Case Study Proposal

Renaissance Technologies Medallion Fund

What Is It

Renaissance Technologies LLC, also known as RenTech or RenTec, is an American private hedge fund that specialized in systematic trading using quantitative models derived from mathematical and statistical analyses. It was founded in 1982 by a mathematician and code-breaker James H. Simons. It consists of three funds – Medallion Fund, Institutional Equities Fund, and Institutional Diversified Alpha. All the three funds have different returns, which implies that Renaissance Technologies uses different investment strategies for each fund. Its prime fund founded in 1988, Medallion Fund, is known for its unprecedented performance that challenges market efficiency.

Why It Matters

Over the course of 30 years, from 1988 through 2018, Medallion Fund has never had negative return. In fact, it has reportedly returned roughly 66% per year before fees. During the dot.com crash and the financial crisis, Medallion's returns were 56.6% and 74.6% respectfully. Medallion's lowest annual return was 31.5%. To put it into perspective, $100 invested in Medallion in 1988 would have grown to $398 million in 30 years.

Table 1 bellow shows Medallion's extraordinary performance over the years.

Table 1

Medallion Performance Data: 1998 to 2018

Year	Medallion Gross Return	Fixed Fee	Performance Fee	Medallion Net Return	Medallion fund size (millions)
1988	16.30%	5%	20%	9.04%	20
1989	1.00%	5%	20%	-3.20%	20
1990	77.80%	5%	20%	58.24%	30
1991	54.30%	5%	20%	39.44%	42
1992	47.00%	5%	20%	33.60%	74
1993	53.90%	5%	20%	39.12%	122
1994	93.40%	5%	20%	70.72%	276
1995	52.90%	5%	20%	38.32%	462
1996	44.40%	5%	20%	31.52%	637
1997	31.50%	5%	20%	21.20%	829
1998	57.10%	5%	20%	41.68%	1,100
1999	35.60%	5%	20%	24.48%	1,540
2000	128.10%	5%	20%	98.48%	1,900
2001	56.60%	5%	36%	33.02%	3,800
2002	51.10%	5%	44%	25.82%	5,240
2003	44.10%	5%	44%	21.90%	5,090
2004	49.50%	5%	44%	24.92%	5,200
2005	57.70%	5%	44%	29.51%	5,200
2006	84.10%	5%	44%	44.30%	5,200
2007	136.10%	5%	44%	73.42%	5,200
2008	152.10%	5%	44%	82.38%	5,200
2009	74.60%	5%	44%	38.98%	5,200
2010	57.50%	5%	44%	29.40%	10,000
2011	71.10%	5%	44%	37.02%	10,000
2012	56.80%	5%	44%	29.01%	10,000
2013	88.80%	5%	44%	46.93%	10,000
2014	75.00%	5%	44%	39.20%	9,500
2015	69.30%	5%	44%	36.01%	9,500
2016	68.60%	5%	44%	35.62%	9,500
2017	85.40%	5%	44%	45.02%	10,000
2018	76.40%	5%	44%	39.98%	10,000
Average	66.07%			39.20%	
St Dev	31.66%			20.34%	

Why This Is Interesting

- James H. Simons graduated from MIT with a Bachelor of Science in Mathematics and completed his doctoral studies in Mathematics at Berkley. Before becoming a hedge fund manager, Simons taught briefly at MIT and Harvard, worked as a code breaker for The Institute of Defense Analysis, and was head of Mathematics department at Stony Brook University. His mathematical work was primarily focused on geometry and topology. He was awarded The American Mathematical Society's Oswald Veblen prize in geometry, including Chern-Simons Theory. Although Simons had always had interest in finance, it wasn't until the age of 40 that he decided to pursue trading full time. Then he recruited one of his old code-breaking colleagues Leonard Baum to join him. Just like Simons, Baum had been credited with significant contributions to the field of mathematics. Baum had previously developed Baum-Welch algorithm, which can be used to find the unknown parameters of Hidden Markov model. This is highly relevant to trading, because financial markets can be described as chains of Hidden Markov model.

- Medallion Fund had created and cleaned massive sets of historical data to feed their models, which makes them the first quantitative investors. At the time, this meant recording data stored in written records and building data sets that could be fed into a computer. They created algorithms to identify patterns and unlike traditional investing they didn't care why these patterns were occurring. They placed frequent short-term trades augmented by lots of leverage to profit from what their models deemed to be irregularities. Their models were so successful at generating winning trades that they eliminated any human intervention, allowing trades that would make no sense to a human.

- A big breakthrough came in the early 1990s when Renaissance recruited Peter Brown and Robert Mercer, two key people from IBM's speech recognition group (speech recognition and financial markets are similarly described as chains of Hidden Markov model). Brown and Mercer developed the strategy to trade stocks, which Medallion had previously struggled with - Medallion only traded futures up to that point. Their trades won only 50.75% of the time, but that's all it takes when a fund is making millions of trades and employing leverage.

- The data suggests that Simons and his team have been able to uncover profitable patterns consistently, which should not be possible in an efficient market.

Resources:

- o "The Man Who Solved the Market" by Gregory Zuckerman
- o https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3504766 ("Medallion Fund: The Ultimate Counterexample?" by Bradford Cornell)
- o https://en.wikipedia.org/wiki/Renaissance_Technologies (Wikipedia page about Renaissance Technologies)
- o https://www.youtube.com/watch?v=hvUyuo53kQQ (YouTube video about Renaissance Technologies Medallion Fund)
- o https://en.wikipedia.org/wiki/Hidden_Markov_model (Wikipedia page about Hidden Markov model)