American Basket Gym

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Skeleton

Abstract

American Basket Gym — ProofEnv proofs (eigen-COS / FW / GH error bounds).

This paper presents 67 machine-verified theorems. All results are formally verified in the Platonic proof kernel (79 verification units, 67 proved statements) and exportable to Lean 4.

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1. Introduction

2. Further Results

Theorem (per_step_nonneg). *Per Step Nonneg.* [Platonic: per_step_nonneg, domain: american_basket_gym]

Theorem (backward_nonneg). *Backward Nonneg.* [Platonic: backward_nonneg, domain: american_basket_gym]

Theorem (backward_le_total). *Backward Le Total.* [Platonic: backward_le_total, domain: american_basket_gym]

Theorem (total_nonneg). *Total Nonneg.* [Platonic: total_nonneg, domain: american_basket_gym]

Theorem (cos_reduction_helps). *Cos Reduction Helps.* [Platonic: cos_reduction_helps, domain: american_basket_gym]

Theorem (fw_reduction_helps). *Fw Reduction Helps.* [Platonic: fw_reduction_helps, domain: american_basket_gym]

Theorem (gh_reduction_helps). *Gh Reduction Helps.* [Platonic: gh_reduction_helps, domain: american_basket_gym]

Theorem (per_step_add_comm). *Per Step Add Comm.* [Platonic: per_step_add_comm, domain: american_basket_gym]

Theorem (mul_nonneg_left). *Mul Nonneg Left.* [Platonic: mul_nonneg_left, domain: american_basket_gym]

Theorem (total_error_split). *Total Error Split.* [Platonic: total_error_split, domain: american_basket_gym]

Theorem (total_error_monotone_in_gh). *Total Error Monotone In Gh.* [Platonic: total_error_monotone_in_gh, domain: american_basket_gym]

Theorem (wave2_mul_add_distrib_M). *Wave2 Mul Add Distrib M.* [Platonic: wave2_mul_add_distrib_M, domain: american_basket_gym]

Theorem (wave2_backward_ge_M_dc). *Wave2 Backward Ge M Dc.* [Platonic: wave2_backward_ge_M_dc, domain: american_basket_gym]

Theorem (wave2_backward_ge_M_df). *Wave2 Backward Ge M Df.* [Platonic: wave2_backward_ge_M_df, domain: american_basket_gym]

Theorem (wave2_te_monotone_in_M). *Wave2 Te Monotone In M.* [Platonic: wave2_te_monotone_in_M, domain: american_basket_gym]

Theorem (wave2_dc_nonneg_implies_Mdc_nonneg). *Wave2 Dc Nonneg Implies Mdc Nonneg.* [Platonic: wave2_dc_nonneg_implies_Mdc_nonneg, domain: american_basket_gym]

Theorem (wave2_df_nonneg_implies_Mdf_nonneg). *Wave2 Df Nonneg Implies Mdf Nonneg.* [Platonic: wave2_df_nonneg_implies_Mdf_nonneg, domain: american_basket_gym]

Theorem (wave2_sub_self_dc). *Wave2 Sub Self Dc.* [Platonic: wave2_sub_self_dc, domain: american_basket_gym]

Theorem (wave2_sub_self_df). *Wave2 Sub Self Df.* [Platonic: wave2_sub_self_df, domain: american_basket_gym]

Theorem (wave2_sub_self_dg). *Wave2 Sub Self Dg.* [Platonic: wave2_sub_self_dg, domain: american_basket_gym]

Theorem (wave2_sub_self_M). *Wave2 Sub Self M.* [Platonic: wave2_sub_self_M, domain: american_basket_gym]

Theorem (wave2_neg_doubles_backstep). *Wave2 Neg Doubles Backstep.* [Platonic: wave2_neg_doubles_backstep, domain: american_basket_gym]

Theorem (wave2_total_plus_neg_te). *Wave2 Total Plus Neg Te.* [Platonic: wave2_total_plus_neg_te, domain: american_basket_gym]

Theorem (wave2_per_step_triangle). *Wave2 Per Step Triangle.* [Platonic: wave2_per_step_triangle, domain: american_basket_gym]

Theorem (wave2_ratio_one). *Wave2 Ratio One.* [Platonic: wave2_ratio_one, domain: american_basket_gym]

Theorem (wave2_le_of_eq_backward). *Wave2 Le Of Eq Backward.* [Platonic: wave2_le_of_eq_backward, domain: american_basket_gym]

Theorem (wave2_symm_total_error). *Wave2 Symm Total Error.* [Platonic: wave2_symm_total_error, domain: american_basket_gym]

Theorem (wave2_expand_te_twice). *Wave2 Expand Te Twice.* [Platonic: wave2_expand_te_twice, domain: american_basket_gym]

Theorem (wave2_dc_le_sum). *Wave2 Dc Le Sum.* [Platonic: wave2_dc_le_sum, domain: american_basket_gym]

Theorem (wave2_df_le_sum). *Wave2 Df Le Sum.* [Platonic: wave2_df_le_sum, domain: american_basket_gym]

Theorem (wave3_diff_implies_measurable). *Wave3 Diff Implies Measurable.* [Platonic: wave3_diff_implies_measurable, domain: american_basket_gym]

Theorem (wave3_vec_dot_comm_inst). *Wave3 Vec Dot Comm Inst.* [Platonic: wave3_vec_dot_comm_inst, domain: american_basket_gym]

Theorem (wave3_vec_norm_sq_nonneg_inst). *Wave3 Vec Norm Sq Nonneg Inst.* [Platonic: wave3_vec_norm_sq_nonneg_inst, domain: american_basket_gym]

Theorem (wave3_vec_dot_smul_left_inst). *Wave3 Vec Dot Smul Left Inst.* [Platonic: wave3_vec_dot_smul_left_inst, domain: american_basket_gym]

Theorem (wave3_finset_sum_nonneg_inst). *Wave3 Finset Sum Nonneg Inst.* [Platonic: wave3_finset_sum_nonneg_inst, domain: american_basket_gym]

Theorem (wave3_finset_prod_nonneg_inst). *Wave3 Finset Prod Nonneg Inst.* [Platonic: wave3_finset_prod_nonneg_inst, domain: american_basket_gym]

Theorem (wave15_two_source_per_step). *Wave15 Two Source Per Step.* [Platonic: wave15_two_source_per_step, domain: american_basket_gym]

Theorem (wave15_per_step_le_twice_max). *Wave15 Per Step Le Twice Max.* [Platonic: wave15_per_step_le_twice_max, domain: american_basket_gym]

Theorem (wave15_fw_approx_eq_c_cv_cubed). *Wave15 Fw Approx Eq C Cv Cubed.* [Platonic: wave15_fw_approx_eq_c_cv_cubed, domain: american_basket_gym]

Theorem (wave15_fw_error_nonneg). *Wave15 Fw Error Nonneg.* [Platonic: wave15_fw_error_nonneg, domain: american_basket_gym]

Theorem (wave15_fw_error_monotone_cv). *Wave15 Fw Error Monotone Cv.* [Platonic: wave15_fw_error_monotone_cv, domain: american_basket_gym]

Theorem (wave15_fw_error_at_zero_cv). *Wave15 Fw Error At Zero Cv.* [Platonic: wave15_fw_error_at_zero_cv, domain: american_basket_gym]

Theorem (wave15_conditioning_reduces_fw_error). *Wave15 Conditioning Reduces Fw Error.* [Platonic: wave15_conditioning_reduces_fw_error, domain: american_basket_gym]

Theorem (wave15_residual_variance_nonneg). *Wave15 Residual Variance Nonneg.* [Platonic: wave15_residual_variance_nonneg, domain: american_basket_gym]

Theorem (wave15_conditional_variance_reduction). *Wave15 Conditional Variance Reduction.* [Platonic: wave15_conditional_variance_reduction, domain: american_basket_gym]

Theorem (wave15_variance_monotone_in_captured). *Wave15 Variance Monotone In Captured.* [Platonic: wave15_variance_monotone_in_captured, domain: american_basket_gym]

Theorem (wave15_residual_zero_at_full_rank). *Wave15 Residual Zero At Full Rank.* [Platonic: wave15_residual_zero_at_full_rank, domain: american_basket_gym]

Theorem (wave15_residual_scales_with_total). *Wave15 Residual Scales With Total.* [Platonic: wave15_residual_scales_with_total, domain: american_basket_gym]

Theorem (wave15_two_nonneg_sum_and_comm). *Wave15 Two Nonneg Sum And Comm.* [Platonic: wave15_two_nonneg_sum_and_comm, domain: american_basket_gym]

Theorem (total_error_halved_when_components_halved). *Total Error Halved When Components Halved.* [Platonic: total_error_halved_when_components_halved, domain: american_basket_gym]

Theorem (error_reduction_factor_positive). *Error Reduction Factor Positive.* [Platonic: error_reduction_factor_positive, domain: american_basket_gym]

Theorem (vega_error_from_vol_bump). *Vega Error From Vol Bump.* [Platonic: vega_error_from_vol_bump, domain: american_basket_gym]

Theorem (cos_terms_improve_accuracy). *Cos Terms Improve Accuracy.* [Platonic: cos_terms_improve_accuracy, domain: american_basket_gym]

Theorem (cos_error_positive). *Cos Error Positive.* [Platonic: cos_error_positive, domain: american_basket_gym]

Theorem (gh_nodes_improve_accuracy). *Gh Nodes Improve Accuracy.* [Platonic: gh_nodes_improve_accuracy domain: american_basket_gym]

Theorem (gh_weight_nonneg_implies_sum_nonneg). *Gh Weight Nonneg Implies Sum Nonneg.* [Platonic: gh_weight_nonneg_implies_sum_nonneg, domain: american_basket_gym]

Theorem (backward_error_accumulates). *Backward Error Accumulates.* [Platonic: backward_error_accumulate domain: american_basket_gym]

Theorem (optimal_stopping_gap). *Optimal Stopping Gap.* [Platonic: optimal_stopping_gap, domain: american_basket_gym]

3. Bounds and Estimates

Theorem (delta_error_bounded_by_price_error). *Delta Error Bounded By Price Error.* [Platonic: delta_error_bounded_by_price_error, domain: american_basket_gym]

Theorem (gamma_error_bounded). *Gamma Error Bounded.* [Platonic: gamma_error_bounded, domain: american_basket_gym]

Theorem (truncation_ratio_bounded). *Truncation Ratio Bounded.* [Platonic: truncation_ratio_bounded, domain: american_basket_gym]

Theorem (exercise_decision_error_bounded). *Exercise Decision Error Bounded.* [Platonic: exercise_decision_error_bounded, domain: american_basket_gym]

4. Regularity

Theorem (wave3_diff_implies_continuous). *Wave3 Diff Implies Continuous.* [Platonic: wave3_diff_implies_continuous, domain: american_basket_gym]

Theorem (wave3_continuous_id_inst). *Wave3 Continuous Id Inst.* [Platonic: wave3_continuous_id_inst, domain: american_basket_gym]

Theorem (wave3_continuous_const_any). *Wave3 Continuous Const Any.* [Platonic: wave3_continuous_const_any, domain: american_basket_gym]

5. Spectral Theory

Theorem (eigenvalue_tail_nonneg). *Eigenvalue Tail Nonneg.* [Platonic: eigenvalue_tail_nonneg, domain: american_basket_gym]

Theorem (more_eigenvalues_less_truncation_error). *More Eigenvalues Less Truncation Error.* [Platonic: more_eigenvalues_less_truncation_error, domain: american_basket_gym]

6. Proof Architecture

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

File	Role
american_basket_gym_proof.py	

7. Discussion

References