

Nsco Sv3 Smile

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Skeleton

Abstract

NSCOSv3 Smile — ProofEnv (Heston-style variance: mean reversion, spreads).

This paper presents 62 machine-verified theorems. All results are formally verified in the Platonic proof kernel (63 verification units, 62 proved statements) and exportable to Lean 4.

1. Introduction

2. Further Results

Theorem (mean_rev_positive_drift). *Mean Rev Positive Drift*. [Platonic: mean_rev_positive_drift, domain: nsco_sv3_smile]

Theorem (mean_rev_negative_drift). *Mean Rev Negative Drift*. [Platonic: mean_rev_negative_drift, domain: nsco_sv3_smile]

Theorem (equilibrium_zero_drift). *Equilibrium Zero Drift*. [Platonic: equilibrium_zero_drift, domain: nsco_sv3_smile]

Theorem (spread_strictly_pos_when_v_below_theta). *Spread Strictly Pos When V Below Theta*. [Platonic: spread_strictly_pos_when_v_below_theta, domain: nsco_sv3_smile]

Theorem (spread_strictly_neg_when_v_above_theta). *Spread Strictly Neg When V Above Theta*. [Platonic: spread_strictly_neg_when_v_above_theta, domain: nsco_sv3_smile]

Theorem (variance_level_square_nonneg). *Variance Level Square Nonneg*. [Platonic: variance_level_square_nonneg, domain: nsco_sv3_smile]

Theorem (centered_variance_square_nonneg). *Centered Variance Square Nonneg*. [Platonic: centered_variance_square_nonneg, domain: nsco_sv3_smile]

Theorem (kappa_spread_nonneg_when_kappa_and_spread_nonneg). *Kappa Spread Nonneg When Kappa And Spread Nonneg*. [Platonic: kappa_spread_nonneg_when_kappa_and_spread_nonneg, domain: nsco_sv3_smile]

Theorem (heston_discriminant_sq_nonneg). *Heston Discriminant Sq Nonneg*. [Platonic: heston_discriminant_sq_nonneg, domain: nsco_sv3_smile]

Theorem (cf_exponent_nonpos). *Cf Exponent Nonpos*. [Platonic: cf_exponent_nonpos, domain: nsco_sv3_smile]

Theorem (heston_cf_modulus_le_one). *Heston Cf Modulus Le One*. [Platonic: heston_cf_modulus_le_one, domain: nsco_sv3_smile]

Theorem (conditional_variance_nonneg). *Conditional Variance Nonneg*. [Platonic: conditional_variance_nonneg, domain: nsco_sv3_smile]

Theorem (conditional_variance_pos). *Conditional Variance Pos*. [Platonic: conditional_variance_pos, domain: nsco_sv3_smile]

Theorem (smile_caplet_error_discount_scaling). *Smile Caplet Error Discount Scaling*. [Platonic: smile_caplet_error_discount_scaling, domain: nsco_sv3_smile]

Theorem (feller_condition_ratio). *Feller Condition Ratio*. [Platonic: feller_condition_ratio, domain: nsco_sv3_smile]

Theorem (smile_w4_add2_nonneg). *Smile W4 Add2 Nonneg*. [Platonic: smile_w4_add2_nonneg, domain: nsco_sv3_smile]

Theorem (smile_w4_add3_nonneg). *Smile W4 Add3 Nonneg*. [Platonic: smile_w4_add3_nonneg, domain: nsco_sv3_smile]

Theorem (smile_w4_mul2_nonneg). *Smile W4 Mul2 Nonneg*. [Platonic: smile_w4_mul2_nonneg, domain: nsco_sv3_smile]

Theorem (smile_w4_mul3_nonneg). *Smile W4 Mul3 Nonneg*. [Platonic: smile_w4_mul3_nonneg, domain: nsco_sv3_smile]

Theorem (smile_w4_mul4_nonneg). *Smile W4 Mul4 Nonneg*. [Platonic: smile_w4_mul4_nonneg, domain: nsco_sv3_smile]

Theorem (smile_w4_sq_mono_nonneg). *Smile W4 Sq Mono Nonneg*. [Platonic: smile_w4_sq_mono_nonneg, domain: nsco_sv3_smile]

Theorem (smile_w4_sub_nonneg_of_le). *Smile W4 Sub Nonneg Of Le*. [Platonic: smile_w4_sub_nonneg_of_le, domain: nsco_sv3_smile]

Theorem (smile_w4_neg_mul_pos). *Smile W4 Neg Mul Pos*. [Platonic: smile_w4_neg_mul_pos, domain: nsco_sv3_smile]

Theorem (smile_w4_pos_mul_neg). *Smile W4 Pos Mul Neg*. [Platonic: smile_w4_pos_mul_neg, domain: nsco_sv3_smile]

Theorem (smile_w4_spread_swap_sign). *Smile W4 Spread Swap Sign*. [Platonic: smile_w4_spread_swap_sign, domain: nsco_sv3_smile]

Theorem (smile_w4_add4_nonneg). *Smile W4 Add4 Nonneg*. [Platonic: smile_w4_add4_nonneg, domain: nsco_sv3_smile]

Theorem (smile_w4_chain_le). *Smile W4 Chain Le*. [Platonic: smile_w4_chain_le, domain: nsco_sv3_smile]

Theorem (smile_w4_double_nonneg). *Smile W4 Double Nonneg*. [Platonic: smile_w4_double_nonneg, domain: nsco_sv3_smile]

Theorem (smile_w4_cube_nonneg). *Smile W4 Cube Nonneg*. [Platonic: smile_w4_cube_nonneg, domain: nsco_sv3_smile]

Theorem (smile_w4_sq_sum_nonneg). *Smile W4 Sq Sum Nonneg.* [Platonic: smile_w4_sq_sum_nonneg, domain: nsco_sv3_smile]

Theorem (smile_w4_ordered_pair_mul_nonneg). *Smile W4 Ordered Pair Mul Nonneg.* [Platonic: smile_w4_ordered_pair_mul_nonneg, domain: nsco_sv3_smile]

Theorem (smile_w4_sub_chain_nonneg). *Smile W4 Sub Chain Nonneg.* [Platonic: smile_w4_sub_chain_nonneg, domain: nsco_sv3_smile]

Theorem (nsco_w14_smile_cap_floor_parity). *Nsco W14 Smile Cap Floor Parity.* [Platonic: nsco_w14_smile_cap_floor_parity, domain: nsco_sv3_smile]

Theorem (nsco_w14_conditional_variance_id). *Nsco W14 Conditional Variance Id.* [Platonic: nsco_w14_conditional_variance_id, domain: nsco_sv3_smile]

Theorem (nsco_w14_conditional_variance_nonneg). *Nsco W14 Conditional Variance Nonneg.* [Platonic: nsco_w14_conditional_variance_nonneg, domain: nsco_sv3_smile]

Theorem (nsco_w14_conditional_variance_pos). *Nsco W14 Conditional Variance Pos.* [Platonic: nsco_w14_conditional_variance_pos, domain: nsco_sv3_smile]

Theorem (nsco_w14_gaussian_cf_exponent_nonpos). *Nsco W14 Gaussian Cf Exponent Nonpos.* [Platonic: nsco_w14_gaussian_cf_exponent_nonpos, domain: nsco_sv3_smile]

Theorem (nsco_w14_heston_exponent_at_zero_nu). *Nsco W14 Heston Exponent At Zero Nu.* [Platonic: nsco_w14_heston_exponent_at_zero_nu, domain: nsco_sv3_smile]

Theorem (nsco_w14_r_scalar_identity). *Nsco W14 R Scalar Identity.* [Platonic: nsco_w14_r_scalar_identity, domain: nsco_sv3_smile]

Theorem (smile_convexity_nonneg). *Smile Convexity Nonneg.* [Platonic: smile_convexity_nonneg, domain: nsco_sv3_smile]

Theorem (smile_atm_is_minimum). *Smile Atm Is Minimum.* [Platonic: smile_atm_is_minimum, domain: nsco_sv3_smile]

Theorem (skew_negative_means_put_costlier). *Skew Negative Means Put Costlier.* [Platonic: skew_negative_means_put_costlier, domain: nsco_sv3_smile]

Theorem (call_price_nonneg). *Call Price Nonneg.* [Platonic: call_price_nonneg, domain: nsco_sv3_smile]

Theorem (put_call_parity_implies_put). *Put Call Parity Implies Put.* [Platonic: put_call_parity_implies_put, domain: nsco_sv3_smile]

Theorem (intrinsic_value_nonneg). *Intrinsic Value Nonneg.* [Platonic: intrinsic_value_nonneg, domain: nsco_sv3_smile]

Theorem (feller_slack_nonneg). *Feller Slack Nonneg.* [Platonic: feller_slack_nonneg, domain: nsco_sv3_smile]

Theorem (vol_of_vol_positive_implies_smile). *Vol Of Vol Positive Implies Smile.* [Platonic: vol_of_vol_positive_implies_smile, domain: nsco_sv3_smile]

Theorem (mean_reversion_half_life). *Mean Reversion Half Life.* [Platonic: mean_reversion_half_life, domain: nsco_sv3_smile]

Theorem (forward_variance_nonneg). *Forward Variance Nonneg.* [Platonic: forward_variance_nonneg, domain: nsco_sv3_smile]

Theorem (term_structure_slope). *Term Structure Slope.* [Platonic: term_structure_slope, domain: nsco_sv3_smile]

Theorem (variance_swap_rate_nonneg). *Variance Swap Rate Nonneg.* [Platonic: variance_swap_rate_nonneg, domain: nsco_sv3_smile]

Theorem (vega_positive_from_vol_sensitivity). *Vega Positive From Vol Sensitivity.* [Platonic: vega_positive_from_vol_sensitivity, domain: nsco_sv3_smile]

Theorem (gamma_nonneg_from_convexity). *Gamma Nonneg From Convexity.* [Platonic: gamma_nonneg_from_convexity, domain: nsco_sv3_smile]

Theorem (theta_time_decay). *Theta Time Decay.* [Platonic: theta_time_decay, domain: nsco_sv3_smile]

Theorem (implied_vol_strictly_positive). *Implied Vol Strictly Positive.* [Platonic: implied_vol_strictly_positive, domain: nsco_sv3_smile]

Theorem (smile_curvature_from_wings). *Smile Curvature From Wings.* [Platonic: smile_curvature_from_wings, domain: nsco_sv3_smile]

3. Bounds and Estimates

Theorem (smile_caplet_bound_pos). *Smile Caplet Bound Pos.* [Platonic: smile_caplet_bound_pos, domain: nsco_sv3_smile]

Theorem (mean_rev_drift_bounded). *Mean Rev Drift Bounded.* [Platonic: mean_rev_drift_bounded, domain: nsco_sv3_smile]

Theorem (call_bounded_by_spot). *Call Bounded By Spot.* [Platonic: call_bounded_by_spot, domain: nsco_sv3_smile]

Theorem (implied_vol_bounded). *Implied Vol Bounded.* [Platonic: implied_vol_bounded, domain: nsco_sv3_smile]

4. Convergence Results

Theorem (nsco_w14_gaussian_has_unlimited_strip). *Nsco W14 Gaussian Has Unlimited Strip.* [Platonic: nsco_w14_gaussian_has_unlimited_strip, domain: nsco_sv3_smile]

Theorem (nsco_w14_heston_gaussian_limit_core). *Nsco W14 Heston Gaussian Limit Core.* [Platonic: nsco_w14_heston_gaussian_limit_core, domain: nsco_sv3_smile]

5. Proof Architecture

All proofs are implemented in the Platonic kernel (elysium/fields/nsco_sv3_smile/).

File	Role
n_s_c_o_sv3_smile_proof.py	

6. Discussion

References