

# PredictNow.AI – Tail Hedging in the Age of Machine Learning

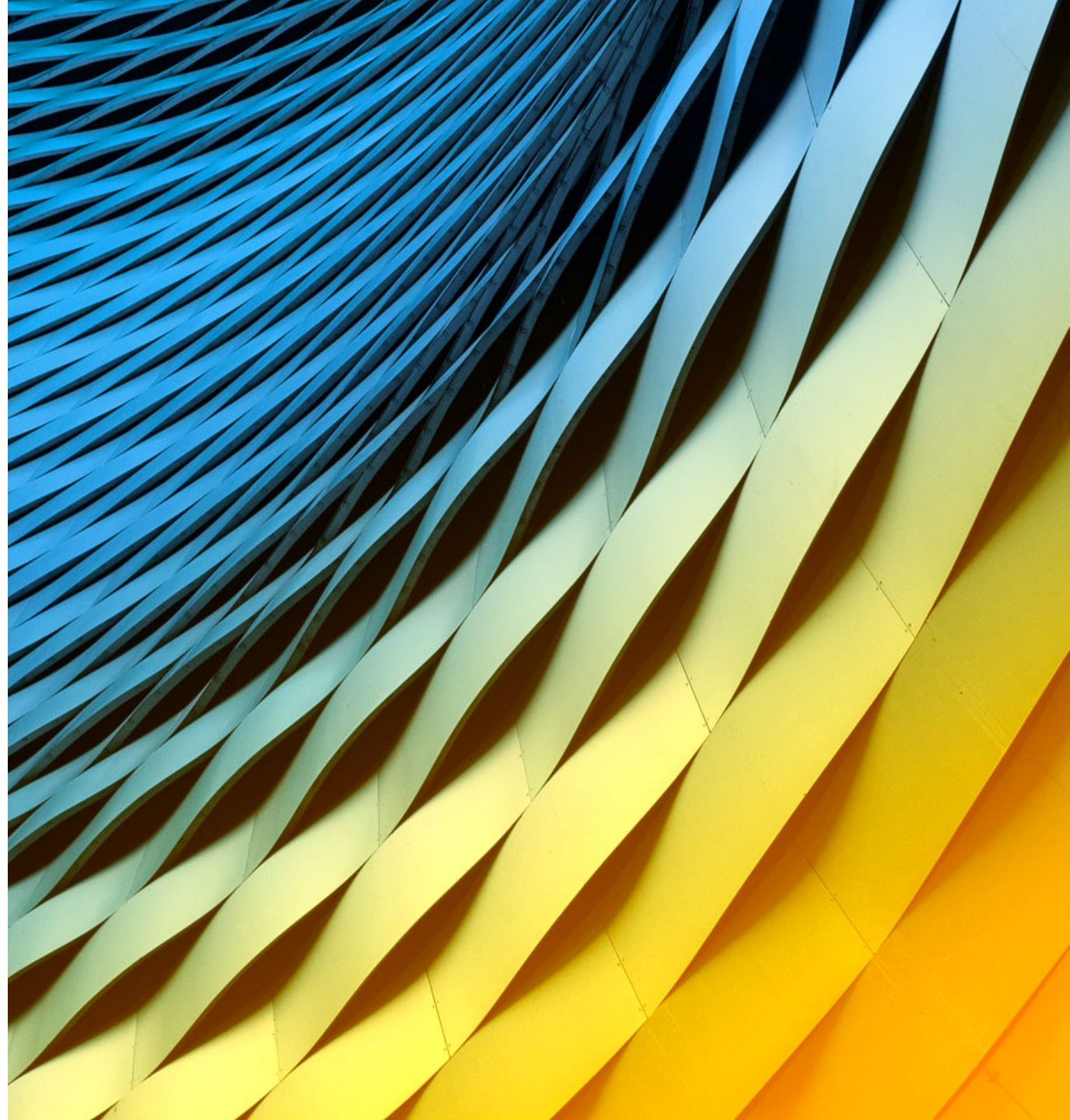
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**Ernest Chan,**  
Founder  
PredictNow.AI

**March 19, 2021**



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# Tail Hedging in the Age of Machine Learning

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**PredictNow.ai**

**Ernest Chan, Ph.D.**  
Founder of PredictNow.ai

# Ernest Chan

- Founder of [PredictNow.ai](http://PredictNow.ai), a financial machine learning SaaS.
- Quantitative hedge fund manager ([www.qtscm.com](http://www.qtscm.com)) and well-known quant finance author ([www.epchan.com](http://www.epchan.com)) and blogger ([epchan.blogspot.com](http://epchan.blogspot.com)).
- 26 years of machine learning R&D experience, starting at IBM T.J. Watson Research Center.
- Author of *Quantitative Trading, Algorithmic Trading, and Machine Trading* (Wiley 2009, 2013, 2017).
- Quoted by Wired, New York Times, Bloomberg, CNBC, and Wall Street Journal.
- Ph.D. in Physics from Cornell University.



# Returns all over the map in 2020 Q1

- Renaissance Institutional Equities Fund: ~ -18%
- Bridgewater Pure Alpha Fund: ~-20%
- D.E. Shaw Oculus Fund: ~+7%
- AQR Managed Futures Fund: ~+3%
- AQR Diversified Convexity Fund: ~+40%

Source: Preqin

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# Tail Hedge Strategies won?

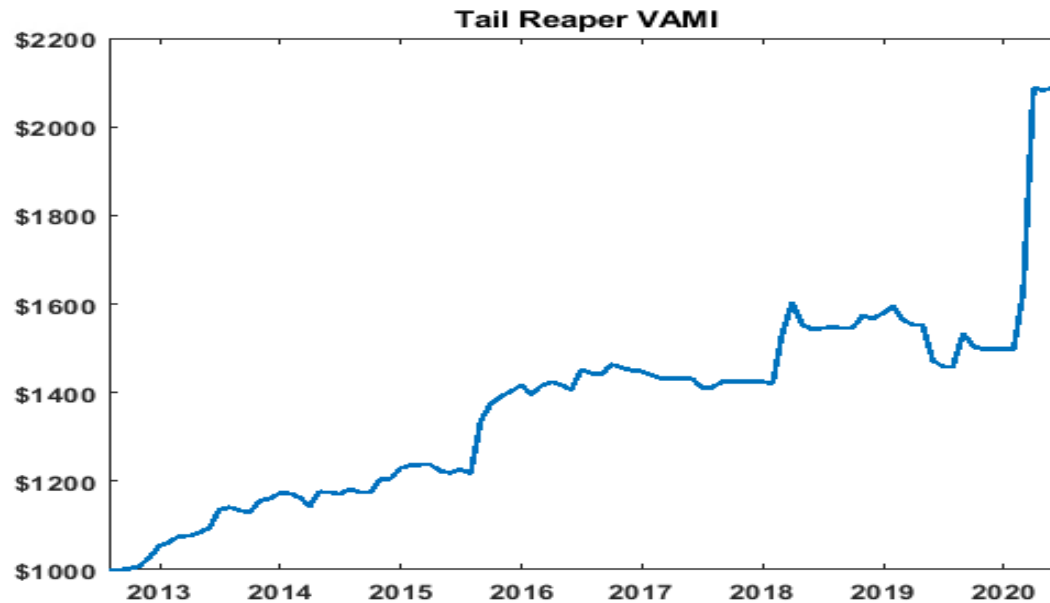
- Mark Spitznagel of Universa Capital up > 4000% in Q1.
  - But what were his returns in calmer years?



*The CBOE Eurekahedge Tail Risk Index is shown for illustrational purposes only.*

# Tail Hedge Strategies won?

- QTS Capital's Tail Reaper strategy up 80% gross in 2020 Q1, but 30% drawdown in 2020 H2.



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# Machine Learning to the Rescue

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- Machine learning can **improve *any* strategy**
  - Simple trend-following strategy like Tail Reaper
  - Factor models (avoiding value traps!)
  - Even discretionary or fundamental strategies!
- Machine learning can compute **Probability of Profit** for a trade.
  - That trade can come from any strategy, as long as it has a track record (backtest or live).
  - We reduced drawdown from 40% to 30% in 2020 H2.



# Do you know the **Probability of Profit** of Your Next Investment?

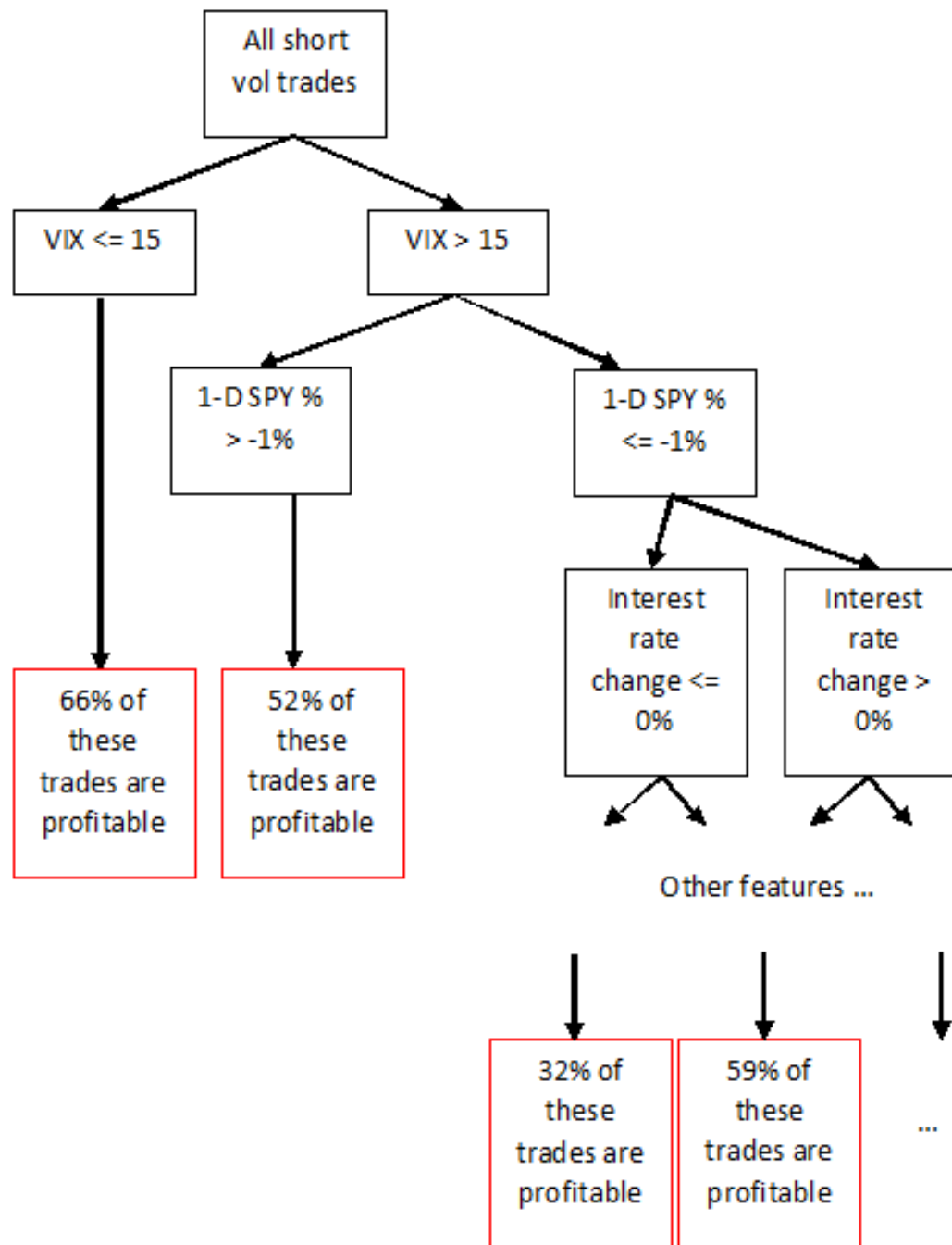
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- Any child can compute their unconditional probability of profit.
  - “Winning ratio”
  - Useless for predicting whether next trade will be profitable *conditioned on current circumstances*.
- Machine learning can compute the **conditional probability of profit**.
  - *Conditioned on a set of predictors external to base strategy.*
  - “Meta-labeling” pioneered by Dr. Marcos Lopez de Prado.

# What machine learning method to use?

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- Logistic regression?
  - Linear models can't pick up nonlinear, hierarchical co-dependence. (See next slide.)
- Deep learning (neural networks)?
  - Financial data at the daily frequency are too sparse for machine learning models with  $> 10K$  parameters.
  - GPT-3 has  $>175$  *billion* parameters.
- Random forest fits the bill.



## Input spreadsheet (for training and live trading)

	A	B	C	D	E
1	Trade ID	VIX	1-day SPY return	Change in interest rate	Return
2	1	15.6	0.01%	0%	1
3	2	14.2	0.55%	0%	0
4	3	13.4	1.10%	0%	0
5	4	17.9	-0.90%	0.25%	1
6	5	17.1	-0.50%	0%	1
7	6	19.1	-1.30%	0%	1

# Output spreadsheet: Probabilities and expected outcome

	A	B
1	pred_target	
2	1	
3		

	A	B
1	pred_probability	
2	0.57	
3		

# Performance Metrics

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```
The range of the CV set is: 2016-02-10 to 2019-01-07  
THE ACCURACY SCORE FOR CV = 0.5956284153005464  
THE F1 SCORE FOR CV = 0.7333333333333333  
THE AUC SCORE FOR CV= 0.4700473909191774
```

```
The range of the test set is: 2019-01-08 to 2019-09-27  
THE ACCURACY SCORE FOR TEST = 0.5300546448087432  
THE F1 SCORE FOR TEST = 0.5168539325842697  
THE AUC SCORE FOR TEST= 0.6176872607982504
```

# Output spreadsheet: Probabilities and expected outcome

	A	B
1	pred_target	
2	1	
3		

	A	B
1	pred_probability	
2	0.57	
3		

# Usage: Capital Allocation and Risk Management

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- If Probability of Profit of the next trade too low: can avoid entering it.
- Can scale trade size based on this Probability.
- E.g Tail Reaper did not enter a single trade Nov 2019 – Jan 2020.
  - ML did not detect tail risk.
  - Starting Feb 1, 2020, ML predicted high probability of tail movements!

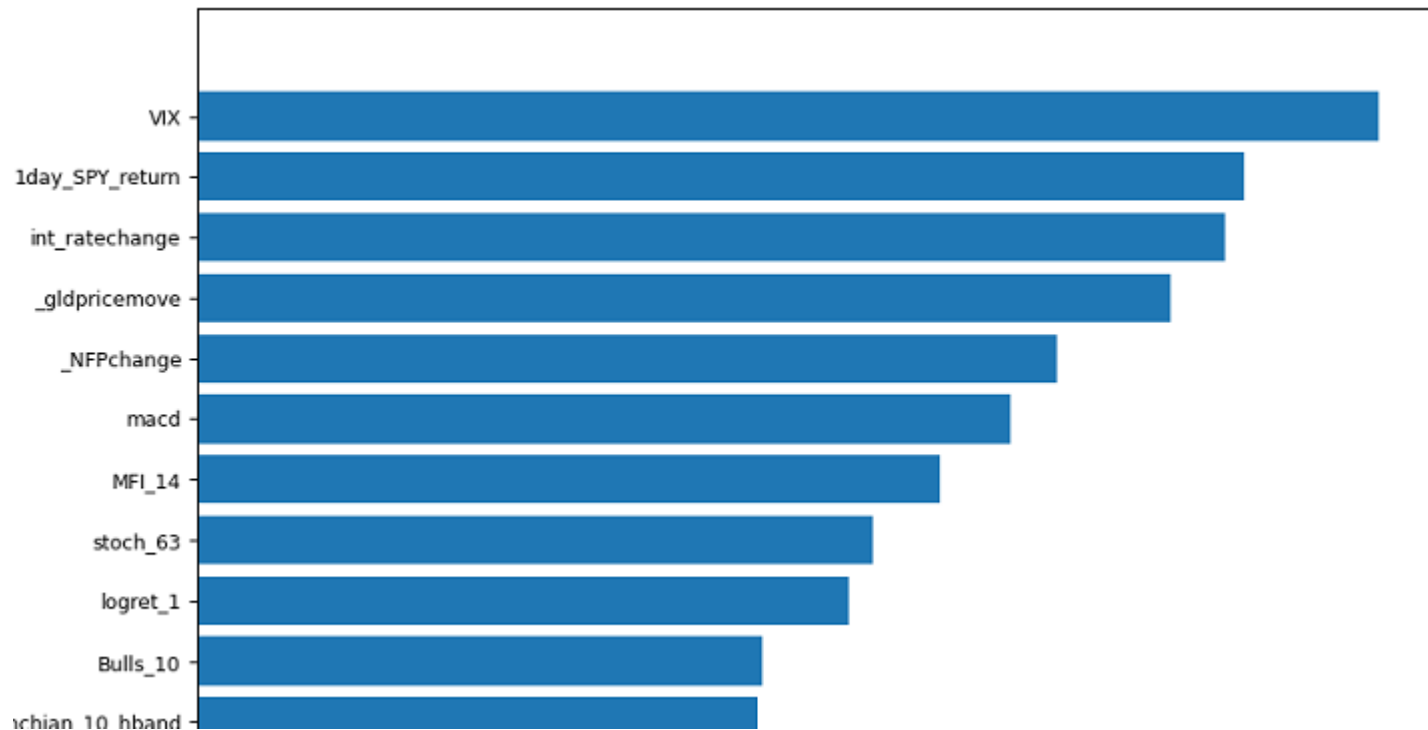


# Usage: Feature Selection

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- Fundamental or discretionary traders dislike black boxes.
- Nobody can explain precisely how ML produces Probability of Profit.
- But we can rank the features that produce this probability.

# Output feature importance rankings:



# Cluster-based Feature Selection

Topic	Cluster Scores	Features
<b>Fundamental</b>	0.667	d/p, d/y, e/p, b/m, ntis, tbl, lty, dfy, dfr, infl
<b>Technical</b>	0.333	d/e, svar, ltr, tms

# Feature Selection

- Feature selection helps improve “interpretability” of machine learning results.
- Feature selection helps traders directly incorporate features into their base strategies.
- Selecting only important features improves the calculation accuracy of machine learning model.
  - Man and Chan, “The best way to select features?” JFDS Winter, 2021.
  - Man and Chan, “Cluster-based Feature Selection” STA Journal Winter, 2021.

# Conclusions

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- Tail hedge strategies benefited from crises but lost money in calm markets.
- Machine learning (metalabeling) is designed to help reduce losses.
  - What is Probability of Profit of a trade?
- Feature selection can help traders understand what important market variables to explore.

# Thank you!

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