Hedge Fund Due Diligence Report

Dominik Dimitrov, Paul Garofalo, Sebastian Lopez-Irizarry, Tao Xie

Prepared for: The New York Bus Driver Pension and Relief Fund (BDPRF)

Purpose: Due diligence analysis for potential hedge fund allocation

https://github.com/originalpaul/hf_dd

*All code used can be found in our github repository: https://github.com/originalpaul/hf_dd

Methods & Metrics Overview

Performance Metrics Analysis

1. Compound Annual Growth Rate (CAGR): shows the funds performance over a given period, higher return means bigger growth potential, you should compare it against the S&P and other hedge funds
Mathematical Formula:

$$\text{CAGR} = \left(\prod_{t=1}^{T}(1 + r_t)\right)^{\frac{P}{T}} - 1$$

```
def cagr(r: pd.Series, periods_per_year: Optional[int] = None) -> float:

    r = _clean_returns(r)

    if r.empty:

        return np.nan

    if periods_per_year is None:

        periods_per_year = _infer_periods_per_year(r.index)

    total_return = (1.0 + r).prod()

    years = len(r) / periods_per_year

    if years <= 0:

        return np.nan

    return total_return ** (1 / years) - 1
```

2. Sharpe Ratio: return per unit of risk, shows what investors actually get as return for risk taken
Mathematical Formula:

$$\text{Sharpe Ratio} = \frac{\text{CAGR}(r_t - r_f)}{\sigma_{\text{ann}}(r_t - r_f)}$$

*All code used can be found in our github repository: https://github.com/originalpaul/hf_dd

```python
def sharpe(r: pd.Series, rf: float = 0.0, periods_per_year: Optional[int] = None) ->
float:
    r = _clean_returns(r)
    if r.empty:
        return np.nan
    if periods_per_year is None:
        periods_per_year = _infer_periods_per_year(r.index)
    rf_period = (1 + rf) ** (1 / periods_per_year) - 1
    ex = r - rf_period
    vol = annualized_vol(ex, periods_per_year)
    if vol == 0 or np.isnan(vol):
        return np.nan
    return cagr(ex, periods_per_year) / vol
```

3. Maximum Drawdown: show when the fund should decrease their positions (reduce risk) and when they can increase it again, important because investors want downside protection
Mathematical Formula:

$$\text{Max Drawdown} = \min_t \left(\frac{V_t - V_{\text{peak},t}}{V_{\text{peak},t}} \right)$$

```python
def max_drawdown(r: pd.Series) -> float:
    dd = drawdown_series(r)
    if dd.empty:
        return np.nan
    return dd.min()
```

4. Alpha (Annualized): measures the excess return after adjusting the return that is due to market movements, true skill of the hedge fund
Mathematical Formula:

$$\alpha_{\text{ann}} = (1 + a)^P - 1$$

```python
x1 = np.column_stack((np.ones(len(x)), x))
  beta_hat = np.linalg.lstsq(x1, y, rcond=None)[0]
  a, b_ = beta_hat[0], beta_hat[1]

alpha_ann = (1 + a) ** periods_per_year - 1
```

5. Beta: shows sensitivity to the market, if beta = 1, then the fund behaves like the S&P 500, if it is < 1 it is less risky, if it is > 1 it is more risky

Mathematical Formula:

$$y_t = a + bx_t + \varepsilon_t \quad \Rightarrow \quad \beta = \frac{\mathrm{Cov}(y_t, x_t)}{\mathrm{Var}(x_t)}$$

More information is provided in the Appendix (6+)

OVERALL PERFORMANCE VISUALIZATION

Cumulative Returns Comparison

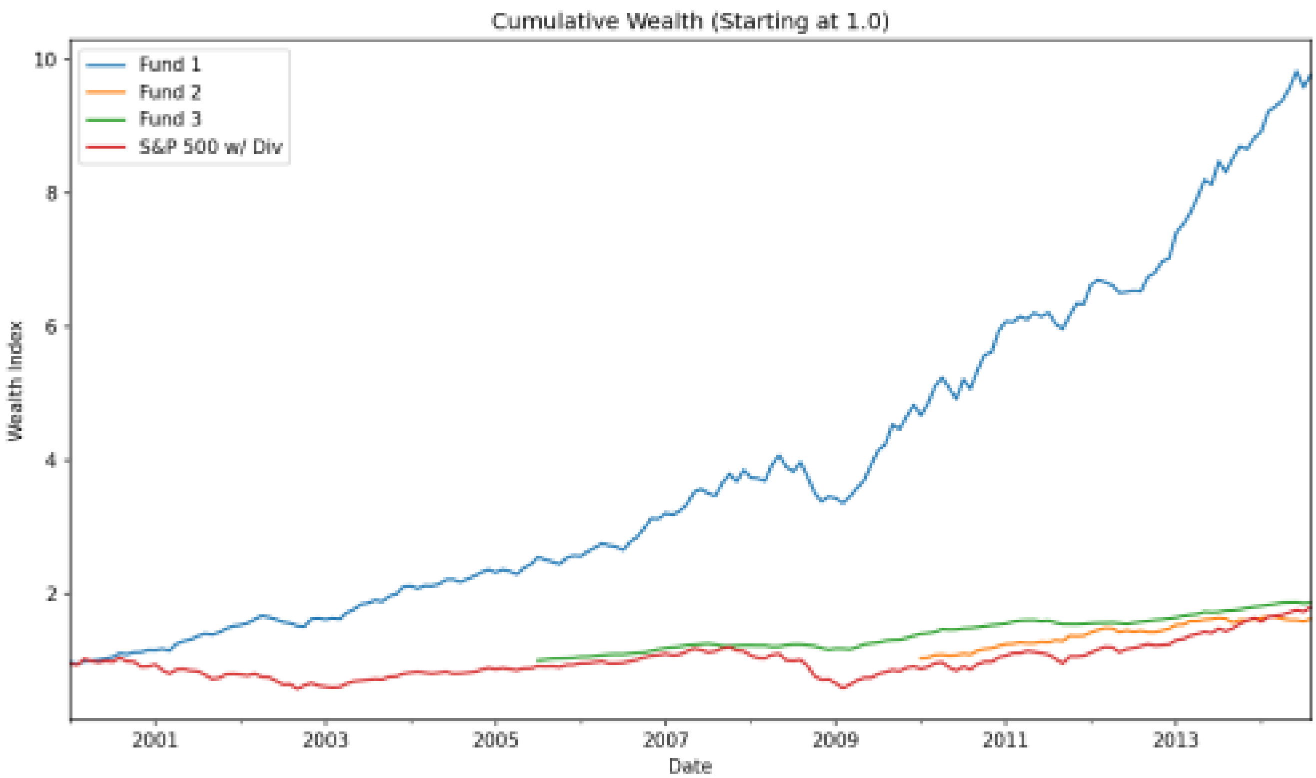


Chart Analysis: The cumulative returns chart shows the growth of $1 invested in each fund compared to the S&P 500 benchmark over the analysis period. This visualization helps identify periods of outperformance and underperformance, as well as the overall trajectory of wealth creation. Steeper slopes indicate higher returns, while periods of decline show drawdowns and recovery patterns.

S&P 500 Benchmark Drawdown Analysis

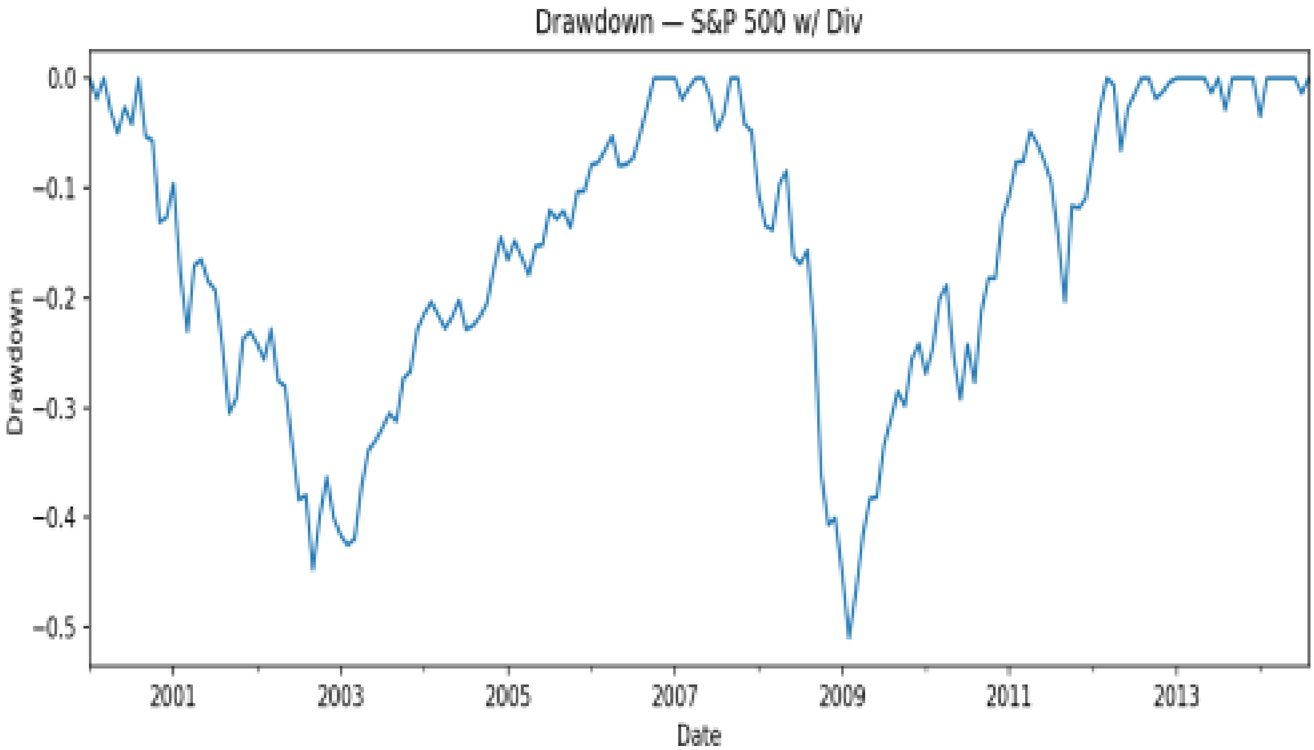


Chart Analysis: The S&P 500 drawdown chart illustrates the benchmark's downside risk patterns over time. Drawdowns represent the percentage decline from peak values, providing insight into market volatility and stress periods. This serves as a baseline for comparing individual fund drawdown characteristics and risk management effectiveness.

Fund Analysis

Fund 1

EXECUTIVE SUMMARY

Key Performance Metrics:
• Annualized Return (CAGR): 16.8%
• Sharpe Ratio: 1.54
• Maximum Drawdown: -17.6%
• Alpha (vs S&P 500): 14.7%
• Beta (vs S&P 500): 0.44

Risk-Reward Analysis:
The fund demonstrates strong risk-adjusted performance with a Sharpe ratio of 1.54. Positive alpha generation of 14.7% indicates superior risk-adjusted returns compared to the S&P 500 benchmark.

Risk Characteristics:
• Maximum drawdown of -17.6% exceeds typical hedge fund standards
• Beta of 0.44 indicates low correlation with market movements

QUANTITATIVE ANALYSIS

Performance Metrics Analysis

1. Compound Annual Growth Rate (CAGR): 16.8%

Interpretation: Fund 1 has generated an annualized return of 16.8% over the analysis period, which is the highest out of the three funds.

2. Sharpe Ratio: 1.54

Interpretation: Fund 1 demonstrates excellent risk-adjusted performance with a Sharpe ratio of 1.54. This indicates the fund effectively generates returns relative to the risk taken, which suggest strong risk management capabilities.

3. Maximum Drawdown: -17.6%

Interpretation: Fund 1 experienced a maximum drawdown of -17.6%, which represents moderate downside risk. This is the highest maximum drawdown out of the three funds and signals that fund 1 requires

*All code used can be found in our github repository: https://github.com/originalpaul/hf_dd

additional risk management oversight. Fund 1's sole PM is also responsible for risk management, which may have contributed to the higher than normal drawdown.

4. Alpha (Annualized): 14.7%

Interpretation: Fund 1 generates a positive alpha of 14.7% annually, which is significantly higher than the other two fund's alpha. This may indicate fund 1's investment edge against other market participants. It also demonstrates the fund's ability to generate excess returns through effective stock selection and market timing.

5. Beta: 0.44

Interpretation: Fund 1 exhibits a beta of 0.44, indicating low sensitivity to market movements. This suggests the fund minimally follows market trends, demonstrating low systematic risk exposure.

INVESTMENT DUE DILIGENCE

Investment Strategy Assessment:
Strengths: Fund 1 adopts a long-term fundamental value approach focused on small to mid-cap US equities. The PM has over 20 years of investment experience and is supported by a lean but disciplined research team. They employ a low turnover approach with an average holding period of 24-36 months.

Weaknesses: Fund 1 exhibits single PM dependency, limited diversification (8-10 positions), high concentration risk, no systematic risk management, and a lack of transparency (not SEC registered). The fund does not require investor lockups, despite its contrarian strategy of preventing liquidity squeeze during market stress. This could lead to high margin requirements and prime brokers forcing the fund to deleverage if financing is pulled.

Performance Attribution:
The fund's performance is driven by stock selection rather than market timing. The fundamental research approach has generated consistent alpha through deep company analysis and identifying mispriced small and mid-cap companies. The fund has a directional long bias by the nature of the design: majority long positions with small, index-based short hedges. This is supported by the fund's Beta of 0.44.

Risk Management Concerns:
- No dedicated risk manager - PM assumes dual role
- Lack of independent oversight in investment decisions
- No systematic stop loss limits: only a soft review threshold at -50%
- Moderately high position concentration (10% per position)
- Limited hedging capabilities (Shorts are limited to ETFs/indices only)

OPERATIONAL DUE DILIGENCE

Operational Strengths:
- Lean and straightforward organizational structure with clear segregation of duties between investment, operations, and administration
- Reputable service providers (prime broker, administrator, legal, and IT)
- Experienced team with long tenure
- Decent transparency, with monthly performance updates and newsletters

Operational Concerns:
- **Key Person Risk:** Heavy reliance on single PM for all investment decisions
- **Succession Planning:** No clear succession plan for PM role, creating continuity risk if the PM steps down

• **Infrastructure:** Outsourced IT and legal functions may create over dependencies
• **Scalability:** Limited team size may constrain growth
• **Turnover:** High employee turnover in the last 5 years raises issues about fund stability

Client Base Analysis:
• High concentration in fund-of-funds (50% of AUM)
• The top client represents 38.89% of fund assets, and the top five investors make up 90%. This represents high client concentration and brings liquidity risk if the fund's biggest investors pull funding.
• Limited institutional diversification, with heavy reliance on funds of funds.

Fund 1 Drawdown Analysis

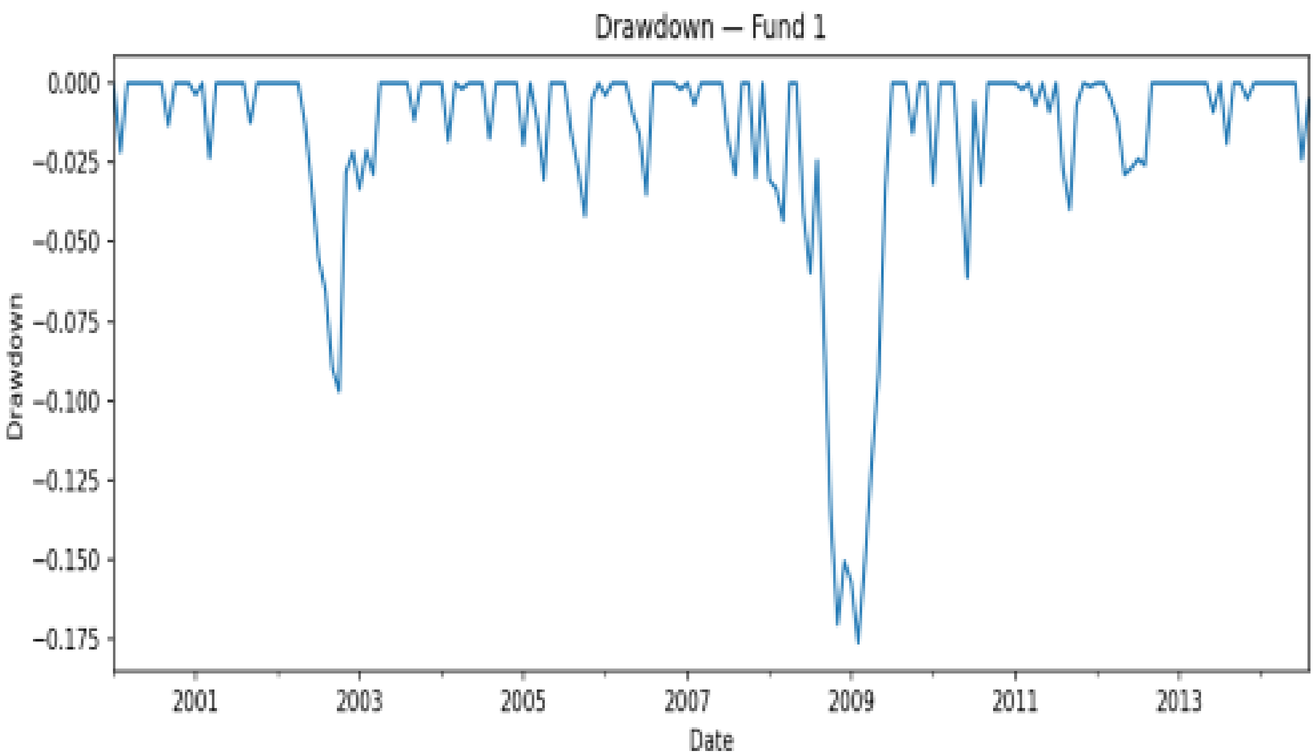


Chart Analysis: The drawdown chart reveals the fund's specific risk patterns and downside protection capabilities. The fund performed poorly during the dot-com bubble in 2001 and the financial crisis around 2008.

INVESTMENT RECOMMENDATION

Recommendation: Avoid

Rationale:
Fund 1 demonstrates a strong performance record, which is reflected in its excellent Sharpe ratio of 1.54 and robust 14.7% alpha. However, the fund poses major operational risks introduced by its heavy reliance on a single portfolio manager. The fund lacks independent risk oversight, SEC registration, and risk management protocol. The fund seems like a solid investment, but it lacks the reliability to be considered an allocation by a large institutional investor such as BDPRF.

Fund 2

EXECUTIVE SUMMARY

Key Performance Metrics:
• Annualized Return (CAGR): 11.0%
• Sharpe Ratio: 1.29
• Maximum Drawdown: -4.4%
• Alpha (vs S&P 500): 6.3%
• Beta (vs S&P 500): 0.29

Risk-Reward Analysis:
• The fund demonstrates strong risk-adjusted performance with a Sharpe ratio of 1.29. Positive alpha generation of 6.3% indicates superior risk-adjusted returns compared to the S&P 500 benchmark.

Risk Characteristics:
• Maximum drawdown of -4.4% is within acceptable limits for typical hedge fund standards.
• Beta of 0.29 indicates low correlation with market movements showing the fund's ability to garner returns independently of the market.

QUANTITATIVE ANALYSIS

Performance Metrics Analysis

1. Compound Annual Growth Rate (CAGR): 11.0%

Interpretation: Fund 2 has generated an annualized return of 11.0% over the analysis period. The CAGR for fund 2 ranks as the 2nd best in terms of annualized return, and this is true also for its volatility with an annual volatility of 6.8% when compared to fund 1 and fund 3.

2. Sharpe Ratio: 1.29

Interpretation: Fund 2 demonstrates a strong Sharpe ratio of 1.29, which reflects a strong risk adjusted return per its volatility. This indicates the fund effectively generates excess returns relative to risk taken. Comparing funds 1 and 3, we see that fund 2 has the lowest sharpe ratio of the three. Although the difference between the three funds' sharpe ratio is less than 0.25.

3. Maximum Drawdown: -4.4%

Interpretation: Fund 2 experienced a maximum drawdown of -4.4%, which represents limited downside risk over the period as the fund only lost that percentage from its peak performance to its worst losses. This reflects that the fund is able to mitigate large losses, meaning it has demonstrated strong volatility controls and risk factors to protect from market movements.

4. Alpha (Annualized): 6.3%

Interpretation: Fund 2 generates a positive alpha of 6.3% annually, indicating superior investment skill relative to the S&P 500 benchmark. This demonstrates the fund's and PM's ability to generate excess returns through an effective strategy suggesting strong active management capabilities. When comparing fund 2 to the other funds it is most comparable to fund 3 (6.4%), and fund 1 is the highest out of all with an alpha of 14.7%.

5. Beta: 0.29

Interpretation: Fund 2 exhibits a beta of 0.29, indicating low sensitivity to market movements. This suggests that fund 2 minimally follows market trends of the S&P, demonstrating low systematic risk exposure. The fund's defensive positioning relative to the market indicates weak correlation with the broader market movements. Fund 2 is in the middle of the pack in terms of beta, it is more in line with fund 1 (0.43) than fund 3 (0.08). Overall this measure signifies that fund 2 moves slightly with the market and may be slightly more exposed to market movements when compared to fund 3, but more protected compared to fund 1.

INVESTMENT DUE DILIGENCE

Investment Strategy Assessment:

• **Strengths:** Fund 2 (the fund) implements a global equity that covers both developed and emerging markets. The fund's strategy is based on the premise of finding companies whose fundamental value isn't properly reflected in the market price because of "complex" and "lesser followed stories" that have yet to be realized. The investment team operates in a collaborative, research-driven environment that fosters both bottom-up and top-down idea generation. The PM brings substantial experience coming from a well known global hedge fund. The fund is diversified, with a balanced mix of 25 long and 25 short positions. The firm also holds a long term horizon on trades to lower turnover and in doing so save in associated costs.

• **Weaknesses:** The fund lacks a verifiable track record, having launched in 2012 with performance data partially based on a hypothetical reconstruction of the PM's prior portfolio. The PM's former fund experienced significant losses during the 2008 financial crisis due to inadequate risk management, excessive exposure to illiquid assets, and a tendency toward aggressive positioning in market downturns. While the firm has since implemented stronger liquidity controls (quarterly redemptions with 45 days' notice and a 12-month lock-up) these measures should be closely monitored given the PM's discretionary control and contrarian bias toward buying into market declines. Additionally, the fund's high management (3.5%) and performance (35%) fees may materially reduce net returns to investors.

Performance Attribution:

The fund benefits from global diversification and the PM's experience from a large institutional fund. However, the track record is relatively short and includes a hypothetical period.

Risk Management Assessment:

• Discretionary risk management by PM only
• No systematic hedging approach
• High gross exposure limits (175% max)
• Stop/Loss process is reviewed no automatic systems in place
• Liquidity requirements may limit investment flexibility
• Lack of full portfolio transparency

OPERATIONAL DUE DILIGENCE

Operational Strengths:

• SEC registered with proper regulatory compliance
• Reputable service providers across all functions
• Strong team with relevant experience
• Academic research environment promotes collaboration and innovation

Operational Concerns:

• **Track Record:** Limited actual performance history (launched 2012)

- **Transparency:** Limited disclosure on the client base and the largest clients
- **Fees:** Higher fee structure (3.5% management, 35% performance)
- **Liquidity:** Quarterly redemptions with 45-day notice and 12-month hard lockup

Risk Factors:

- PM's previous fund failed during the 2008 crisis
- Hypothetical track record period raises questions

Fund 2 Drawdown Analysis

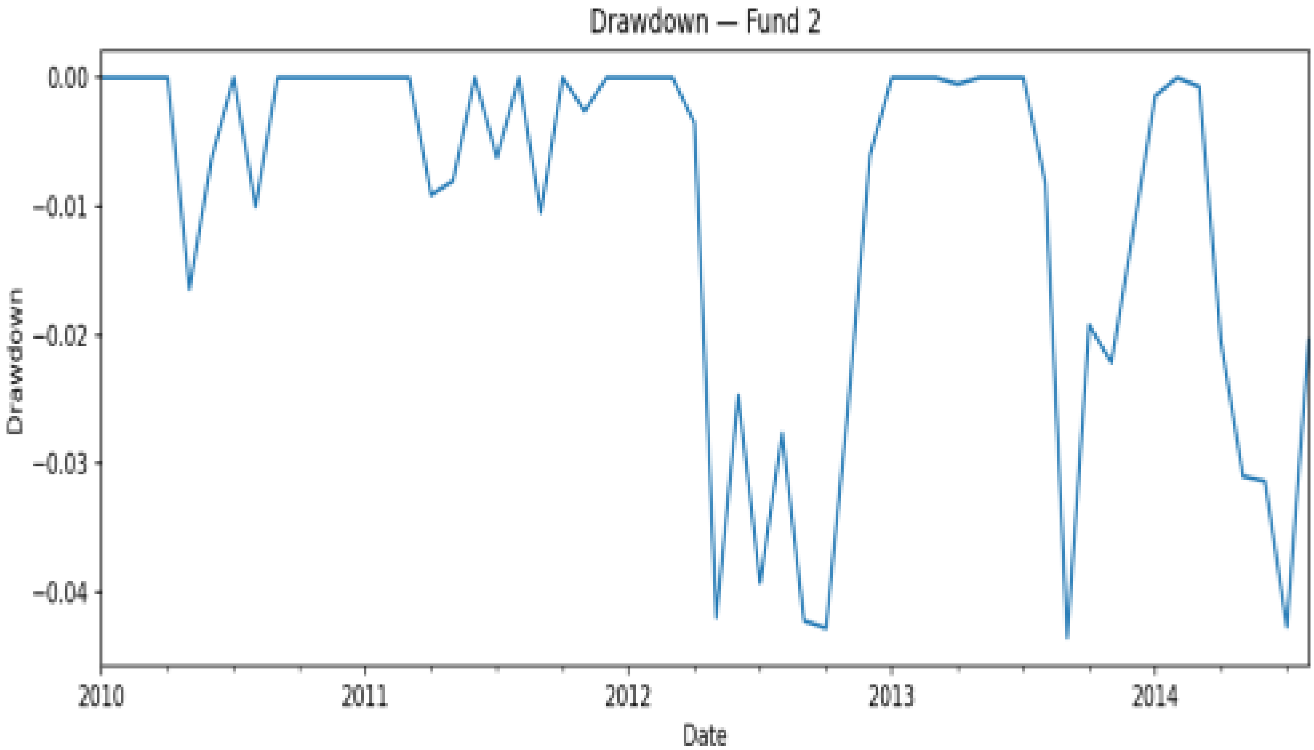


Chart Analysis: The drawdown chart reveals the fund's specific risk patterns and downside protection capabilities. Here we see slight fluctuations during the post 2008 financial crisis recovery between 2010 through 2015. We see the highest losses between 2013 and 2014. Although in general the losses and maximum drawdown periods were not for extended periods and typically did not seem to last that long. It is needed to acknowledge that the largest losses incurred during this period from its peak were -4.4%, which is minimal.

INVESTMENT RECOMMENDATION

Recommendation: Avoid

Rationale:
The fund has performed well over the period generating high alpha (6.3%), high returns (11%), acceptable Sharpe ratio (1.29), low beta (0.29) and low maximum drawdown (-4.4%). This overall analysis demonstrates fund 2 as a good investment option per these metrics as the fund is able to generate returns independently of market swings. Doing so the fund has shown its ability to create meaningful alpha and ability to generate returns, but from a due diligence perspective we cannot recommend the fund. The PM has sole control and oversight of the fund's management, along with the fund having higher fees compared to the other funds. The PM has also previously been involved in a fund that went under due to a lack of necessary due diligence and risk management. We view the current PM to still exemplify those traits of being aggressive in market downturns and as having a tendency to fall into a gambler's ruin scenario. We are not fully comfortable with the current structure of the firm for this reason having the PM as the sole risk manager and trader. Therefore we propose to avoid investing in fund 2 although strong returns, the lack of transparency and consolidated control is an unwarranted risk we recommend avoiding.

Fund 3

EXECUTIVE SUMMARY

Key Performance Metrics:
• Annualized Return (CAGR): 7.0%
• Sharpe Ratio: 1.41
• Maximum Drawdown: -7.2%
• Alpha (vs S&P 500): 6.4%
• Beta (vs S&P 500): 0.08

Risk-Reward Analysis:
The fund demonstrates strong risk-adjusted performance with a Sharpe ratio of 1.41. Positive alpha generation of 6.4% indicates superior risk-adjusted returns compared to the S&P 500 benchmark.

Risk Characteristics:
• Maximum drawdown of -7.2% is within acceptable limits for typical hedge fund standards
• Beta of 0.08 indicates low correlation with market movements

QUANTITATIVE ANALYSIS

Performance Metrics Analysis

1. Compound Annual Growth Rate (CAGR): 7.0%

Interpretation: Fund 3 has realized a CAGR of 7.0% over the analysis period, which is the lowest out of the three funds, but still higher than the S&P 500. Even though the smoothed annual return lags behind the return of Fund 1 and Fund 2, the low volatility (3.5%) means that the fund achieved growth with very little fluctuation. The 7% CAGR and 3.5% volatility position Fund 3 as a stability/ diversification player rather than an alpha driver.

2. Sharpe Ratio: 1.41

Interpretation: Fund 3 has a strong Sharpe ratio (1.41) which is explained by its low volatility (3.5%). This means the fund generates returns efficiently given the low risk and strong risk management capabilities.

3. Maximum Drawdown: -7.2%

Interpretation: Compared to the market (-50.9%), Fund 3 has only lost -7.2% at its worst point which seems very productive. This is consistent with the Fund's low volatility (3.5%) and investors would not panic compared to the major swings in the S&P 500.

4. Alpha (Annualized): 6.4%

Interpretation: Fund 3 generates an alpha of 6.4% annually, which means it has an annualized 6.4% return above the S&P 500 benchmark after adjusting for risk. In simple terms it means that the return of the fund is because of skill and not just luck.

5. Beta: 0.08

Interpretation: Fund 3 has a beta of 0.08, meaning it is mostly uncorrelated with the market. For example, if the market goes down by 10%, then Fund 3 is expected to move only -0.8%. This means that Fund 3's returns come mostly from management decisions (idiosyncratic strategies) and not from market movements.

INVESTMENT DUE DILIGENCE

Investment Strategy Assessment:
Strengths: Fund 3 employs a US equity long/short strategy with a multi-PM structure. Its investment strategy is well-defined and has been consistent since inception in 2005. The fund has a dedicated risk team, led by one Head of Risk and three analysts, which provides robust oversight in managing the fund's risk. The use of proprietary and external risk systems offers real-time visibility into portfolio risk. The fund has a standard 1.75%/20% fee structure. The 12-month soft lock and 45-day quarterly redemption terms are reasonable for the strategy, though the 2% redemption fee is a slight negative. All standard offering, subscription, and regulatory (SEC, FSA) documents are in place. Service providers (Prime Broker, Administrator) are reputable.

Weaknesses: The siloed PM structure may reduce collaboration across the PM teams, this could lead to uncoordinated portfolio exposures if the CIO does not impose tight controls. The fund also has high PM turnover in recent years, which may disrupt investment strategy's continuity. A significant flag was raised regarding the CIO's departure from her previous employer. It was "contentious," and she was perceived as secretive and highly competitive. Her personal trading record during the non-compete year was poor (+2% vs. S&P +10%), which, while not representative of the fund's strategy, is a data point on her ability to generate alpha outside a structured environment.
The CIO's overwhelming authority over capital allocation may mean that the fund's overall investment direction, style, and coordination are all heavily dependent on the CIO's discretion. If the CIo were to leave or make poor decisions, the fund's performance would be seriously affected, despite the presence of multiple PMs.

Performance Attribution:
The fund's returns are driven by stock selection rather than market exposure, enabling the fund to achieve a 7.05% annual return, higher than S&P 500. The fund's low beta indicates that the fund has low market dependence and that returns come from PM discretion and the investment strategy.

Risk Management Concerns:
• Strict portfolio risk limits exist at both the PM and fund level, ensuring balanced exposures and drawdowns
• Autonomous risk oversight provides quantitative checks on beta, sector, and liquidity exposures
• Stop-loss and exposure caps are systematically enforced

OPERATIONAL DUE DILIGENCE

Operational Strengths:
• SEC registered with proper regulatory compliance
• Reputable third-party service providers across all functions (audit, legal, and prime brokerage)
• Dedicated risk and compliance teams that are independent from the investment teams
• Established operational infrastructure supported by parent firm's resources

Operational Concerns:
• High staff turnover (17 departures in 5 years with 4 PMs leaving)
• Shared resources with the parent firm could create conflicts of interest or oversight in accountability
• Key person dependency on the CIO's discretion in investment decisions
• Complex organizational structure may hinder communication

PERFORMANCE VISUALIZATION

Fund 3 Drawdown Analysis

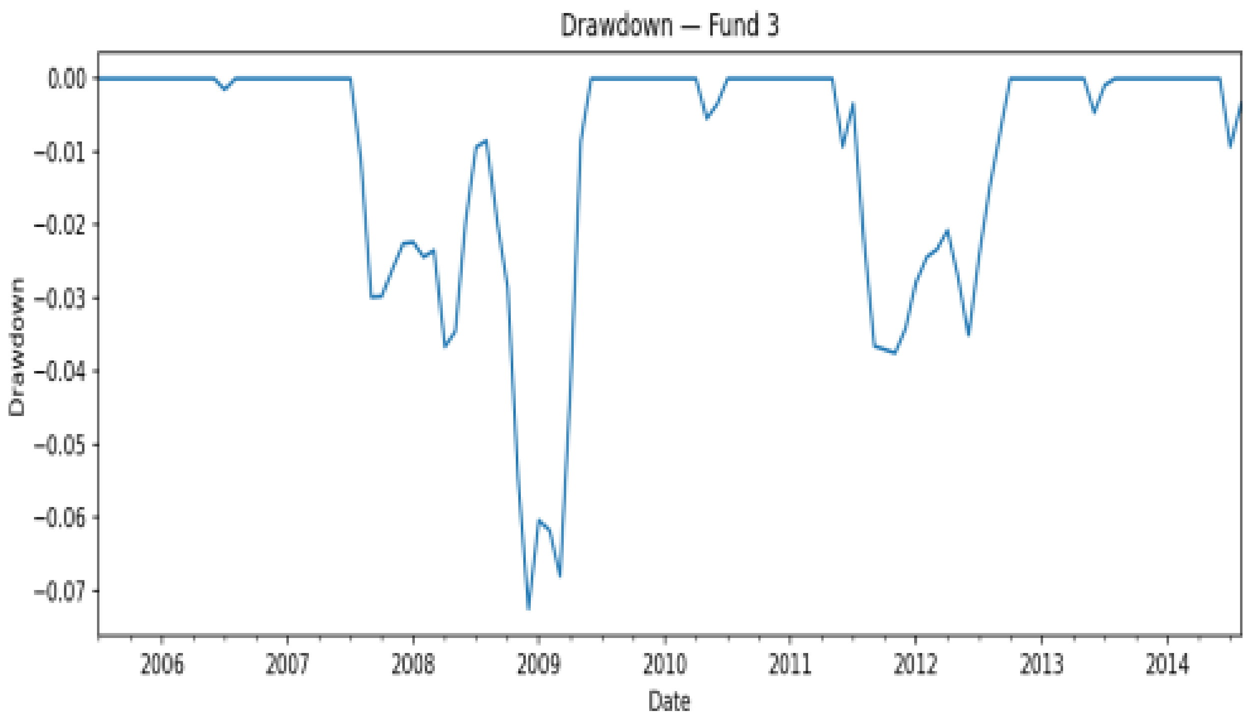


Chart Analysis: The drawdown chart reveals the fund's specific risk patterns and downside protection capabilities. Fund 3 performed poorly after the financial crisis in 2008 and around 2012.

INVESTMENT RECOMMENDATION

Recommendation: Invest

Rationale:

Investing in Fund 3 makes sense because one gets stock-like returns for bond-like risk and only little correlation to market movements. It has a CAGR of 7.05% with a low volatility of only 3.52%. The Sharpe ratio of 1.41 shows strong risk-adjusted performance, while a beta of 0.08 and correlation of 0.34 prove the returns come from real manager skill, not luck, which shows that the hedge fund is ideal as a diversifier and for risk-averse investors like pension funds. The annualized alpha of 6.36% adds to this statement and a hit rate of 80.91% proves that the hedge funds strategy delivers steady, predictable results. There are risks like the heavy reliance on the CIO and high employee turnover but the fund has an independent risk manager with authority over trading. Furthermore, while turnover is high, it’s also part of the fund’s model to constantly bring in new top-tier talent.

Investment Recommendation Overview

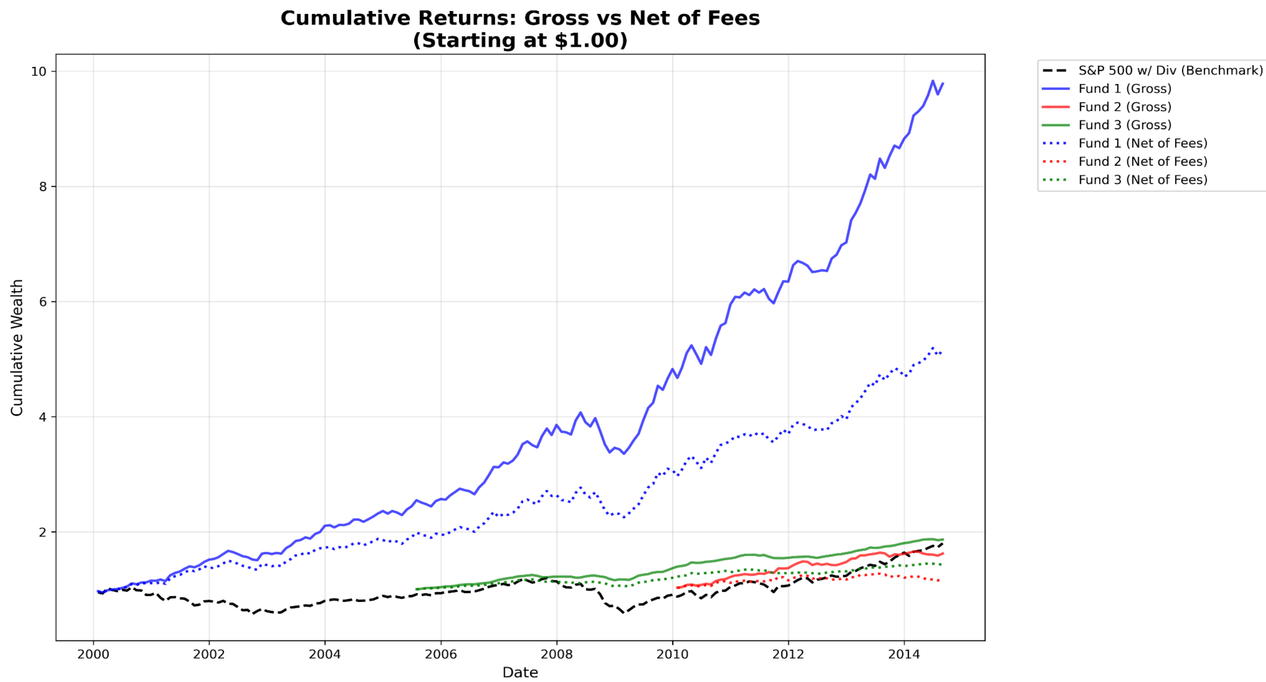


Chart Analysis: Net of fees, fund 3's performance lags behind S&P 500, although the fund exhibits very low covariance with the market. Fund 1 generates the most returns out of the three funds regardless of management fees. Fund 2 delivers the worst performance out of the three funds in comparison to fund 1 and 3 in terms of returns, risk, and market movement.

Covariance between the funds and the S&P 500:

Covariance means how two assets move together. In our case, Fund 1 has the highest correlation with the S&P 500 (0.71) which is moderately positive. Because the correlation is strong and the volatility is not too low, the covariance of Fund 1 and the S&P 500 is relatively high. This means that Fund 1 tends to move in the same direction as the market but with smaller swings (Beta = 0.44).

Fund 2 has a correlation of 0.57 with the S&P 500 and volatility of 6.8%. This means that the covariance between Fund 2 and the market is smaller than the first fund because both correlation and volatility are lower. Fund 2 will likely move with the S&P 500 sometimes but not strongly and because of its very low maximum drawdown and Beta, the losses will be less severe when the market falls.

Fund 3 has a very low correlation with the S&P 500 (0.34) and the lowest volatility out of all three funds (3.5%), which means that the covariance between the fund and the market is tiny and the fund moves mostly independent of the market (Beta = 0.08). Fund 3 works best as a diversifier for lowering overall portfolio risk.

If we look at the covariance between the three funds, it is important to find funds that have low or negative covariance in order to smooth portfolio risk. Since BDPRF already holds a long-only S&P portfolio, the best complement would be funds that are low covariance with the S&P and with each other. Both Fund 1 and Fund 2 have correlations with the S&P 500 over 0.5 so adding both funds into their portfolio would not add much diversification because they behave somewhat similarly. Fund 1 barely moves with the market, so the covariance between Fund 1 and 3 is the lowest and adds the most diversification. Fund 3 offsets some of Fund 1's market-driven risk. Fund 2 and 3 together add less diversification than the previous combination but still only moderate to low covariance and both Funds are relatively defensive which means that it is a safe and stable option but the alpha would be weaker.

Recommendation for BDPRF:

Fund 3 is the most suitable investment for the New York Bus Driver Pension and Relief Fund (BDPRF), aligning with its goal of enhancing alpha while maintaining stability relative to its S&P 500–benchmarked equity portfolio. The fund's low beta (0.08), strong Sharpe ratio (1.41), and robust annualized alpha (6.4%) indicate consistent, skill-driven performance with minimal market dependency. Despite posting slightly lower nominal returns than the S&P 500, its 3.5% annual volatility and limited maximum drawdown of -7.2% provide exceptional downside protection. For a pension fund seeking stable, predictable returns, Fund 3's ability to deliver stock-like performance at bond-level risk levels makes it a clear fit. Its 80.9% hit ratio further reinforces its consistency, while a correlation of just 0.34 with the S&P 500 establishes its value as a diversifier that can reduce overall portfolio volatility and improve risk-adjusted performance.

Beyond performance metrics, Fund 3's institutional-grade structure and robust governance framework strengthen its appeal and our comfortability with recommending to invest. The fund features a dedicated and autonomous risk management team with strict exposure limits and stop-loss policies, providing a disciplined approach to downside control. It is SEC-registered, uses reputable third-party service providers, and adheres to strong compliance protocols- all markers of operational soundness suitable for institutional investors like BDPRF. Although there are concerns regarding high staff turnover (17 departures over five years, including four PMs) and potential overreliance on the CIO, these risks are mitigated by the firm's established processes, strong oversight, and a culture of continuously onboarding top-tier talent. Compared to Fund 1, which lacks regulatory oversight and centralizes control under a single PM, and Fund 2, which suffers from questionable transparency and an unstable management history, Fund 3 offers the most balanced profile of credibility, consistent alpha generation, and controlled market exposure. Its combination of strong quantitative performance, rigorous risk management, and stable institutional infrastructure makes it the most prudent and strategically aligned choice for BDPRF's hedge fund allocation.

Further Information Considerations:

After running our analysis we found certain gaps that could've been useful in our process, but were missing. Operational due diligence remains the most critical missing piece, including detailed biographies and track records of all senior investment professionals, succession planning (especially crucial for Fund 1 and 2's single PM structure), and comprehensive investment process documentation including risk management policies, and decision-making processes. Additionally, regulatory oversight details such as current compliance status, audit procedures, and any historical regulatory findings would provide added governance context. Fund structure and client intelligence would also enhance the current analysis from fund 2. Understanding the current investor base composition, client retention rates, reasons for historical redemptions, and references from similar institutional investors. Finally, comprehensive legal documentation would round out the operational risk assessment.

Appendix

Series	Fund 1	Fund 2	Fund 3	S&P 500 w/ Div
CAGR	0.168217512	0.109562117	0.07048074759	0.040984189
AnnVol	0.09474593374	0.06810932427	0.0351833507	0.1540450387
Sharpe	1.536301644	1.291345883	1.409002767	0.1336391521
Sortino	1.900284061	1.59496374	1.280087294	0.1173668536
MaxDrawdown	-0.1762769772	-0.04350808	-0.07242230392	-0.5094874754
HitRatio	0.6477272727	0.2045454545	0.5056818182	0.6193181818
Skew	-0.04769618549	0.1717687009	-0.3265228753	-0.5680033466
KurtosisExcess	-0.3407602469	0.5661042794	1.388089463	0.9401797758
Alpha_ann	0.147187633	0.06338303047	0.06360898089	
Beta	0.4366366511	0.2882802996	0.07896176922	
R2	0.5039815592	0.3195357459	0.1159347979	
Corr_SPX	0.7099165861	0.5652749295	0.3404919939	
TrackingError	0.1094714599	0.1104148342	0.1435973484	
InformationRatio	0.984702718	-0.4905060949	-0.2122048682	

6. Hit Ratio: fraction of periods with a positive return; higher means more frequent gains and steadier compounding

Mathematical Formula:

$$\text{Hit Ratio} = \frac{1}{T}\sum_{t=1}^{T} \mathbf{1}\{r_t > 0\}$$

```python
def hit_ratio(r: pd.Series) -> float:
    r = _clean_returns(r)
    if r.empty:
        return np.nan
    return (r > 0).mean()
```

7. Skewness: measures the asymmetry of a fund's return distribution

Mathematical Formula:

$$\text{Skewness} = \frac{E[(r_t - \mu)^3]}{\sigma^3}$$

```
def skewness(r: pd.Series) -> float:
    r = _clean_returns(r)
    return r.skew()
```

8. Tracking Error: the volatility of the deviation from the benchmark

Mathematical Formula:

$$\text{Tracking Error} = \sqrt{P \cdot \frac{1}{T-1} \sum_{t=1}^{T} \left[(r_t - b_t) - \overline{(r - b)}\right]^2}$$

```
def tracking_error(r: pd.Series, bench: pd.Series, periods_per_year: Optional[int] = 
None) -> float:
    diff = pd.concat([_clean_returns(r), _clean_returns(bench)], axis=1).dropna()
    if diff.empty:
        return np.nan
    d = diff.iloc[:, 0] - diff.iloc[:, 1]
    if periods_per_year is None:
        periods_per_year = _infer_periods_per_year(diff.index)
    return d.std(ddof=1) * np.sqrt(periods_per_year)
```

9. Information Ratio: addresses this by focusing on the risk- adjusted abnormal return or, said differently, the risk- adjusted alpha

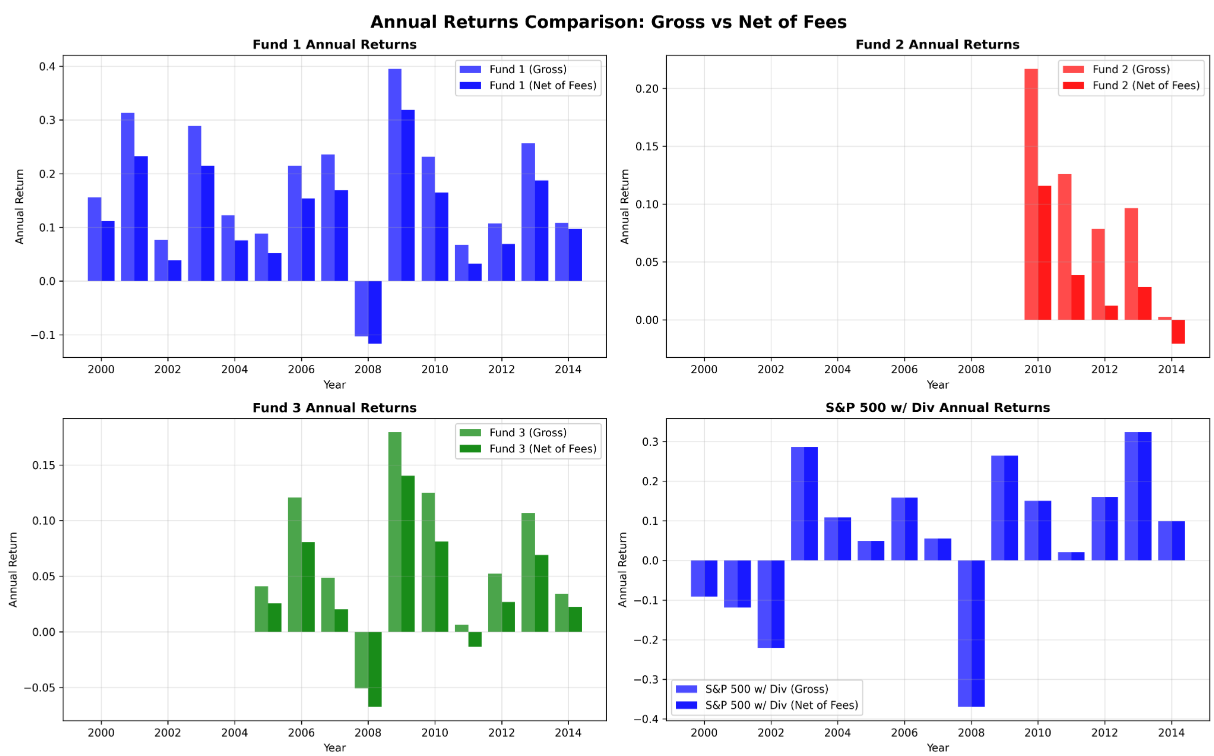
Mathematical Formula:

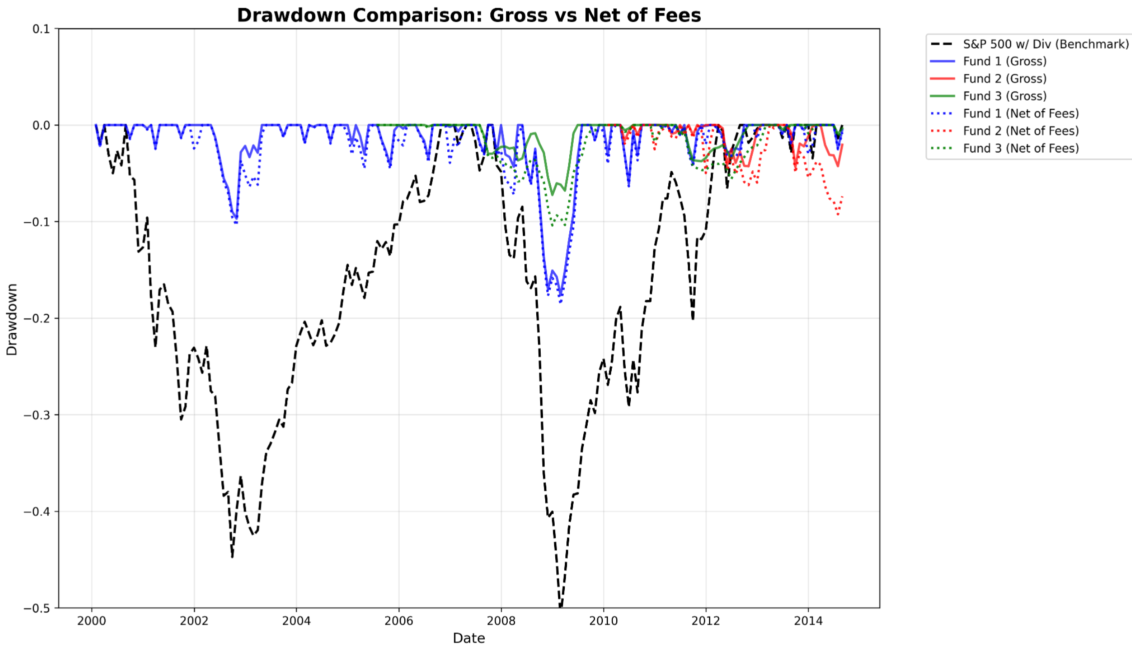
$$\text{Information Ratio} = \frac{\text{CAGR}(r_t - b_t)}{\text{Tracking Error}}$$

$$\text{Information Ratio} = \frac{\left(\prod_{t=1}^{T}(1 + r_t - b_t)\right)^{\frac{P}{T}} - 1}{\sqrt{P} \cdot \sigma(r_t - b_t)}$$

```
def information_ratio(r: pd.Series, bench: pd.Series, periods_per_year: Optional[int] = 
None) -> float:
    diff = pd.concat([_clean_returns(r), _clean_returns(bench)], axis=1).dropna()
    if diff.empty:
```

```
    return np.nan
d = diff.iloc[:, 0] - diff.iloc[:, 1]
if periods_per_year is None:
    periods_per_year = _infer_periods_per_year(diff.index)
ann_excess = cagr(d, periods_per_year)
te = tracking_error(r, bench, periods_per_year)
if te == 0 or np.isnan(te):
    return np.nan
return ann_excess / te
```





The rest of the performance metrics calculations can be found in
https://github.com/originalpaul/hf_dd/blob/main/src/performance_metrics.py