🔺 Pyramid Poker Dataset Comparison

Three-Method Optimization Analysis: Points → Empirical → Tiered

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📊 Dataset Overview

Method (Chronological Order)	Rounds	Total Hands	Optimization Function	Expected Value Calculation
1. Points (2024)	12,000	72,000	Direct point maximization	Sum of point values (High Card = 1, Pair = 1)
2. Empirical (2024)	10,000	60,000	Win probability × point value	EV = Points × Win Rate (learned from Points data)
3. Tiered (2025)	11,000	66,000	Win probability × point value	EV = Points × Win Rate (mathematical hierarchy)

🥉 Front Position Comparison (Ordered by Hand Strength)

Hand Type	Points 12K	Empirical 10K	Tiered 11K	Key Pattern
Straight Flush	100.0% (1)	100.0% (1)	- (0)	Extremely rare hand
Four of a Kind	100.0% (58)	100.0% (56)	100.0% (87)	Consistent elite performance
Full House	97.6% (3,136)	97.7% (2,529)	97.5% (2,627)	Very consistent across methods
Flush	88.3% (10,348)	87.2% (10,073)	88.6% (9,537)	Consistent strong performance
Straight	67.0% (18,331)	65.8% (14,279)	**63.3% (21,613)**	Tiered optimization uses stronger cards elsewhere
Three of a Kind	51.5% (6,103)	50.7% (5,472)	**43.6% (6,396)**	**Tiered: Lower-ranking trips remain after optimization**
Pair	26.9% (28,625)	22.5% (27,590)	**19.2% (25,740)**	**Tiered: Lower-ranking pairs remain after optimization**
High Card	3.9% (5,398)	0.0% (0)	0.0% (0)	**Points: EV same as pairs (1 point each). Empirical/Tiered: Much lower EV**

🥈 Middle Position Comparison (Ordered by Hand Strength)

Hand Type	Points 12K	Empirical 10K	Tiered 11K	Key Pattern
6-card Straight Flush	- (0)	- (0)	100.0% (10)	**Tiered: Superior cross-position optimization**
5 of a Kind	100.0% (70)	100.0% (66)	100.0% (29)	Elite hands consistent
Straight Flush	99.9% (243)	99.9% (218)	100.0% (135)	Very consistent elite performance
Four of a Kind	97.4% (4,074)	97.4% (3,593)	97.3% (4,309)	Extremely consistent
Full House	76.7% (24,252)	77.7% (18,356)	78.8% (18,066)	Consistent performance range
Flush	40.4% (28,771)	43.2% (23,826)	**50.0% (21,095)**	**Tiered: Higher-ranking flushes after optimization**
Straight	14.0% (8,358)	15.8% (8,231)	**19.3% (17,747)**	**Tiered: More strategic middle straight usage**
Two Pair	4.6% (5,349)	5.1% (4,938)	3.8% (3,904)	Consistently weak performance
Pair	1.5% (489)	1.5% (772)	1.1% (705)	Very weak in middle position
High Card	0.2% (394)	0.0% (0)	0.0% (0)	Points only: Same logic as front position

🏆 Back Position Comparison (Ordered by Hand Strength)

Hand Type	Points 12K	Empirical 10K	Tiered 11K	Key Pattern
8-card Straight Flush	99.9% (150)	100.0% (77)	100.0% (89)	Elite large hand performance
7 of a Kind	100.0% (2)	100.0% (3)	**100.0% (22)**	**Tiered: Much better rare hand sampling**
7-card Straight Flush	99.8% (589)	99.9% (429)	99.8% (421)	Very consistent elite performance
6 of a Kind	99.0% (439)	99.0% (348)	99.6% (298)	Consistent elite performance
6-card Straight Flush	97.9% (2,142)	97.8% (1,669)	97.9% (1,904)	Very consistent strong performance
5 of a Kind	93.9% (2,773)	94.6% (1,996)	94.9% (1,907)	Consistent strong performance
Straight Flush	88.6% (6,426)	89.8% (5,118)	89.9% (6,016)	Consistent strong performance
Four of a Kind	68.8% (21,098)	69.5% (18,458)	**71.5% (16,833)**	**Tiered: Higher-ranking 4Ks after optimization**
Full House	35.6% (23,221)	35.0% (19,921)	**41.5% (20,886)**	**Tiered: Better resource allocation to back**
Flush	11.2% (14,177)	10.4% (11,482)	**15.9% (14,144)**	**Tiered: Strategic back flush allocation**
Straight	1.0% (555)	0.7% (442)	**2.1% (3,474)**	**Tiered: More strategic straight usage in back**
Two Pair	0.4% (428)	0.0% (57)	0.0% (6)	Very poor back position performance

🎯 Optimization Function Analysis

📊 Expected Value Calculation Differences:

- **Points Method:** EV = Point Value (High Card = 1, Pair = 1 → Same EV)
- **Empirical Method:** EV = Point Value × Win Rate (High Card = 1 × 0% = 0, Pair = 1 × 22.5% = 0.225)
- **Tiered Method:** EV = Point Value × Win Rate (High Card = 1 × 0% = 0, Pair = 1 × 19.2% = 0.192)

🔍 Why Hand Distributions Differ:

- **Lower win rates don't mean "avoidance":** Methods optimize total arrangement EV across all three positions
- **Tiered front pairs have lower win rates:** Higher-ranking pairs were allocated to stronger positions for better total EV
- **Resource allocation differences:** Each method finds different optimal ways to distribute the same 17 cards

🎯 Cross-Position Optimization:

- **Tiered unique patterns:** 6-card SF in middle, higher back hand win rates suggest sophisticated position value calculations
- **Points flexibility:** Uses High Card arrangements when total point value is optimized
- **Empirical limitations:** Learned relationships may not capture all strategic possibilities

📈 Method Evolution Summary

> ### 1. Points Method (2024) - Foundation:
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> - **Direct Optimization:** Sum of point values across three positions
> - **Complete Coverage:** Uses all hand types when mathematically optimal
> - **No Bias:** Treats equal-point hands equally (High Card = Pair = 1 point)

- **Baseline Performance:** Established optimization framework

2. Empirical Method (2024) - Learning Approach:

- **Probability Integration:** EV = Points × Win Rate (learned from Points data)
- **Small Sample Issues:** Win rates corrupted by limited rare hand samples
- **Strategic Gaps:** Missing arrangements due to 0% learned win rates
- **Performance:** Consistently 15-20% behind optimal in test cases

3. Tiered Method (2025) - Mathematical Hierarchy:

- **Probability Integration:** EV = Points × Win Rate (mathematical hierarchy)
- **Immune to Sample Size:** Win rates based on logical hand strength ordering
- **Cross-Position Optimization:** Sophisticated resource allocation across positions
- **Superior Performance:** Best strategic decisions in complex scenarios

Dataset Analysis: Three optimization methods applied to Pyramid Poker arrangements

Points: 72,000 hands | Empirical: 60,000 hands | Tiered: 66,000 hands

Key Finding: Different optimization functions produce measurably different hand distributions, revealing distinct strategic approaches to the same mathematical problem