HCP Tracker Product Requirements Document

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Status: Theme Strength Calculation Framework with IPS v3.10 Alignment
Current Code Version: v6.3

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1. Executive Summary

1.1 Product Vision

The HCP Tracker is a browser-based portfolio optimization tool implementing the Humble Conviction Portfolio (HCP) Investment Policy Statement. It provides a guided 10-step workflow with ALL calculations performed client-side, using moving average comparisons for signal generation.

1.2 Key Changes in v3.4

- **IPS v3.10 Alignment:** Updated to reflect critical theme strength calculation fix
- **Module Version Updates:** FileHandler v1.4, ThemeCalculator v2.6, Integration Test v3.2.9
- **Conceptual Framework:** Documents theme strength confidence vs regime transition probability correction
- **Boundary Condition Fix:** Resolved uniform probability issue that prevented proper signal expression
- **Extended MA History:** 450-point historical data support for sophisticated probability calculations

1.3 Previous Features (Retained from v3.3)

- ALL calculations in Tracker
- MA Comparison Framework
- Fixed Tier Weights: 35% canary, 40% primary, 25% structural
- 13 unique indicators across 4 themes
- Three-tier signal framework

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2. Critical Display Specifications (RETAINED v3.3)

2.1 Scenario Probability Color Coding

The 16-scenario matrix uses a 5-tier color system based on probability ranges:

Probability Range	Color	CSS Class	Hex Code	Description
> 25%	Dark Green	scenario-very-high	#155724	Extremely likely scenarios
10-25%	Light Green	scenario-high	#28a745	Likely scenarios
5-10%	Yellow	scenario-medium	#ffc107	Moderate probability
1-5%	Light Red	scenario-low	#dc3545	Unlikely scenarios
< 1%	Dark Red/Gray	scenario-very-low	#6c757d	Extremely unlikely

Implementation Note: Do NOT use confidence labels (HIGH/MEDIUM/LOW) with probabilities. The color coding itself indicates likelihood.

2.2 Theme Color Assignments

Fixed theme colors for consistency across all displays:

Theme	Color Name	CSS Class	Hex Code	RGB
USD	Red	theme-usd	#dc3545	rgb(220, 53, 69)
AI/Innovation	Blue	theme-ai	#007bff	rgb(0, 123, 255)
P/E	Yellow	theme-pe	#ffc107	rgb(255, 193, 7)
International	Green	theme-intl	#28a745	rgb(40, 167, 69)

2.3 Data Confidence Indicators

Separate from probability colors, data confidence shows quality of underlying data:

Confidence Level	When to Use	Display
HIGH	All indicators fresh, complete history	Green dot
MEDIUM	Some stale data or interpolation	Yellow dot
LOW	Significant missing data	Red dot

Critical: Data confidence is about data quality, NOT probability levels.

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3. Data Key Mapping (CLARIFIED v3.3)

3.1 Required Indicator Keys

The FileHandler and data structures MUST use these exact keys:

```javascript
// USD Theme (4 indicators)
indicators: {
  usd: {
    'dxy': { /* DXY Index data */ },
    'gold_purchases': { /* Central Bank Gold data */ },
    'yuan_swift': { /* Yuan SWIFT Share data */ },
    'reserve_share': { /* USD Reserve Share data */ }
  },

  // Innovation Theme (3 indicators)
  innovation: {
    'qqq_spy': { /* QQQ/SPY Ratio data */ },
    'productivity': { /* Productivity Growth data */ },
    'net_margins': { /* S&P Net Margins data */ }
  },

  // P/E Theme (3 indicators)
  pe: {
    'forward_pe': { /* Forward P/E data */ },
    'cape': { /* Shiller CAPE data */ },
    'risk_premium': { /* Equity Risk Premium data */ }
  },

  // International Theme (3 indicators)
  intl: {
    'acwx_spy': { /* ACWX/SPY Relative data */ },
    'sp_vs_world': { /* S&P vs MSCI World data */ },
    'tic_flows': { /* TIC Net Flows data */ }
  }
}
```

3.2 Moving Average Specifications (IPS v3.10)

```javascript
```

```
const maComparisons = {
  'dxy': {short: 200, long: 400},
  'qqq_spy': {short: 50, long: 200},
  'yuan_swift': {short: 12, long: 36},
  'gold_purchases': {short: 4, long: 12},
  'cape': {short: 'current', long: 240},
  'risk_premium': {short: 6, long: 18},
  'productivity': {short: 2, long: 8},
  'net_margins': {short: 4, long: 12},
  'reserve_share': {short: 4, long: 8},
  'sp_vs_world': {short: 6, long: 12},
  'acwx_spy': {short: 30, long: 90}
};

// Fixed threshold exceptions:
// - tic_flows: Fixed at 0 (12-month sum)
// - forward_pe: 1Y vs 3Y MA (special calculation)
```

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4. Theme Strength Calculation Framework (NEW v3.4)

4.1 Critical Conceptual Foundation (IPS v3.10)

CORRECTED APPROACH: The system calculates **theme strength confidence** for portfolio allocation, NOT **regime transition probabilities** for academic forecasting.

Key Distinction:

- **Theme Strength Logic (CORRECT):** Strong bullish momentum away from trigger = high confidence in bullish theme = 75%
- **Regime Transition Logic (INCORRECT):** Strong bullish momentum away from trigger = low probability of regime change = 5%

4.2 Algorithm Framework

Based on IPS v3.10 Appendix H corrected methodology:

1. **Current State:** Determine if indicator is currently triggered (above/below MA threshold)
2. **Momentum Calculation:** Rate and direction of change (-1 to +1 range)
3. **Distance to Trigger:** Percentage distance from MA crossing point
4. **Time Estimation:** Physics-based months-to-trigger calculation

5. **Directional Logic:**
    - **For triggered indicators:** Moving away from trigger = strengthening theme confidence
    - **For non-triggered indicators:** Moving toward trigger = building theme confidence

4.3 Expected Results Validation

With corrected theme strength calculations:

Tech Boom Scenario Data:

- AI theme should show 70-80% (blue bar)
- USD theme should show 20-30% (red bar)
- All 13 indicators must be present
- No uniform 5% probabilities across themes

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5. Three-Tier Signal Framework (from v3.2)

5.1 Fixed Tier Weights

- **Canary:** 35% (early warning)
- **Primary:** 40% (core signals)
- **Structural:** 25% (confirmation)

5.2 Indicator Classification

Tier	Indicators	Weight	Per-Indicator Weight
Canary	DXY, QQQ/SPY, Risk Premium, ACWX/SPY	35%	8.75% each
Primary	Forward P/E, Net Margins, Yuan SWIFT, CAPE	40%	10% each
Structural	Productivity, Reserve Share, Gold Purchases, TIC Flows	25%	6.25% each

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6. UI Display Requirements

6.1 Step 3 Theme Display

Each theme shows:

- Theme name with theme color bar
- Percentage probability (large, bold)

- NO confidence labels on probabilities
- Theme color fill proportional to probability

6.2 Scenario Matrix Display

Grid of 16 scenarios with:

- Scenario rank (#1-16)
- Binary representation (e.g., "1101")
- Probability percentage
- Background color from 5-tier system
- Theme indicators (USD↓, AI↑, etc.)

6.3 Missing Data Handling

If indicators are missing:

- Display error message listing missing indicators
- Prevent calculation until all data present
- Show which theme is affected

Example error:

```
Missing Innovation indicators:
- qqq_spy: QQQ/SPY Ratio
- net_margins: S&P Net Margins

Please ensure data file contains all 13 indicators.
```

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7. Common Implementation Errors to Avoid

7.1 Data Key Mismatches

- ❌ Wrong: 'qqqSpy', 'netMargins' (camelCase)
- ✅ Right: 'qqq_spy', 'net_margins' (snake_case)

7.2 Confidence Label Confusion

- ❌ Wrong: Showing "HIGH" next to 5% probability
- ✅ Right: No labels on probabilities, only color coding

7.3 Missing Indicators

- ❌ Wrong: Generating only 1 of 3 AI indicators
- ✅ Right: All 13 indicators present in every data generation

7.4 Color Inconsistency

- ❌ Wrong: Using different colors for themes across displays
- ✅ Right: Consistent theme colors everywhere

7.5 Boundary Condition Errors

- ❌ Wrong: Uniform 30%/5% probabilities due to boundary condition interference
- ✅ Right: Variable probabilities based on momentum and trend analysis

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8. Testing Validation

8.1 Scenario Probability Colors

Test that probabilities display correct colors:

- 30% → Dark Green
- 15% → Light Green
- 7% → Yellow
- 3% → Light Red
- 0.5% → Dark Red/Gray

8.2 Theme Calculations (UPDATED v3.4)

With tech_boom scenario data and corrected theme strength calculations:

- AI theme should show 70-80% (blue bar)
- USD theme should show 20-30% (red bar)
- All indicators must be present
- **No uniform low probabilities** (was critical bug in previous versions)

8.3 Data Completeness

FileHandler must generate:

- Exactly 13 indicators

- All with correct keys
- Proper history arrays (450 data points for MA calculations)

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9. Module Integration Architecture (UPDATED v3.4)

9.1 Current Module Versions

- **TrackerCore:** v1.0 (navigation, state management)
- **DataEditor:** v1.0 (modal editing system)
- **Indicators:** v1.0 (13-indicator framework)
- **FileHandler:** v1.4 (nested theme structure + 450-point MA history)
- **ThemeCalculator:** v2.6 (boundary conditions removed + IPS v3.10 theme strength)

9.2 Integration Test Framework

- **Current Version:** v3.2.9
- **Key Validation:** Theme strength calculations produce realistic probabilities
- **Critical Test:** Tech boom data → AI theme 70-80%, not uniform 5%

9.3 IPS Alignment

- **Current IPS Version:** v3.10
- **Key Framework:** Theme strength confidence calculation
- **Mathematical Model:** Three-component (State + Momentum + Distance) with corrected directional logic

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10. Implementation Notes (NEW v3.4)

10.1 Theme Strength vs Regime Transition

The fundamental breakthrough in v3.4 was correcting the conceptual framework. Previous versions calculated when themes would END (regime transition) instead of how strong themes currently ARE (theme confidence for allocation).

10.2 Boundary Condition Removal

ThemeCalculator v2.6 removed problematic boundary conditions that were forcing uniform 30%/5% probabilities and preventing the sophisticated IPS v3.9 methodology from expressing strong signals.

10.3 Extended Historical Data

FileHandler v1.4 generates 450 data points instead of 6 to support moving average calculations up to 400 periods (required for DXY long MA).

10.4 Nested Data Structure

All data generation uses nested theme structure: `{usd: {dxy: {...}}, innovation: {qqq_spy: {...}}}` for proper ThemeCalculator integration.

End of Product Requirements Document v3.4