

Pyramid Poker 3-Tuple System Documentation

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Purpose: Complete specification for systematic 3-tuple lookup table generation

Format: [handTypeRank, primaryRank, secondaryRank]

Hand Type Rankings (First Element)

Standard 5-Card Hands

- **1:** High Card
- **2:** Pair
- **3:** Two Pair
- **4:** Three of a Kind
- **5:** Straight
- **6:** Flush
- **7:** Full House
- **8:** Four of a Kind
- **9:** Straight Flush

Special Large Hands

- **10:** Five of a Kind (5K)
- **11:** Six-card Straight Flush (6-card SF)
- **12:** Six of a Kind (6K)
- **13:** Seven-card Straight Flush (7-card SF)
- **14:** Seven of a Kind (7K)
- **15:** Eight-card Straight Flush (8-card SF)
- **16:** Eight of a Kind (8K)

Primary Rank Rules (Second Element)

For most hands: The rank of the primary component

- **Pair:** Rank of the pair (2-14, where A=14)
- **Three/Four of a Kind:** Rank of the trips/quads
- **Full House:** Rank of the trips portion

- **Straight/Straight Flush:** Highest card in sequence
- **Large of a Kind:** Rank of the repeated card

Special Cases:

- **Wheel Straight (A-2-3-4-5):** [5, 14, 5] (straight, ace high, 5 second-highest)
- **High Card/Flush:** Highest card rank

Secondary Rank Rules (Third Element)

Position-Independent Rules

- **High Card/Straight/Flush/Straight Flush:** Second-highest card rank
- **Pair/Four of a Kind:** Highest kicker rank
- **Two Pair:** Lower pair rank
- **Full House:** Pair rank (the pair portion)
- **Large of a Kind (5K, 6K, 7K, 8K):** Highest suit (1-4)
- **Large Straight Flushes (6-8 card SF):** Second-highest card in sequence

Position-Dependent Rule

- **Three of a Kind:**
 - **Front Position:** Highest suit (1-4)
 - **Middle/Back Position:** Highest kicker rank

Card Count Rules by Position

Back Hand

- **Standard:** 5 cards
- **Special:** 6, 7, or 8 cards (only for 6K, 7K, 8K, 6-card SF, 7-card SF, 8-card SF)

Middle Hand

- **Standard:** 5 cards
- **Special:** 6 or 7 cards (only for 6K, 7K, 6-card SF, 7-card SF)

Front Hand

- **Standard:** 3 cards
- **Optional:** 5 cards (only if straight or better)

Multiple Arrangements for Same Hand Type

Kicker Variations

For hands with kickers (Pair, Three of a Kind, Four of a Kind), multiple 3-tuples exist:

Example - Three of a Kind with 10s (Middle/Back position):

- [4, 10, 14] - trips tens, ace kicker (best)
- [4, 10, 13] - trips tens, king kicker
- [4, 10, 12] - trips tens, queen kicker
- [4, 10, 11] - trips tens, jack kicker
- etc.

Example - Pair of Kings:

- [2, 13, 14] - pair kings, ace kicker (best)
- [2, 13, 12] - pair kings, queen kicker
- [2, 13, 11] - pair kings, jack kicker
- etc.

Suit Variations (Large Hands Only)

For large of-a-kind hands, multiple 3-tuples exist based on highest suit:

Example - Six of a Kind Aces:

- [12, 14, 4] - 6 aces, highest suit = spades
- [12, 14, 3] - 6 aces, highest suit = hearts
- [12, 14, 2] - 6 aces, highest suit = diamonds
- [12, 14, 1] - 6 aces, highest suit = clubs

Suit Encoding (When Applicable)

- 1: ♣ Clubs
- 2: ♦ Diamonds
- 3: ♥ Hearts
- 4: ♠ Spades

Systematic Generator Requirements

Complete Coverage Needed

1. **All hand types (1-16)** with all possible primary ranks
2. **All kicker combinations** for hands that use kickers
3. **All suit combinations** for large hands that use suits
4. **Position-specific variants** for Three of a Kind
5. **Card count variations** where applicable

Output Format

Each row represents one unique hand possibility:

csv

```
position,handType,primaryRank,secondaryRank,winProbability  
back,4,10,14,[to_be_inserted]  
back,4,10,13,[to_be_inserted]  
back,4,10,12,[to_be_inserted]  
front,4,10,4,[to_be_inserted]  
middle,4,10,14,[to_be_inserted]
```

Column Explanation:

- **position:** front, middle, or back
- **handType:** 1-16 (hand type ranking)
- **primaryRank:** 2-14 (primary rank value)
- **secondaryRank:** 1-14 or 1-4 (secondary rank value, depends on hand type)
- **winProbability:** [Placeholder for later insertion]

Key Differences from Empirical Data

- **Systematic:** Covers ALL possible combinations mathematically
- **Complete:** No gaps or missing combinations
- **Predictable:** Rule-based generation vs observed data
- **Scalable:** Can generate any scenario without playing games

Critical Implementation Notes

1. **Kicker Logic:** Secondary rank represents the HIGHEST remaining card, not lowest
2. **Position Dependency:** Three of a Kind uses different secondary rank logic for front vs middle/back

3. **Card Count Impact:** Large hands (6-8 cards) only valid in specific positions
 4. **Completeness:** Every possible valid 3-tuple must be included for 100% coverage
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Usage: This specification enables building a complete systematic lookup table that replaces the need for empirical data collection while maintaining identical functionality to the current win probability system.