



VEKTOR

BY
INVESTPUPPY

PLATFORM OVERVIEW · 2026

Rigour at every step.

Any market. Any currency. Every mandate.

The complete eleven-step workflow — from stock screening to funded, trade-ready positions.
Systematic, auditable, data-driven.

For professional and institutional investors only

Rigour at every step.

The eleven steps documented here are not aspirational. They describe what the platform does today — on your data, at live prices, for any listed equity market you configure.

Vektor coordinates three roles — Stock Analyst, Portfolio Manager, and Operations — through a single admin portal. Each has a defined scope. Every action is logged.

Stock Analyst

Screens the universe, runs optimisation, selects per-instrument signals.

Portfolio Manager

Reviews strategy, onboards clients, allocates capital.

Operations

Funds accounts, maintains the full audit trail.

Result: a quantitatively constructed, genuinely diversified, compliance-ready portfolio — from first client meeting to funded positions — in a fraction of the time.

10,000

portfolio configurations per strategy

Efficient frontier mapped across 10,000 portfolio configurations. MPT selects max-Sharpe.

98.94%

capital allocation efficiency

Of target allocation deployed (SGX, 100-share lots).

6

signals per instrument

Indicators evaluated per stock, 3 years of data.

3 yrs

daily data, refreshed daily

Current signals, not stale history.

The example throughout this document uses a Singapore equity mandate (SGX, SGD). The platform is market-agnostic — eight exchanges are configured and active: SGX, LSE, NYSE, NASDAQ, HKEX, SIX, ASX, TSE. Any listed equity market is a configuration, not a development task. Run all your mandates — across any market and currency — on a single platform. Configure your exchange, benchmark, currency, and lot sizes — and the engine does the rest.

STEPS 01–03 · STOCK ANALYST

Strategy Research & Construction

STEP 01

Screen the Universe

Vektor's research workbench screens any listed equity universe by sector, daily liquidity, and dividend continuity — turning thousands of candidates into a clean, implementation-ready set. Singapore example: ~700 SGX-listed stocks filtered by sector (financials, real estate, industrials), average daily volume >100K, and dividend continuity.

Result: a ranked, filtered universe of implementation-ready equities — from several hundred candidates to a clean working set, configured entirely through market parameters. No code required from the portfolio manager.

*The research workbench runs automatically. The Stock Analyst configures parameters; the platform executes the screen. See **The Proof Behind the Fancy Screens** for full technical documentation of this step.*

CODE	NAME	COUNTRY	CURRENCY	LOT SIZE	TIMEZONE	T+N	STATUS	ACTIONS
ASX	Australian Securities Exchange	AUS	AUD	1	Australia/Sydney	T+2	Active	View
HKEX	Hong Kong Stock Exchange	HKG	HKD	100	Asia/Hong_Kong	T+2	Active	View
LSE	London Stock Exchange	GBR	GBP	1	Europe/London	T+2	Active	View
NASDAQ	NASDAQ Stock Market	USA	USD	1	America/New_York	T+2	Active	View
NYSE	New York Stock Exchange	USA	USD	1	America/New_York	T+2	Active	View
SGX	Singapore Exchange	SGP	SGD	100	Asia/Singapore	T+2	Active	View
SIX	SIX Swiss Exchange	CHE	CHF	1	Europe/Zurich	T+2	Active	View
TSE	Tokyo Stock Exchange	JPN	JPY	100	Asia/Tokyo	T+2	Active	View

Exchange registry — eight exchanges configured and active: SGX, LSE, NYSE, NASDAQ, HKEX, SIX, ASX, TSE. Any listed equity market is a configuration, not a development task.

STEP 02

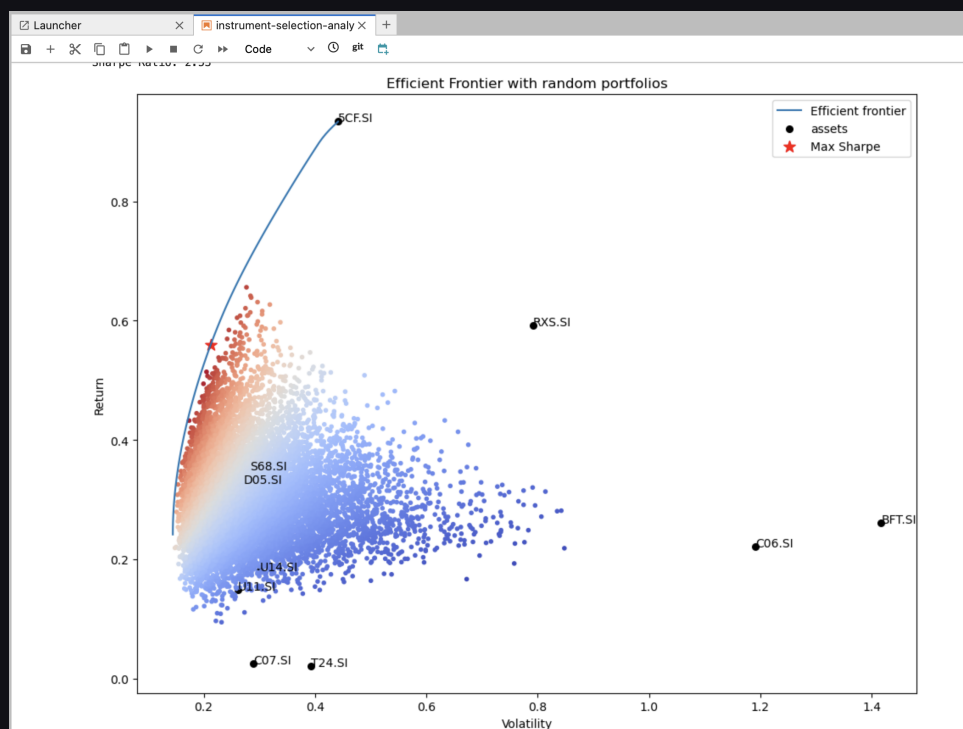
Optimise the Portfolio

The system generates 10,000 portfolio configurations to map the efficient frontier, then applies Modern Portfolio Theory to identify the max-Sharpe allocation — the combination of stocks and weights that maximises risk-adjusted return.

Result: the max-Sharpe portfolio — the specific combination of instruments and weights that delivers the best risk-adjusted return within your mandate parameters.

*The optimisation runs 10,000 configurations automatically. The portfolio manager reviews the output — the efficient frontier chart and selected allocation — not the simulation process itself. See **The Proof Behind the Fancy Screens** for full technical documentation of this step.*

PLATFORM INTERFACE



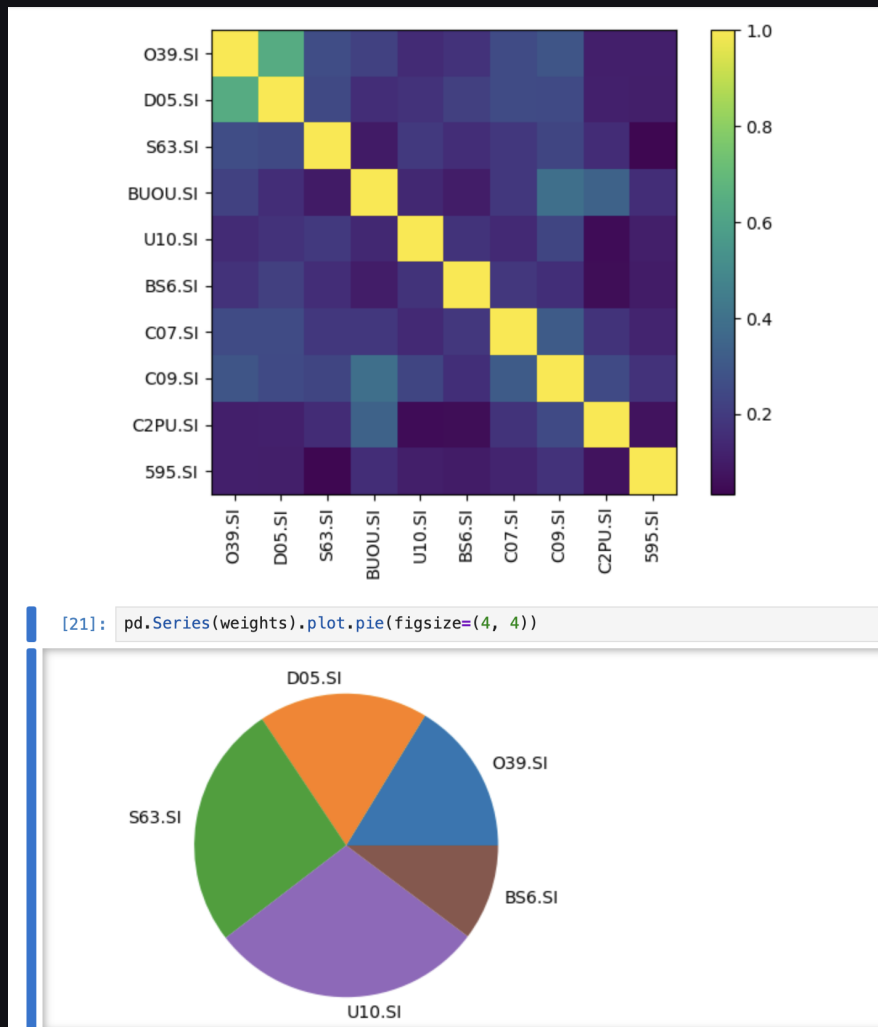
Efficient frontier — 10,000 portfolio configurations mapped across risk-return space. Red = high Sharpe, blue = low Sharpe. Red star = max-Sharpe selection via Modern Portfolio Theory.

STEP 03

Validate Diversification

A correlation heatmap confirms the portfolio is genuinely diversified — not just spread across names that move in lockstep. Strategy weights are then locked in.

RESEARCH ENVIRONMENT · AUTOMATED



Correlation heatmap (top) — diagonal yellows confirm genuine diversification. Allocation weights pie chart (bottom) — max-Sharpe portfolio weights by instrument. Generated automatically by the research workbench; portfolio manager reviews the output in the strategy portal.

STEP 04 · AUTOMATED

Per-Stock Signal Selection

One-size-fits-all trading signals leave alpha on the table. Vektor gives every holding its own optimised edge — the technical indicator configuration that actually worked for that specific instrument over three years of price history.

The six indicators evaluated:

- SMA — Simple Moving Average crossover
- EMA — Exponential Moving Average crossover
- MACD — EMA convergence / divergence momentum
- BB — Bollinger Bands volatility breakout
- RSI — Relative Strength Index overbought/oversold
- SO — Stochastic Oscillator closing price vs range

An XGBoost layer validates every live signal before execution. Two layers of rigour, zero guesswork.

Each instrument's winning indicator, its optimised parameters, and its backtest Sharpe ratio are saved to the strategy record and visible to the portfolio manager before sign-off.

*Signal selection and XGBoost validation run automatically. The portfolio manager reviews the per-instrument results in the strategy portal — not the model training process. See **The Proof Behind the Fancy Screens** for full technical documentation of this step.*

STEPS 05–06 · PORTFOLIO MANAGER

Strategy Review & Client Onboarding

Full transparency before a single order is placed. The portfolio manager reviews instruments, weights, indicators, and backtest Sharpe ratios — before the strategy is approved. No black boxes. No surprises at execution.

PLATFORM INTERFACE

The screenshot displays the 'SGP Equity Strategy' configuration page in the Vektor InvestPuppy admin portal. The interface includes a sidebar with navigation options like Dashboard, Client Management, Portfolio Management, Trading & Orders, and Market Data. The main content area shows the strategy details for 'sgp-stocks', including market region (SGX), currency (SGD), max instruments (10), selected instruments (10), total weight (NaN%), and creation date (5/10/2026). A table of selected instruments lists 10 stocks with their symbols, names, scores, weights, technical indicators (RSI, MACD, SMA, EMA), optimization status (YES), and selection dates. Below the table, the selection criteria are listed.

SGP Equity Strategy
sgp-stocks

Market Region: **SGX** | Currency: **SGD** | Max Instruments: **10** | Selected: **10 instruments** | Total Weight: **NaN%** | Created: **5/10/2026**

Description: Dividend-paying stocks from financial-services, real-estate, industrials sectors

Selected Instruments

Symbol	Name	Score	Weight	Indicator	Optimized	Selected
C2PU	Parkway Life Real Estate Investment Trust	10	0.0%	RSI	YES	5/10/2026
S63	Singapore Technologies Engineering Ltd	10	26.1%	EMA	YES	5/10/2026
C89	City Developments Limited	10	0.0%	MACD	YES	5/10/2026
S95	GKE Corporation Limited	10	0.0%	RSI	YES	5/10/2026
U18	UOB-Kay Hian Holdings Limited	10	29.3%	SMA	YES	5/10/2026
B00U	Fraser's Logistics & Commercial Trust	10	0.0%	MACD	YES	5/10/2026
C87	Jardine Cycle & Carriage Limited	10	0.0%	SMA	YES	5/10/2026
D85	DBS Group Holdings Ltd	10	18.0%	MACD	YES	5/10/2026
039	Oversea-Chinese Banking Corporation Limited	10	16.3%	EMA	YES	5/10/2026
B56	Yangzijiang Shipbuilding (Holdings) Ltd.	10	10.2%	RSI	YES	5/10/2026

Selection Criteria

SGP Equity Strategy — admin portal. Ten instruments with allocation weights, assigned technical indicators (BB, MACD, SMA, EMA, RSI), optimisation status and selection date. All ten validated and ready for client assignment.

Client onboarding — two steps:

- Create Client — name, type (individual / institutional), risk profile, base currency.
- Create Portfolio — link client, assign strategy, set investment capital.

PLATFORM INTERFACE

Customer Management

Search customers by name... Search Clear

Name	Type	Currency	Risk Profile	KYC Status	Status	Created
Chen Family Office 40036800-8364-489a-3c05-bc7754f59d96	Family_office	SGD	Aggressive	PENDING	ACTIVE	5/10/2026
Meridian Capital Ltd 5468e4ba-5848-6b77-b4f5-88d56dc62d4	Institutional	SGD	Moderate	PENDING	ACTIVE	5/10/2026

Customer management — clients listed with type, currency, risk profile, KYC status, and account status. Individual or institutional. Any currency.

STEPS 07–08 · PORTFOLIO MANAGER

Asset Allocation at Live Prices

Weights in a spreadsheet are just numbers. Vektor turns them into actual positions — at real prices, rounded to the correct lot size for the target exchange.

- Live market prices fetched at execution time
- Percentage weights converted to share quantities automatically
- SGX board lot sizes applied (multiples of 100 shares — configurable per market)
- Configurable cash buffer reserved for fees and slippage

The trade-ready position set:

Every instrument. Every quantity. Every signal. Every price. Reviewed and approved. Nothing moves until this is complete. The eleven steps end here.

PLATFORM INTERFACE

Asset Allocation

Allocation calculated successfully

MANDATE: SGD 500,000.00 Target: SGD 469,948.00 Residual: SGD 5,052.00 Efficiency: 98.94%

Cash Reserve: SGD 25,000.00 (5%)

Symbol	Weight	Price	Shares	Amount
USD	29.30%	SGD 4.29	33,100	SGD 139,820.00
S63	26.07%	SGD 15.66	11,800	SGD 121,896.00
D05	18.04%	SGD 18.68	1,400	SGD 42,152.00
Q38	14.21%	SGD 21.92	3,500	SGD 76,720.00
R88	10.23%	SGD 4.00	12,100	SGD 48,400.00
Total	100.00%			SGD 469,948.00

Asset allocation — SGD 500,000 mandate. SGD 469,948 allocated across five active positions at live prices. Cash reserve: SGD 25,000 (5%). Lot-rounding residual: SGD 5,052. Efficiency: 98.94% (SGX 100-share board lots).

PLATFORM INTERFACE

VEKTOR

Dashboard
Overview & Analytics

CLIENT MANAGEMENT

Clients
Profiles & KYC

Onboarding
New Client Setup

PORTFOLIO MANAGEMENT

Portfolios
Portfolio Overview

Strategies
Strategy Composition

Allocations
Asset Allocation

Rebalancing
Rebalance Portfolios

TRADING & ORDERS

Orders
Trade Orders

PM Portfolio Manager
demo@investpuppy.com

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Chen SGP Growth
aa3d017f-c2e1-429b-93ef-980cbb73dfac

Deposit / Withdraw

Total Capital
SGD 500,000.00

Strategy
sgp-stocks

Currency
SGD

Risk
aggressive

Positions (5)

Cash Accounts

Cash Movements

Target Value
SGD 469,948.00

Market Value
SGD 0.00

Unrealized P&L
SGD 0.00

Symbol	Weight	Target Qty	Target Value	Actual Qty	Market Value	P&L	Indicator	Status
U10	29.35%	33,100	SGD 139,020.00	0	SGD 0.00	SGD 0.00	SMA	PENDING
S63	26.07%	11,600	SGD 123,656.00	0	SGD 0.00	SGD 0.00	EMA	PENDING
D05	18.04%	1,400	SGD 82,152.00	0	SGD 0.00	SGD 0.00	MACD	PENDING
O39	16.31%	3,500	SGD 76,720.00	0	SGD 0.00	SGD 0.00	EMA	PENDING
BS6	10.23%	12,100	SGD 48,400.00	0	SGD 0.00	SGD 0.00	RSI	PENDING

Portfolio positions — target quantities and values vs actual holdings. All positions pending execution. Target value SGD 469,948. Indicator assigned to each position visible.

STEPS 09–11 · OPERATIONS & ADMIN

Cash Funding, Market Data & Audit

Clean data in. Clean audit trail out.

Operations records the client's wire transfer — currency, amount, reference — and the cash account is live immediately. Every deposit is logged with a full audit trail, ready for compliance review.

PLATFORM INTERFACE

VEKTOR

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Strategies
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Asset Allocation

PM Portfolio Manager
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Chen SGP Growth
aa3d017f-c2e1-429b-93ef-980cbb73dfac

Deposit / Withdraw

Deposit of SGD 500,000 recorded

Total Capital
SGD 500,000.00

Strategy
sgp-stocks

Currency
SGD

Risk
aggressive

Positions (5)

Cash Accounts

Cash Movements

Date	Type	Amount	Reference
5/10/2026	DEPOSIT	+500,000.00	-

Cash movements — SGD 500,000 deposit recorded 30/04/2026. Date, type, amount, and wire reference logged. Immediately available for allocation.

Global market data — always current:

- Instrument master — symbol, company, exchange, currency, sector, market cap
- 3 years daily OHLCV — auto-refreshed every morning at 8 AM SGT
- FX rates updated daily — any currency pair

— All actions logged — strategy, allocation, cash movements

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INVESTPUPPY

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Asset Allocation

Rebalancing
Rebalance Portfolios

TRADING & ORDERS

Orders
Trade Orders

Executions
Trade Executions

Settlements
Trade Settlements

MARKET DATA

Instruments
Securities Master

Exchange Rates
FX Rates (SGD/USD)

PM Portfolio Manager
demo@investpuppy.com Logout

Instruments

Search by symbol, name, or sector...

Showing 10 of 10 instruments

Symbol	Name	Type	Exchange	Sector	Market Cap	Actions
S95	GKE Corporation Limited	equity	SGX	Industrials	\$70M	Prices
B56	Yangzijiang Shipbuilding (Holdings) Ltd.	equity	SGX	Industrials	\$15.7B	Prices
B00U	Frasers Logistics & Commercial Trust	equity	SGX	Real Estate	\$3.8B	Prices
C87	Jardine Cycle & Carriage Limited	equity	SGX	Industrials	\$13.0B	Prices
C89	City Developments Limited	equity	SGX	Real Estate	\$7.4B	Prices
C2PU	Parkway Life Real Estate Investment Trust	equity	SGX	Real Estate	\$2.6B	Prices
D85	DBS Group Holdings Ltd	equity	SGX	Financial Services	\$166.5B	Prices
O39	Oversea-Chinese Banking Corporation Limited	equity	SGX	Financial Services	\$98.4B	Prices
S63	Singapore Technologies Engineering Ltd	equity	SGX	Industrials	\$33.3B	Prices
U18	UOB - Kay Hian Holdings Limited	equity	SGX	Financial Services	\$4.1B	Prices

Instruments master — ten SGX-listed securities with symbol, company name, type, exchange, sector, and market cap. Full securities database.

PLATFORM INTERFACE

InvestPuppy Admin Portal	Tan Chow Pin chowpin.tan@investpuppy.com
Dashboard Overview & Analytics	5CF — OKP Holdings Limited 61450a60-2781-4511-95da-4ce217ac35cf
CLIENT MANAGEMENT	
Customers Client Profiles & KYC	Type: equity
Onboarding New Client Setup	Exchange: SGX
	Currency: SGD
	Country:
	Sector: Industrials
	Market Cap: \$430M
PORTFOLIO MANAGEMENT	Price History (Last 30 Days)
Portfolio Portfolio Overview	
Strategies Investment Strategies	
Allocations Asset Allocation	
Rebalancing Portfolio Rebalancing	
TRADING & ORDERS	
Orders Trade Orders	
Executions Trade Executions	
Settlements Trade Settlements	
MARKET DATA	
Instruments Securities Master	

Date	Open	High	Low	Close
3/31/2026	0.6650	0.6650	0.6350	0.6400
4/1/2026	0.6600	0.7000	0.6500	0.6900
4/2/2026	0.7000	0.7250	0.6850	0.6900
4/6/2026	0.7000	0.7200	0.6850	0.7150
4/7/2026	0.7050	0.7200	0.6950	0.7050
4/8/2026	0.7250	0.7400	0.7150	0.7250
4/9/2026	0.7250	0.7400	0.7100	0.7150
4/10/2026	0.7150	0.7400	0.7150	0.7150
4/13/2026	0.7300	0.7300	0.7000	0.7100
4/14/2026	0.7100	0.7300	0.7050	0.7250
4/15/2026	0.7250	0.7500	0.7250	0.7350
4/16/2026	0.7350	0.7700	0.7350	0.7600

Price history detail — 5CF (OKP Holdings Limited). Daily OHLCV data auto-refreshed at 8 AM SGT. Three years of history for signal backtests.

MULTI-CURRENCY SUPPORT · STEP 11

Daily FX rate collection supports multi-currency mandates and cross-border portfolio valuation. Any currency pair, updated every morning.

PLATFORM INTERFACE

InvestPuppy Admin Portal	Tan Chow Pin chowpin.tan@investpuppy.com	Logout
Dashboard Overview & Analytics	SGD / USD 22c0c68-10e4-4718-889f-0941282a284	
CLIENT MANAGEMENT	Latest Open: 0.783800	Latest Date: 4/25/2026
Customers Client Profiles & KYC		Period: 60 days
Onboarding New Client Setup		Pair: SGD/USD
PORTFOLIO MANAGEMENT	Rate History (Latest 60 Days)	
Portfolio Portfolio Overview		
Strategies Investment Strategies		
Allocations Asset Allocation		
Rebalancing Portfolio Rebalancing		
TRADING & ORDERS		
Orders Trade Orders		
Executions Trade Executions		
Settlements Trade Settlements		
MARKET DATA		
Instruments Securities Master		

Date	Open	High	Low	Close	Change
4/25/2026	0.783800	0.783800	0.783800	0.783800	+0.153%
4/24/2026	0.782600	0.783900	0.781800	0.782600	-0.166%
4/23/2026	0.783800	0.784600	0.782800	0.783900	-0.181%
4/22/2026	0.785500	0.786400	0.784200	0.785400	-0.254%
4/21/2026	0.787300	0.787700	0.785300	0.787400	+0.280%
4/20/2026	0.785200	0.787800	0.785200	0.785200	-0.038%
4/17/2026	0.785700	0.789400	0.785400	0.785500	-0.181%
4/16/2026	0.787100	0.788300	0.785500	0.787000	+0.013%
4/15/2026	0.786900	0.787200	0.785600	0.786900	+0.051%
4/14/2026	0.785200	0.787600	0.784800	0.786500	+0.485%
4/13/2026	0.782600	0.785200	0.782500	0.782700	-0.344%
4/10/2026	0.785400	0.786200	0.783900	0.785400	+0.102%
4/9/2026	0.784600	0.786400	0.783800	0.784600	+0.102%

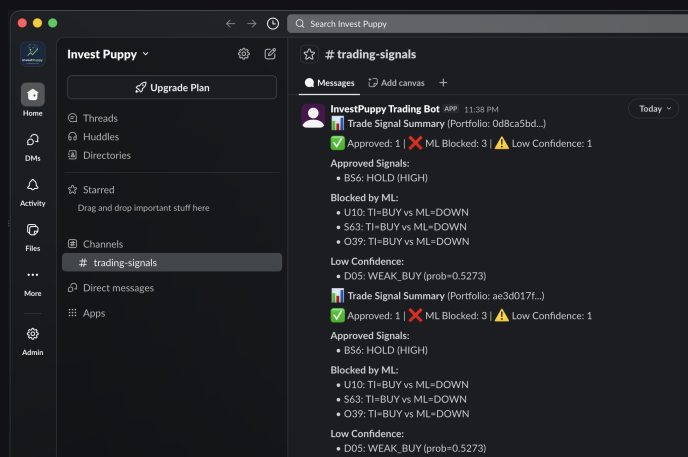
SGD/USD exchange rate history — 60 days. Daily open, high, low, close, and change. Auto-collected at 8 AM SGT from Yahoo Finance. Any FX pair supported.

PLATFORM STATUS

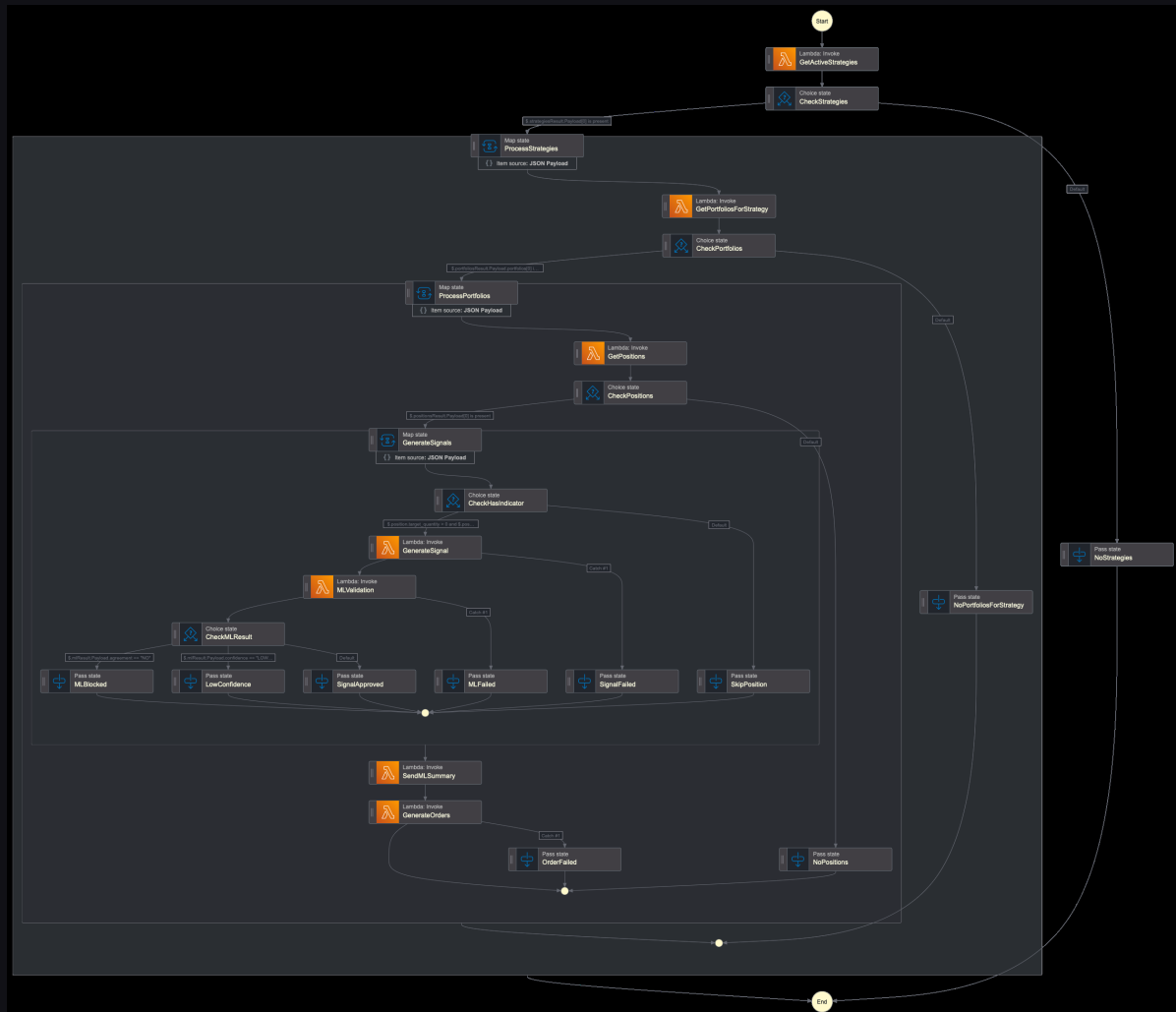
What's Live. What's Next.

LIVE TODAY	COMING NEXT	BUILT TO SCALE
Strategy creation & optimisation	Live client execution via IBKR — real-money order submission	Automated rebalancing
XGBoost signal validation	Real-time position updates post-fill	External PMS integration
ML model training & deployment	Live P&L; & performance dashboards	SAA & model portfolios
Three-state signal approval	Walk-forward strategy validation	
Client onboarding & portfolio setup	Infrastructure RBAC / maker-checker	
Asset allocation at live prices		
IBKR integration — connectivity validated		
SGX, LSE, NYSE, NASDAQ, HKEX, SIX, ASX, TSE — eight exchanges active. Any listed market is a configuration		
Cash funding & full audit trail		
Order preparation, queuing & Slack notification		

PLATFORM INTERFACE



InvestPuppy Trading Bot in the #trading-signals Slack channel — live signal summary: Approved, ML Blocked, and Low Confidence signals per portfolio, delivered automatically after each execution cycle.



AWS Step Functions order workflow — the complete automated pipeline from GetActiveStrategies through MLValidation to GenerateOrders. Observable, retryable, fully audited at every step.

WE'LL SHOW YOU THE PLATFORM.

Pick any listed equity market, any currency, any benchmark. We will run the full Vektor workflow against it and show you the output: the efficient frontier, the correlation matrix, the max-Sharpe allocation, and the per-instrument signal selection. No slides. No promises. Just the platform, working on your data.

Become a Proof Partner at investpuppy.com/proof-partners

For methodology: Vektor Research Series (WP-01 through WP-10) · For Proof Partners programme details:
[vk-proof-partners.pdf](#) · investpuppy.com/proof-partners

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*'This page has been intentionally left blank.' It
hasn't. Our build process left it blank. We just
didn't want to lie to you about it.*

The Proof Behind the Fancy Screens

Vektor's research environment — documented.

The portal interface the portfolio manager uses every day is built on top of a research environment that runs automatically. Steps 01, 02, and 04 each involve computational work — universe screening, portfolio optimisation, and ML signal validation — that executes in Vektor's back-end infrastructure without requiring any code from the portfolio manager.

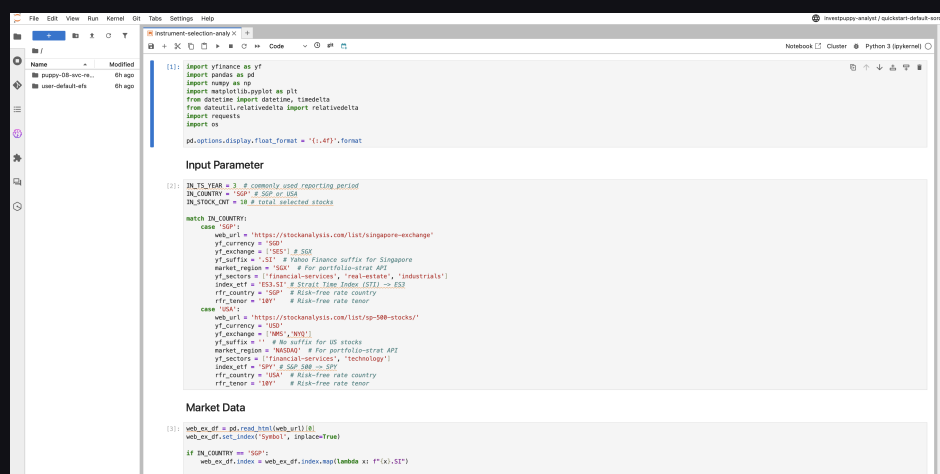
This section documents what that infrastructure looks like: the actual research workbench running on AWS SageMaker, with real SGX market data, producing the outputs the portfolio manager reviews and approves in the portal. The code is not the product. The output is.

STEP 01 · RESEARCH WORKBENCH

Universe Screening — How It Works

The screening workbench evaluates every listed equity in the configured universe against three criteria: sector membership, average daily liquidity, and dividend continuity. Parameters — sectors, volume threshold, continuity window — are set per strategy. The workbench runs on AWS SageMaker and returns a ranked, filtered universe ready for optimisation.

RESEARCH ENVIRONMENT · AUTOMATED



```
[1]: import yfinance as yf
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from datetime import datetime, timedelta
from datetime import datetime, timedelta
import requests
import os
pd.options.display.float_format = '{:,.4f}'.format

Input Parameter

[2]: IN_TS_YEAR = 3 # commonly used reporting period
IN_COUNTRY = 'SG' # SG or USA
IN_STOCK_CN = 50 # total selected stocks

match_IN_COUNTRY:
case 'SG':
    web_url = 'https://stockanalysis.com/list/singapore-exchange/'
    yf_currency = 'SGD'
    yf_exchange = 'SGSE' # SSE
    yf_suffix = '.SI' # Yahoo Finance suffix for Singapore
    market_region = 'SG' # For portfolio-creator API
    yf_sectors = ['financial-services', 'real-estate', 'industrials']
    index_ref = 'VIXSI' # VIXSI Time Index (2021) == SG
    rfr_country = 'SG' # Risk-free rate country
    rfr_tenor = '180' # Risk-free rate tenor
case 'USA':
    web_url = 'https://stockanalysis.com/list/us-500-stocks/'
    yf_currency = 'USD'
    yf_exchange = 'NYSE'
    yf_suffix = '' # No suffix for US stocks
    market_region = 'NASDAQ' # For portfolio-creator API
    yf_sectors = ['financial-services', 'technology']
    index_ref = 'SP500' # SP500 == US
    rfr_country = 'USA' # Risk-free rate country
    rfr_tenor = '180' # Risk-free rate tenor

Market Data

[3]: web_ex_df = pd.read_html(web_url)[0]
web_ex_df.set_index('Symbol', inplace=True)

if IN_COUNTRY == 'SG':
    web_ex_df.index = web_ex_df.index.map(lambda x: f'{x}.SI')
web_ex_df.info()
```

Research workbench — instrument selection notebook running on SageMaker. Market parameters configured for SGX: sectors, liquidity filters, benchmark index, and risk-free rate. This process runs automatically; the portfolio manager reviews the output in the Vektor portal.

STEP 02 · RESEARCH WORKBENCH

Portfolio Optimisation — How It Works

The optimisation logic runs 10,000 portfolio configurations across the filtered universe, maps the efficient frontier, and identifies the max-Sharpe allocation using Modern Portfolio Theory. Weight calculation, tracking error, and information ratio are computed for each configuration. The portfolio manager sees the result — the efficient frontier chart, the selected instruments, and the allocation weights — in the Vektor portal.

OPTIMISATION ENGINE · AUTOMATED

Target Optimization Logic

The tracking optimization algorithm aims to find the optimal subset of stocks that best replicates the performance of our price-weighted index (PWI) with minimal tracking error.

Mathematical Formula

For each simulation iteration, we:

1. **Random Selection:** Randomly select n stocks from the universe of N dividend-paying stocks
2. **Weight Calculation:** Calculate price-weighted portfolio weights at time t :

$$w_{i,t} = \frac{P_{i,t}}{\sum_{j=1}^n P_{j,t}}$$

3. **Portfolio Returns:** Calculate tracking portfolio returns:

$$R_{portfolio,t} = \sum_{i=1}^n w_{i,t-1} \times R_{i,t}$$

4. **Active Returns:** Compute active returns against the benchmark:

$$R_{active,t} = R_{portfolio,t} - R_{index,t}$$

5. **Tracking Error:** Calculate annualized tracking error:

$$TE = \sigma(R_{active}) \times \sqrt{252}$$

6. **Information Ratio (optional):** Measure risk-adjusted active return:

$$IR = \frac{R_{active}}{TE}$$

The algorithm runs **10,000 simulations** to find the combination with the lowest tracking error, ensuring optimal index replication with the selected number of stocks. This approach follows industry standards used by major index fund providers like Vanguard and BlackRock.

```
[1]: # Tracking optimization
const = div_sym.to_list()
n = len(const)
i = IN_STOCK_CNT
sims = 10000
```

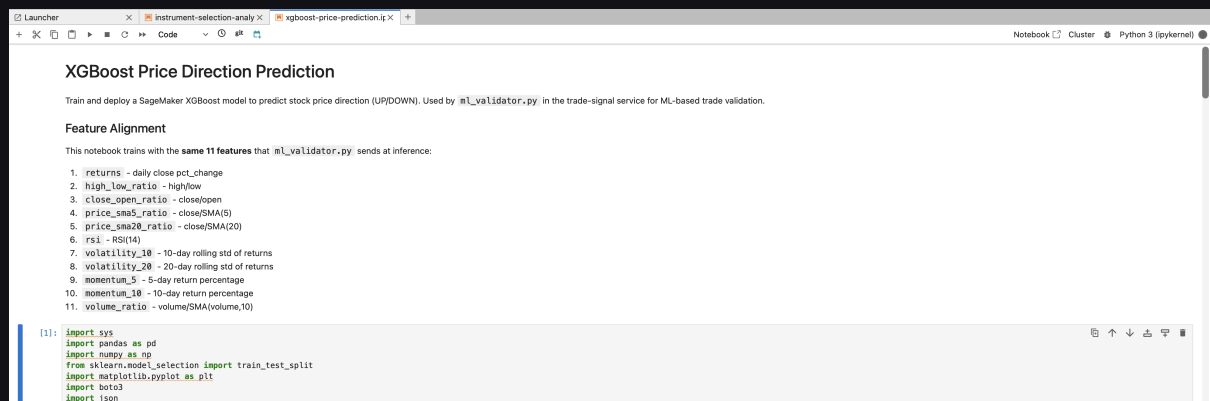
Target optimisation logic — 10,000 configurations. Mathematical formula for weight calculation, tracking error, and information ratio. Industry standard approach used by major index fund providers including Vanguard and BlackRock. Runs automatically on SageMaker; output reviewed in the Vektor portal.

STEP 04 · RESEARCH WORKBENCH

XGBoost Signal Validation — How It Works

An XGBoost model trained on 11 price-derived features validates every live trading signal before execution. The model is trained and deployed on SageMaker. At inference, the same 11 features are sent to the deployed endpoint, which returns a direction prediction (UP/DOWN), a probability score, and a confidence classification (HIGH/LOW). Signals that disagree with the ML prediction are flagged or blocked. The portfolio manager sees the per-instrument signal outcome — approved, blocked, or low-confidence — in the strategy review screen.

ML VALIDATION · AUTOMATED



XGBoost Price Direction Prediction

Train and deploy a SageMaker XGBoost model to predict stock price direction (UP/DOWN). Used by `ml_validator.py` in the trade-signal service for ML-based trade validation.

Feature Alignment

This notebook trains with the same 11 features that `ml_validator.py` sends at inference:

1. `returns` - daily close pct_change
2. `high_low_ratio` - high/low
3. `close_open_ratio` - close/open
4. `price_sma5_ratio` - close/SMA(5)
5. `price_sma20_ratio` - close/SMA(20)
6. `rsi` - RSI(14)
7. `volatility_10` - 10-day rolling std of returns
8. `volatility_20` - 20-day rolling std of returns
9. `momentum_5` - 5-day return percentage
10. `momentum_10` - 10-day return percentage
11. `volume_ratio` - volume/SMA(volume,10)

```
[1]: import sys
import pandas as pd
import numpy as np
from sklearn.model_selection import train_test_split
import matplotlib.pyplot as plt
import boto3
import json
```

XGBoost Price Direction Prediction — 11 features trained at SageMaker, same features sent at inference. Output: WEAK_BUY, WEAK_SELL, or HOLD with probability score and confidence classification. Deployed as a live endpoint; called automatically during signal generation.

The research environment is not a prototype or demonstration setup. It is the production infrastructure that generates every allocation Vektor produces. The portal interface the portfolio manager uses is the review and approval layer above it.