The Fallacy of High Frequency Attribution

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Major Point
Polite Version

- Hypothesis: Moving to higher frequency attribution will detract from rather than improve our ability to understand the strengths and weakness of our investment process. This is because our analytical statistics are based on assumptions that are only approximately true. As we increase the frequency of analysis, the quality of this approximation becomes much, much worse, invalidating the results.

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Performance Attribution versus Performance Measurement

- Performance measurement is the process of computing and reporting the observed returns on a particular investment
  - Knowledge of daily holdings and trading provides more exact measurement
- Performance attribution is the process of disentangling the observed returns so as to understand the strengths and weaknesses of our investment process. Otherwise why bother?
  - This requires understanding the statistical significance of the attributed returns. Do they arise from skill or luck?

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Fallacy #1: Distributional Assumptions

- The usual statistical procedures for analyzing the significance of investment return observations are parametric. There are numerous important assumptions
  - Investment returns are normally distributed
  - Returns are independently and identically distributed
  - There is no serial correlation in the observed return data
- These assumptions are simply not true, and the lack of truth gets worse as we shorten the time periods we observe

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A Small Sample of Hundreds of Research Studies

- Lo, Andrew W. and A. Craig MacKinlay. "Stock Market Prices Do Not Follow Random Walks: Evidence From A Simple Specification Test," Review of Financial Studies, 1988, v1(1), 41-66.
- LeBaron, Blake. "Some Relations Between Volatility And Serial Correlations In Stock Market Returns," Journal of Business, 1992, v65(2), 199-220.
- Corhay, A. and A. Tourani Rad. "Statistical Properties Of Daily Returns: Evidence From European Stock Markets," Journal of Business Finance and Accounting, 1994, v21(2), 271-282.
- Hinich, Melvin J. and Douglas M. Patterson. "Evidence Of Nonlinearity In Daily Stock Returns," Journal of Business and Economic Statistics, 1985, v3(1), 69-77.
- Morse, Dale. "An Econometric Analysis Of The Choice Of Daily Versus Monthly Returns In Tests Of Information Content," Journal of Accounting Research, 1984, v22(2), 605-623.
- Tucker, Alan L. "A Reexamination Of Finite- And Infinte-Variance Distributions As Models Of Daily Stock Returns," Journal of Business and Economic Statistics, 1992, v10(1), 83-82.
- Lau, Hon-Shiang and John R. Wingender. "The Analytics Of The Intervaling Effect On Skewness And Kurtosis Of Stock Returns," Financial Review, 1989, v24(2), 215-234.
- Watanabe, Toshiaki. "Excess Kurtosis Of Conditional Distribution For Daily Stock Returns: The Case Of Japan," Applied Economics Letters, 2000, v7(6,Jun), 353-355.
- Lamoureux, Christopher G. and William D. Lastrapes. "Heteroskedasticity In Stock Return Data: Volume Versus GARCH Effects," Journal of Finance, 1990, v45(1), 221-230.
- Brooks, Robert D., Robert W. Faff and Tim R. L. Fry. "GARCH Modelling Of Individual Stock Data: The Impact Of Censoring, Firm Size And Trading Volume," Journal of International Financial Markets, Institutions and Money, 2001, v11(2,Jun), 215-222.

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The Results

- Security return distributions have kurtosis. Big stuff happens more frequently than it should according to our assumptions
- Distributions are heteroskedastic. Both time series and cross sectional volatility levels vary through time.
- Returns in one period are not independent of returns in other periods. This is a necessary but sufficient assertion for active management. We cannot simultaneously assume relationships for portfolio management, and then attribute the returns achieved assuming the opposite. You can have it one way or the other, you can't have both.
- At monthly intervals, the imperfections of our assumptions are small. **With daily returns, we must consistently reject our assumptions**
- Anyone remember the difference between Type 1 and Type 2 errors?

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What's the Problem with Daily Returns

- Financial markets are driven by the arrival of information in the form of "news" (truly unanticipated) and the form of "announcements" that are anticipated with respect to time but not with respect to content.

- The time intervals it takes markets to absorb and adjust to new information ranges from minutes to days. Generally much smaller than a month, but up to and often larger than a day. That's why markets were closed for a week at September 11th.

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Volatility Estimates on an Airline Portfolio

- 42 stocks, capitalization weighted
- 9/10, 9/17,11/30 Some Key Dates
- 589, 2755, 1145 Factor Variance
- 98, 161, 177 Specific Variance
- 26, 54, 35 Total Risk

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Driven by Noise?

	31 August	30 September
P&C Insurance	13.04	16.87
Manufacturing	20.88	19.38
Foods	11.56	11.31

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More Reading

- Ederington and Lee, “Creation and Resolution of Market Uncertainty: The Importance of Information Releases, Journal of Financial and Quantitative Analysis, 1996
- Kwag, Shrieves and Wansley, “Partially Anticipated Events: An Application to Dividend Announcements”, University of Tennessee Working Paper, March 2000
- Abraham and Taylor, “Pricing Currency Options with Scheduled and Unscheduled Announcement Effects on Volatility”, Managerial and Decision Science 1993

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Possible Fixes

- Failures of cross-sectional distribution assumptions can be dealt through use of non-parametric statistical tests. For example use the Komolgorov-Smirnoff Type 2 test in place of T statistics
- Model the time series problems as n-dimensional multivariate GARCH problems
- Use event study methods instead of typical longitudinal statistics
- Unless you have two math PhDs, don't try this at home

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But Doesn't Daily Allow You to Capture "Event-Driven" Factors?

- Some people would argue that daily attribution allows the estimation of "event-driven" factors such as earnings surprises
- Jones, Charles M., Owen Lamont and Robin L. Lumsdaine. "Macroeconomic News And Bond Market Volatility," Journal of Financial Economics, 1998, v47(3,Mar), 315-337.
  - Treasury markets have nearly no transaction costs
  - Traders can and do make daily "bets"
  - Stock market transaction costs are much higher so better information even if you get it may not be actionable

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More on Event Factors

- The other problem:
  - If the event is wholly unanticipated you don't have a factor for it in your model by definition
  - If the event is partially anticipated, market participants behavior is effected on the days prior to the event
  - Most anticipated events such as government announcements, statistical releases and Fed meetings are either on a monthly schedule or ad hoc but less frequent. Corporate earnings announcements are quarterly.
- By controlling for event factors, you may get a better estimate of return to other non-event factors but trading costs are way too high to allow for daily shifting of growth/value bets

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Fallacy #2: The Assumption of Independent Observations

- When we do statistical analysis one of the most basic assumptions is that different observations represent independent events
- Consider a dead portfolio manager
  - Invests his portfolio in large cap growth stocks, January 1, 1990, then dies.
  - We perform attribution at December 31, 1995.
  - How many observations of management skill do we have?
- Thanks to Evan Shulman, Santa Fe, 1994

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Fallacy #2 Continues

- In a world where transactions costs are non-zero, this is a ridiculous assumption. It is saying that we start our investment portfolios fresh everyday.
  - Maybe we can argue that what we hold now is independent of what we held a year ago (transaction costs are usually small compared to annual returns)
  - For monthly returns the assumption gets weaker
  - For daily returns its silly. Can we believe that we hold today is unrelated to what we held yesterday?
- In the real world, there are limits on turnover and possibly taxes on realization of gains. Serious path dependence! Independence assumption is clearly rejected

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Fallacy #3: Microstructure Doesn't Count

- Microstructure effects are small relative to typical monthly returns but large compared to typical daily returns
  - Bid / Asked Bounce
  - Non synchronous trading
  - Painting the tape
- Many microstructure effects are controlled by portfolio personnel and hence can be gamed

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Even More Reading

- Gosnell, Thomas F., Arthur J. Keown and John M. Pinkerton. "The Intraday Speed Of Stock Price Adjustment To Major Dividend Changes: Bid-Ask Bounce And Order Flow Imbalances," Journal of Banking and Finance, 1996, v20(2,Mar), 247-266.
- Chu, Quentin C., David K. Ding and C. S. Pyun. "Bid-Ask Bounce And Spreads In The Foreign Exchange Futures Market," Review of Quantitative Finance and Accounting, 1996, v6(1,Jan), 19-37.
- Perry, Philip R. "Portfolio Serial Correlation And Nonsynchronous Trading," Journal of Financial and Quantitative Analysis, 1985, v20(4), 517-523.
- Wood, Robert A. and Thomas H. McInish. "Bias From Nonsynchronous Trading In Tests Of The Levhari-Levi Hypothesis," Review of Economics and Statistics, 1985, v67(2), 346-351.
- Shanken, Jay. "Nonsynchronous Data And The Covariance-Factor Structure Of Returns," Journal of Finance, 1987, v42(2), 221-231.

Fallacy #4: The Cross-Product Problem is Solved

- Numerous papers have been written on how to mathematically transform interaction effects between factors in attribution to minimize value of cross-products as compared to the value of products. All are approximate methods
- As the number periods increases, these methods becoming increasingly approximate
- See the technical appendix to chapter 17, *Active Portfolio Management*, Grinold & Kahn, 2nd Edition, McGraw-Hill, New York, 1999

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Fallacy #5: High Frequency Attribution is Relevant to Investors

- Investors invest to accumulate wealth. The standard expression of investor utility is the mean variance utility function
  - Levy, H. and H. M. Markowitz. "Approximating Expected Utility By A Function Of Mean And Variance," American Economic Review, 1979, v69(3), 308-317

- The Levy-Markowitz function is a single period model. The future is one long period. If we impose discrete time all the math has to be redone
  - Introduction to Mathematical Finance: Discrete Time Models. Stanley Pliska, Blackwell Publishers, Oxford UK, 1997
  - Performance measures such as alpha, Sharpe ratio, etc. all have to be redefined. Shouldn't someone tell portfolio managers, we've changed all the rules

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Conclusions

- Daily performance attribution accumulates values more closely to correct measurements of performance, but at a tremendous cost in the ability to judge the statistical significance of the results
- Most of the imperfections of daily attributions result in upward biased estimates of manager skill, leading to persistent Type 1 errors. Such errors are typically much more costly in economic terms than Type 2 errors.

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