    "national_code": "<CSSF AIF national code>",
    "lei": "<AIF LEI>",
    "base_currency": "<base currency>"
  },
  "pipeline_paths": {
    "working_pack": ".",
    "official_sources": "13_official_sources",
    "full_pipeline_script": "08_python_scripts/run_full_pipeline.py"
  },
  "controls": {
    "largest_counterparty_pct_aum_threshold": 10.0,
    "gross_leverage_pct_nav_threshold": 150.0,
    "top_sector_pct_aum_threshold": 35.0
  },
  "status": "production_template_requires_real_source_data"
}
```

## 00\_config/business\_rules.json

```

{
  "rule_catalog_status": "prototype_config_for_production_rule_engine",
  "rules": [
    {
      "rule_id": "BR-001",
      "area": "NAV/AUM",
      "description": "AUM must be greater than or equal to NAV",
      "severity": "error",
      "expression": "aum >= nav",
      "owner": "Finance"
    },
    {
      "rule_id": "BR-002",
      "area": "Counterparty concentration",
      "description": "Largest counterparty exposure should not exceed configured
threshold without review",
      "severity": "review",
      "expression": "largest_counterparty_pct_aum <=
controls.largest_counterparty_pct_aum_threshold",
      "owner": "Risk"
    },
    {
      "rule_id": "BR-003",
      "area": "Leverage",
      "description": "Gross leverage should not exceed configured threshold without
review",
      "severity": "review",
      "expression": "gross_leverage_pct_nav <=
controls.gross_leverage_pct_nav_threshold",
      "owner": "Risk"
    },
    {
      "rule_id": "BR-004",
      "area": "Strategy allocation",
      "description": "Strategy percentages must total 100%",
      "severity": "error",
      "expression": "abs(strategy_total - 100) < 0.01",
      "owner": "Portfolio Management"
    },
    {
      "rule_id": "BR-005",
      "area": "Investor profile",
      "description": "Investor percentages must total 100%",
      "severity": "error",
      "expression": "abs(investor_total - 100) < 0.01",
      "owner": "Investor Relations"
    },
    {
      "rule_id": "DQ-LEI-001",
      "area": "Identifier validation",

```

```
    "description": "LEI should be 20 characters and alphanumeric",
    "severity": "error",
    "expression": "len(lei) == 20 and lei.isalnum()",
    "owner": "Static Data"
  },
  {
    "rule_id": "DQ-ISO-001",
    "area": "Country/currency validation",
    "description": "Country and currency codes should be validated against ISO
reference data",
    "severity": "error",
    "expression": "country in iso_3166 and currency in iso_4217",
    "owner": "Static Data"
  }
]
}
```

**00\_config/schema\_register.json**

```

{
  "schema_register_status": "production_governance_template",
  "schemas": [
    {
      "name": "AIFMD_DATMAN_V1.2.xsd",
      "report": "DATMAN",
      "local_path": "official_xsd/AIFMD_DATMAN_V1.2.xsd",
      "source": "ESMA/CSSF AIFMD reporting XML documents",
      "version": "1.2",
      "effective_from": "2015-01-30",
      "checksum_algorithm": "SHA256",
      "production_control": "Calculate and record checksum before each filing cycle"
    },
    {
      "name": "AIFMD_DATAIF_V1.2.xsd",
      "report": "DATAIF",
      "local_path": "official_xsd/AIFMD_DATAIF_V1.2.xsd",
      "source": "ESMA/CSSF AIFMD reporting XML documents",
      "version": "1.2",
      "effective_from": "2015-01-30",
      "checksum_algorithm": "SHA256",
      "production_control": "Calculate and record checksum before each filing cycle"
    },
    {
      "name": "AIFMD_REPORTING_DataTypes_V1.2.xsd",
      "report": "DATMAN/DATAIF shared data types",
      "local_path": "official_xsd/AIFMD_REPORTING_DataTypes_V1.2.xsd",
      "source": "ESMA/CSSF AIFMD reporting XML documents",
      "version": "1.2",
      "effective_from": "2015-01-30",
      "checksum_algorithm": "SHA256",
      "production_control": "Assess mapping and validation impact when this file
changes"
    }
  ]
}

```

**00\_config/source\_reconciliation\_register.json**

```
{
  "reconciliation_status": "production_control_template",
  "expected_sources": [
    {
      "source": "fund_admin_nav_file",
      "control": "NAV reconciliation",
      "expected_output": "runs/<run_id>/reconciliation/NAV_reconciliation.xlsx"
    },
    {
      "source": "portfolio_accounting_system",
      "control": "Market value and position count reconciliation",
      "expected_output":
"runs/<run_id>/reconciliation/position_count_reconciliation.xlsx"
    },
    {
      "source": "risk_system_output",
      "control": "DV01, CS01, VaR and stress metric reconciliation",
      "expected_output":
"runs/<run_id>/reconciliation/risk_metric_reconciliation.xlsx"
    },
    {
      "source": "static_data_master",
      "control": "LEI, ISIN, country, currency and AIF/AIFM identifier validation",
      "expected_output": "runs/<run_id>/reconciliation/static_data_validation.xlsx"
    },
    {
      "source": "previous_filing",
      "control": "Period-on-period movement analysis",
      "expected_output":
"runs/<run_id>/reconciliation/previous_submission_comparison.xlsx"
    }
  ]
}
```

# Appendix C - Runnable Scripts

---

The runnable scripts should orchestrate a reporting run from existing controlled inputs. They should not create synthetic fund data inside the pipeline.

In a real AIFM, the source files normally come from fund accounting, portfolio accounting, risk, investor services, static-data, and prior filing records. The scripts should read those files, validate them, transform them into the Annex IV mapping layer, generate DATMAN/DATAIF XML, validate against XSD, and produce evidence.

Expected input pattern:

```
01_input_data/  
  aifm_static.xlsx  
  aif_static.xlsx  
  portfolio_positions.xlsx  
  investor_profile.xlsx  
  liquidity_profile.xlsx  
  counterparty_exposures.xlsx  
  financing_and_leverage.xlsx  
  previous_submission.xml  
00_source_templates/  
  aif_source_data_template.xlsx  
  aifm_source_data_template.xlsx  
  mapping_matrix.xlsx  
  validation_rule_catalogue.xlsx
```

Recommended run order:

```
python 08_python_scripts/01_validate_input_files.py  
python 08_python_scripts/02_calculate_risk_metrics.py  
python 08_python_scripts/03_run_control_checks.py  
python 08_python_scripts/04_generate_xml.py  
python 08_python_scripts/05_validate_xsd.py  
python 08_python_scripts/06_generate_excel_pack.py  
python 08_python_scripts/07_generate_management_report.py
```

**run\_pipeline.py**

```
from __future__ import annotations

import subprocess
import sys
from pathlib import Path

ROOT = Path(__file__).resolve().parent
SCRIPTS = ROOT / "08_python_scripts"
RUN_ORDER = [
    "01_validate_input_files.py",
    "02_calculate_risk_metrics.py",
    "03_run_control_checks.py",
    "04_generate_xml.py",
    "05_validate_xsd.py",
    "06_generate_excel_pack.py",
    "07_generate_management_report.py",
]

def main() -> None:
    for script in RUN_ORDER:
        subprocess.run([sys.executable, str(SCRIPTS / script)], cwd=ROOT, check=True)

if __name__ == "__main__":
    main()
```

**08\_python\_scripts/01\_validate\_input\_files.py**

```

from __future__ import annotations

from pathlib import Path

ROOT = Path(__file__).resolve().parents[1]
INPUT_DIR = ROOT / "01_input_data"
REQUIRED_INPUTS = [
    "aifm_static.xlsx",
    "aif_static.xlsx",
    "portfolio_positions.xlsx",
    "investor_profile.xlsx",
    "liquidity_profile.xlsx",
    "counterparty_exposures.xlsx",
    "financing_and_leverage.xlsx",
]

def main() -> None:
    missing = [name for name in REQUIRED_INPUTS if not (INPUT_DIR / name).exists()]
    if missing:
        raise FileNotFoundError("Missing required source files: " + ",
            ".join(missing))
    print("Input file check passed.")

if __name__ == "__main__":
    main()

```

08\_python\_scripts/02\_calculate\_risk\_metrics.py

```

from __future__ import annotations

from pathlib import Path

import pandas as pd

ROOT = Path(__file__).resolve().parents[1]
INPUT_DIR = ROOT / "01_input_data"
OUTPUT_DIR = ROOT / "02_calculations"
OUTPUT_DIR.mkdir(parents=True, exist_ok=True)

def main() -> None:
    positions = pd.read_excel(INPUT_DIR / "portfolio_positions.xlsx")
    aif_static = pd.read_excel(INPUT_DIR / "aif_static.xlsx")

    nav = float(aif_static.loc[aif_static["Field"] == "NAV", "Value"].iloc[0])
    aum = float(aif_static.loc[aif_static["Field"] == "AUM", "Value"].iloc[0])
    gross_exposure = positions["GrossExposure"].abs().sum()
    commitment_exposure = positions["CommitmentExposure"].abs().sum()

    calculations = pd.DataFrame(
        [
            {"Metric": "NAV", "Value": nav},
            {"Metric": "AUM", "Value": aum},
            {"Metric": "Gross exposure", "Value": gross_exposure},
            {"Metric": "Commitment exposure", "Value": commitment_exposure},
            {"Metric": "Gross leverage % NAV", "Value": gross_exposure / nav * 100},
            {"Metric": "Commitment leverage % NAV", "Value": commitment_exposure / nav
* 100},
        ]
    )
    calculations.to_excel(OUTPUT_DIR / "calculation_outputs.xlsx", index=False)

if __name__ == "__main__":
    main()

```

## Production Note

The scripts above are deliberately small orchestration examples. In a production process, calculation functions, XML mapping functions, validation rules, and report rendering should live in reusable modules with unit tests. The command-line scripts should only coordinate a controlled filing run from approved source files.

---

## Appendix D - Glossary

Term	Definition
AIF	Alternative Investment Fund
AIFM	Alternative Investment Fund Manager
AIFMD	Alternative Investment Fund Managers Directive
Annex IV	AIFMD reporting data set for managers and funds
AUM	Assets under management
BIC	Business Identifier Code
CSSF	Luxembourg financial sector regulator
CS01	Credit-spread sensitivity to a one basis point move
DATAIF	Fund-level AIFMD XML report
DATMAN	Manager-level AIFMD XML report
DV01	Interest-rate sensitivity to a one basis point move
eDesk	CSSF online submission procedure
ESMA	European Securities and Markets Authority
Evidence pack	Archived set of filing support files
Gross exposure	Absolute economic exposure used in gross leverage
ISIN	International Securities Identification Number
LEI	Legal Entity Identifier
NAV	Net asset value
S3/API	CSSF API/object-storage style submission channel
VaR	Value-at-Risk
XML	Extensible Markup Language
XSD	XML Schema Definition

# Appendix E - Official Source Register

Before each production filing cycle, re-check official sources, download the current files, and record checksums.

Source	URL
CSSF AIFM Reporting Technical Guidance	<a href="https://www.cssf.lu/en/Document/aifm-reporting-technical-guidance/">https://www.cssf.lu/en/Document/aifm-reporting-technical-guidance/</a>
CSSF eDesk/S3 communication means from 1 July 2024	<a href="https://www.cssf.lu/en/2024/07/edesk-s3-communication-means-only-applicable-for-aifm-reporting-submission-as-of-1-july-2024/">https://www.cssf.lu/en/2024/07/edesk-s3-communication-means-only-applicable-for-aifm-reporting-submission-as-of-1-july-2024/</a>
CSSF reporting to be submitted by IFMs	<a href="https://www.cssf.lu/en/reporting-to-be-submitted-by-ifms/">https://www.cssf.lu/en/reporting-to-be-submitted-by-ifms/</a>
CSSF AIFMD FAQ	<a href="https://www.cssf.lu/wp-content/uploads/FAQ-AIFMD_200525.pdf">https://www.cssf.lu/wp-content/uploads/FAQ-AIFMD_200525.pdf</a>
CSSF Circular 23/844	<a href="https://www.cssf.lu/wp-content/uploads/cssf23_844eng.pdf">https://www.cssf.lu/wp-content/uploads/cssf23_844eng.pdf</a>
ESMA library	<a href="https://www.esma.europa.eu/databases-library/esma-library">https://www.esma.europa.eu/databases-library/esma-library</a>