

QUANT COPILOT

User Guide

ZAR Quantitative Workbench for Treasury, Risk & Fixed-Income Desks

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1. Introduction

Quant Copilot is a ZAR-denominated quantitative workbench that consolidates financial mathematics into a single, tested platform. It replaces scattered spreadsheets and one-off scripts with an auditable, consistent pricing and risk engine covering the instruments your desk uses every day.

What Quant Copilot Does

The platform is built on three integrated layers:

Layer	Purpose
quant-core	Python financial mathematics library. Implements all pricing models, yield curve construction, and risk calculations. 678 tests. Source of truth for all numbers.
FastAPI backend	HTTP orchestration layer. Exposes quant-core through a typed REST API. 902 tests. Powers both the Streamlit UI and any direct API consumer (Excel, Python scripts, third-party tools).
Streamlit workbench	Analyst-facing web UI. No coding required. Runs locally or on your network.

Who This Guide Is For

This guide is written for quant analysts, treasury teams, fixed-income desks, and risk teams using the Streamlit workbench. Developer setup and API reference are covered in the technical README.

Instrument Coverage

Quant Copilot covers the following instrument classes in the current release:

- Interest Rate Swaps (IRS)
- Forward Rate Agreements (FRA)
- FX Forwards
- FX Swaps
- FX Options (vanilla)
- Equity Options
- Bond pricing, risk, and YTM solving
- Yield Curve Construction (mixed-instrument bootstrapping)
- Risk Ladders and Scenario Analysis

2. Getting Started

Accessing the Workbench

Quant Copilot is available as a hosted trial at:

<https://quant-copilot-sa.streamlit.app>

For on-premises or institutional deployment, contact george@quantspace.co.za. The backend and Streamlit app can be deployed within your network boundary with no external data dependencies.

Navigation

The left sidebar contains all instrument modules. Select a module to load its input form. No page reload is required between modules — state is maintained within the session.

Input Conventions

Dates	Use YYYY-MM-DD format throughout.
Rates	Enter as decimals, not percentages. 5% = 0.05.
Notional	ZAR amounts unless the module specifies a foreign currency.
Day count	Select from the dropdown. ACTUAL/365 is the default for ZAR instruments.
Currency pair	Domestic/foreign convention, e.g. USDZAR = 18.50 means 1 USD = 18.50 ZAR.

3. Interest Rate Swap (IRS) Pricing

Prices fixed-for-floating ZAR interest rate swaps using a bootstrapped discount curve. Outputs NPV, DV01, and a full cashflow schedule.

Inputs

Trade date	Date on which the swap is agreed.
Start date	Effective date of the first coupon period.
Maturity	Final exchange of cashflows.
Notional	ZAR notional amount.
Fixed rate	Annual fixed coupon, entered as a decimal.
Floating index	JIBAR tenor (1M, 3M, 6M).
Spread	Spread over floating index, entered as a decimal. Default 0.
Day count	Day count convention for fixed and floating legs.
Discount curve	Upload or select a curve; defaults to the built-in bootstrapped JIBAR curve.

Outputs

- NPV (ZAR) — net present value of the swap from the perspective of the fixed-rate receiver.
- DV01 (ZAR per basis point) — dollar value of a one basis point shift in rates.
- Fixed-leg cashflow schedule with discount factors and present values.
- Floating-leg cashflow schedule with projected rates and present values.

Notes

The floating leg uses a forward-rate projection from the bootstrapped curve. If no curve is supplied, the engine uses the default built-in JIBAR curve.

4. Forward Rate Agreement (FRA) Pricing

Prices FRAs against the JIBAR curve. A FRA is a short-dated agreement to fix a future borrowing or lending rate.

Inputs

Settlement date	Date on which the FRA is settled (beginning of the reference period).
Maturity date	End of the reference period.
Notional	ZAR notional.
Contract rate	Fixed rate agreed in the FRA, as a decimal.
Day count	Day count convention.
Buyer/Seller	Buyer pays fixed and receives floating; seller is the reverse.

Outputs

- FRA NPV (ZAR) — settlement value of the FRA at today's rates.
- Implied forward JIBAR rate for the reference period.
- DV01 — sensitivity to a one basis point shift.

5. FX Forward Pricing

Calculates outright FX forward rates and the MTM value of an existing FX forward position using covered interest rate parity.

Inputs

Spot rate	Current spot rate in domestic/foreign convention (e.g. USDZAR).
Settlement date	Forward value date.
ZAR rate	ZAR risk-free rate (JIBAR or ZARONIA equivalent), as a decimal.
Foreign rate	Foreign currency risk-free rate (e.g. SOFR for USD), as a decimal.
Notional	Amount in the foreign currency.
Contracted forward rate	Rate agreed in the forward (for MTM of existing positions).

Outputs

- Theoretical forward rate — fair value forward rate implied by interest rate differentials.
- Forward points — difference between forward and spot, in pips.
- MTM value (ZAR) — profit or loss on an existing contracted position at current rates.

6. FX Swap Pricing

A FX swap is a pair of FX transactions: a spot deal and a forward deal in opposite directions. This module values the combined position.

Inputs

Near date	Date of the near leg (typically spot or same day).
Far date	Date of the far leg.
Near rate	FX rate agreed for the near leg.
Far rate	FX rate agreed for the far leg.
Notional	Foreign currency notional.
ZAR rate, Foreign rate	As per FX Forward module.

Outputs

- Near-leg NPV (ZAR).
- Far-leg NPV (ZAR).
- Net swap NPV — combined MTM of both legs.
- Swap points — difference between far and near rate.

7. FX Options

Prices European vanilla FX options (calls and puts) using the Garman-Kohlhagen model, which extends Black-Scholes to account for two risk-free rates.

Inputs

Option type	Call or Put.
Spot rate	Current spot in domestic/foreign convention.
Strike	Option strike rate.
Expiry	Option expiry date.
ZAR rate	Domestic risk-free rate, as a decimal.
Foreign rate	Foreign risk-free rate, as a decimal.
Volatility	Implied or historical volatility, as a decimal (20% = 0.20).
Notional	Foreign currency notional.

Outputs

- Option premium (ZAR and % of notional).
- Delta — sensitivity to spot rate movement.
- Gamma — rate of change of delta.
- Vega — sensitivity to volatility.
- Theta — daily time decay.
- Rho — sensitivity to the domestic interest rate.

Notes

All Greeks are calculated analytically. Implied volatility input can be sourced from broker quotes or internal vol surfaces.

8. Equity Options

Prices European and American equity options using the Black-Scholes-Merton model with optional dividend yield adjustment.

Inputs

Option type	Call or Put.
Exercise style	European (analytic) or American (numerical approximation).
Spot price	Current equity price in ZAR.
Strike	Option strike in ZAR.
Expiry	Option expiry date.
Risk-free rate	ZAR risk-free rate, as a decimal.
Dividend yield	Continuous dividend yield, as a decimal. Enter 0 for non-dividend-paying equities.
Volatility	Implied or historical volatility, as a decimal.

Outputs

- Option premium (ZAR).
- Full Greeks: Delta, Gamma, Vega, Theta, Rho.

9. Bond Pricing & Risk

Prices fixed-rate ZAR bonds, calculates yield to maturity (YTM), and produces a full duration and convexity profile.

Inputs

Face value	Par value of the bond in ZAR.
Coupon rate	Annual coupon, as a decimal.
Coupon frequency	Semi-annual (2) or annual (1).
Settlement date	Trade settlement date.
Maturity date	Final redemption date.
YTM / Price	Enter either price or YTM; the engine solves for the other.
Day count	Bond day count convention (ACTUAL/365, 30/360, etc.)

Outputs

- Clean price and dirty price (ZAR).
- Accrued interest.
- Yield to maturity (if price is input).
- Modified duration.
- Macaulay duration.
- Convexity.
- DV01 (ZAR per basis point per ZAR 1,000,000 face value).
- Full cashflow schedule with discount factors.

Notes

YTM solving uses iterative Newton-Raphson. Convergence is guaranteed for investment-grade bonds with positive yields.

10. Yield Curve Construction

Bootstraps a ZAR discount and forward curve from a mixed set of market instruments: deposits, FRAs, futures, and swaps.

Inputs

Instrument set	Upload or select instruments. Supported types: JIBAR deposits, FRAs, interest rate futures, and IRS.
Settlement lag	Market convention for settlement (T+0 or T+2).
Interpolation	Linear on log-discount factors (default) or cubic spline.

Outputs

- Bootstrapped discount factors at each pillar date.
- Forward JIBAR rates for each period.
- Zero coupon yield curve (annually compounded).
- Exportable curve as CSV for downstream use.

Notes

The bootstrapped curve is used automatically by all other modules. If you upload a custom curve here, it overrides the default in the current session.

11. Risk Ladders & Scenario Analysis

Generates rate-shocked P&L profiles and key rate duration ladders for a single instrument or a portfolio of instruments.

Inputs

Portfolio	Load a previously priced instrument or combine multiple instruments.
Shock type	Parallel shift, key rate shift, or custom scenario.
Shock range	Minimum and maximum rate shock in basis points (e.g. -200bp to +200bp).
Shock steps	Number of increments across the shock range.

Outputs

- P&L at each shock level (ZAR).
- DV01 contribution by bucket.
- Convexity profile across the shock range.
- Exportable scenario table as CSV.

Notes

For portfolios, the risk ladder aggregates DV01 contributions by tenor bucket, giving a clear picture of where the book is exposed.

12. Exporting Results

All modules support result export. Use the Export button in the module footer.

CSV	Cashflow schedules, risk ladders, curve data. Compatible with Excel and Python.
JSON	Full pricing response including inputs, outputs, and metadata. Suitable for system-to-system integration.
Print / PDF	Use your browser's print function (Ctrl+P) to produce a clean PDF of the current module output.

13. Model Governance & Audit

Quant Copilot is designed with model governance requirements in mind.

Test Coverage

- quant-core pricing library: 678 tests.
- FastAPI backend: 902 tests.
- Streamlit integration: 9 smoke tests.

Auditability

Every API response includes the input parameters, model version, and timestamp. Results are fully reproducible from the logged inputs. No stateful black-box transformations occur between input and output.

Limitations

- FX option pricing uses the Garman-Kohlhagen model (European exercise only). Exotic options are not covered in the current release.
- Bond pricing assumes bullet (non-callable) structures. Callable bonds are on the roadmap.
- The default JIBAR curve is bootstrapped from a representative market dataset. For live pricing, replace with a current-day curve upload.
- American option pricing uses a numerical approximation; for regulatory valuation, verify against your internal model.

14. Contact & Support

Product	Quant Copilot — ZAR Quantitative Workbench
Developer	QuantSpace (Pty) Ltd
Email	george@quantspace.co.za
Website	quantspace.co.za
Trial access	quant-copilot-sa.streamlit.app
Enterprise deployment	Contact for on-premises or cloud deployment within your network boundary.

For model queries, data questions, or institutional licensing, contact george@quantspace.co.za directly. Include your organisation name and the instrument class you are working with.