
Algorithm 1 Modular Factor Backtest Framework

Input: Date Ranges \mathcal{T} , Stock Pools \mathcal{P} , Factor List \mathcal{F} , Config \mathcal{C}

Output: IC/ICIR Statistics, Group Returns, Visualized PDF Reports

```
1: Initialize PATHMANAGER with output directory root
2:  $Tasks \leftarrow \text{GENERATETASKCOMBINATIONS}(\mathcal{T}, \mathcal{P}, \mathcal{C}.Scenarios)$ 
3: for each  $task(t, p, s) \in Tasks$  in parallel do                                 $\triangleright$  Parallel execution via ThreadPool
4:    $Dir \leftarrow \text{PATHMANAGER.CreateDir}(task)$ 
5:    $U \leftarrow \text{GETVALIDUNIVERSE}(p, t)$                                           $\triangleright$  Load valid stock list
6:    $R \leftarrow \text{LOADRETURNS}(t, \mathcal{C}.RetIdx)$                                       $\triangleright$  Load & slice returns
7:   for each  $name \in \mathcal{F}$  do
8:      $D_{\text{raw}} \leftarrow \text{LOADFACTORPARQUET}(name)$ 
9:      $D \leftarrow D_{\text{raw}} \cap U \cap t$                                                $\triangleright$  Filter by universe and time range
10:    if  $\mathcal{C}.IndNeu$  then
11:       $D \leftarrow \text{ZSCORENEUTRALIZE}(D, \text{Industry})$                                 $\triangleright$  Industry Neutralization
12:    end if
13:     $M \leftarrow \text{MERGE}(D, R)$                                                   $\triangleright$  Align factor with next period returns
14:     $IC, RankIC \leftarrow \text{CALCCORRELATIONS}(M)$                                  $\triangleright$  Calc IC & Newey-West T-stat
15:    if  $\mathcal{C}.GroupRet$  then
16:       $G_{\text{ret}}, G_{ts} \leftarrow \text{CALCGROUPRETURNS}(M, \text{bins} = 10)$ 
17:       $\text{PLOTCHARTS}(G_{ts}, Dir)$                                                $\triangleright$  Draw Bar & Cumulative Line charts
18:    end if
19:     $\text{SAVETOCSS}(IC, G_{\text{ret}}, Dir)$ 
20:  end for
21:   $\text{AUTOMERGERESULTS}(Dir)$                                                $\triangleright$  Merge dispersed CSV files
22:   $\text{GENERATEPDF}(Dir)$                                                         $\triangleright$  Compile charts & stats into PDF
23: end for
```
