On statistical surveillance of the performance of fund managers

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1 Aim

The aim of this report is to describe if and how statistical surveillance methods for monitoring of the performance of fund managers has been used. Statistical surveillance is a methodology for on-line monitoring, in which a warning signal is given if the performance declines. Since these methods are advanced you can expect the methods to be described in scientific literature.

Problems in this area which will not be treated in this report are:
1. Estimation of the performance.
2. Hypothesis testing of if this manager always have a poor performance.
3. Examination of how managers are influenced by being evaluated.

2 Databases searched

The databases which we used to find literature on statistical surveillance methods for monitoring of the performance of fund managers were
1. Web of Knowledge, including
    a. Web of Science
    b. Scientific Citation
2. Google Scholar

The Web of Knowledge was chosen since it is limited to papers in journals with high impact and thus we can avoid large numbers of technical reports, master theses and similar work. The Google Scholar was chosen since it includes journals of lower scientific impact such as the Financial Review, apart from the high-impact journals. In case the number of hits was large, the search was narrowed down to only include economics. Some searches in Google Scholar still gave too many hits to be useful. In these cases only Web of Knowledge was used. In some cases quotation marks was used to focus on exact phrases and stars as a wildcard character, which gives a match to any character, e.g. manager* matches both manager and managers. .

These databases cover (among much else) the following set of journals, which were considered to be of main interest:

Journal of finance
Journal of Economic Theory
Journal of Financial Economics
Journal of Financial and Quantitative Analysis
Journal of Financial Research
Review of Financial Studies
Journal of Portfolio Management

European financial management
Journal of empirical finance
Journal of financial market
American economic review
Journal of political economy
International journal of management reviews

Google Scholar also covers Financial Review.

3 Search expressions

In the databases we searched for articles which included important combinations of words. The search result from Web of Science is limited to words appearing in the title, abstract or keywords, while Google Scholar searches the entire text of the article. We combined words which indicate the statistical method with words indicating the financial problem. In addition to this, the reference lists of seemingly interesting articles were checked for additional results.

The following words or expressions indicating fund managers performance were used:
A. Fund performance
B. Fund manager
C. Manager performance
D. Performance attribution
E. Active manager
F. Performance evaluation was suggested but found to be too generic to be useful.

The following words or expressions indicating statistical surveillance were used:
1. Surveillance
2. Monitoring
3. Change point
4. Stopping rule
5. CUSUM

All combinations with one search expression from each of the groups were tried. The number of hits is indicated in the report of results in Section 4.3. Also other expressions were discussed, but were not searched for.

4 Results

4.1 *Publications on the target subject*

One journal article and one book chapter on statistical surveillance of manager skills were found in several of the searches e.g. by the search words "Fund performance" and "CUSUM".
1. Yashchin, E Philips, TK and Stein DM (1997). Monitoring active portfolios using statistical process control. In *Computational approaches to economic problems. Selected papers from the 1st conference of the Society for Computational Economic*

a. **Abstract:** We consider the problem of estimating the performance of a portfolio via an on-line algorithm; i.e. the return of the portfolio is measured at regular (typically monthly) intervals, and every time a new return for the portfolio is received, the estimate of the portfolio's current performance is updated. An alarm is raised when sufficient statistical evidence accrues to determine that the portfolio is not meeting some prespecified criterion of satisfactory performance.

b. **Comments**: In Yashchin, Philips and Stein (1997) a statistically qualified analysis is made. The minimax optimal CUSUM method is used. The first author is an expert on statistical surveillance and the others are financial managers.

2. Philips, TK, Yashchin, E and Stein DM (2003) Using Statistical Process Control to Monitor Active Managers. *Journal of Portfolio Management, 30, 86-95.*

a. **Abstract:** Investors and chief investment officers who are invested in (or bear responsibility for) many products face a resource allocation problem. Which products deserve their attention and scrutiny? Ideally investors will focus on products that appear to be in trouble, but these are not easily identified using the classic methods of performance evaluation. In fact, it is often claimed that it takes 40 years to determine whether an active portfolio outperforms its benchmark. The authors demonstrate that a statistical process control scheme known as the CUSUM can be used to detect flat-to-the-benchmark performance in 40 months, and to detect underperformance faster still. By rapidly detecting underperformance, the CUSUM allows investors and CIOs to focus their attention on potential problems before they have a serious impact on the performance of the overall portfolio. The CUSUM procedure is provably optimal; for any given rate of false alarms, no other procedure can detect underperformance as quickly. It is robust to the distribution of excess returns, allowing its use in almost any asset class without modification.

b. **Comments:** Details of how to apply the method by Yashchin et al. (1997) are given and there is a detailed example.

4.1.1 References to the target publications

To investigate if the results in the target publications, described above, had been further used we searched for references to them. Four references were found to Philips, Yashchin and Stein (2003). All these citations discussed the statistical issues but none discussed the performance of managers. We found 6 references to Yashchin et al. (1997) but except Philips et al. (2003) none concerned the target subject. A working paper by Bolster, diBartolomeo and Warrick (2006) used CUSUM and concerned the performance of managers. However, CUSUM was not used as a surveillance method but as an intermediate tool to construct a measure of skill. It is interesting to see that it is stated that a possible decline of skill is of great interest. In Philips et al. (2003) it is claimed that the CUSUM procedure is "currently being used by plan sponsors, consultants and money managers on three continents to monitor over $500 billion". This is not documented by any reference but refers probably to the authors own use.

4.2 *Target aim - but neglect of statistical surveillance theory*

Since very few positive hits were found, we will also discuss two papers with the target aim but where statistical surveillance is not used. This is to give a full picture of how the problem can be treated.

1. Dimson E, Jackson A (2001) High-Frequency Performance Monitoring. Journal of Portfolio Management.

   a. **Abstract:** Improvements in technology and increasing emphasis on performance have led many investors to monitor the performance of fund managers on a high-frequency basis: quarterly, monthly, or more frequently. The authors examine the impact that frequency of performance measurement has on the probability distribution of observed outcomes. With more frequent monitoring of rolling returns, there is a greatly increased probability of observing seemingly extreme observations. The authors demonstrate that if performance is appraised by focusing on returns to date, it is important to adjust the definition of extreme performance for the frequency with which returns are monitored. Failure to do so may lead to costly actions such as strategy revisions or manager terminations, which increase transaction costs and have detrimental effects on manager incentives.

   b. **Comments:** This paper state the target aim but the theory of statistical surveillance is not used and the conclusion are affected by this neglect. Dimson and Jackson (2001) warn against frequent monitoring on the grounds of the fact that it results in "a greatly increased probability of observing seemingly extreme results" and thus have "detrimental effects on manager incentives." The statements are supported by simple calculations and many simple graphs. However, the conclusions are only true for the method discussed, (moving average with a fixed alarm limit) and not for statistical surveillance methods with controlled properties.

2. Dangl, T., Wu, Y., and Zechner, J. (2008). Market Discipline and Internal Governance in the Mutual Fund Industry. Review of Financial Studies 21, 2307-2343.

   a. **Abstract:** We develop a continuous-time model in which a portfolio manager is hired by a management company. On the basis of observed portfolio returns, all agents update their beliefs about the manager's skills. In response, investors can move capital into or out of the mutual fund, and the management company can fire the manager. Introducing firing rationalizes several empirically documented findings, such as the positive relation between manager tenure and fund size or the increase of portfolio risk before a manager replacement and the following risk decrease. The analysis predicts that the critical performance threshold that triggers firing increases significantly over a manager's tenure and that management replacements are accompanied by capital inflows when a young manager is replaced but may be accompanied by capital outflows when a manager with a long tenure is fired. Our model yields much lower valuation levels for management companies than simple applications of discounted cash

flow (DCF) methods and is thus more consistent with empirical observations.

b. **Comments:** This paper has a very wide aim and discusses many aspects. The problem of when to fire a manager is treated as an optimization problem rather than surveillance. Within the model the optimal time of firing a manager is derived. The model developed is motivated by empirical findings from other papers. There is no empirical evidence for the predictions of optimal manager replacement. The evaluation measures and optimality criteria which are important for statistical surveillance are not considered.

    i. In Section 1.2 they make specifications about their model for managerial ability. It is assumed that the model and its parameters are completely known - even the true expected market return. The only exception is the parameter which represents the true managerial ability at time t, θ_t. The posterior distribution of θ_t is thus a known function of the observed returns. The robustness of the method can be doubted since the model plays such an important role.

    ii. In Section 2 they suggest that their model is used for giving a manager replacement signal. The monitoring method uses a threshold for the posterior mean , a_t, of θ_t.

    iii. Based on the posterior distribution, they decide between two states (skill bad and replacement of the manager motivated or not). This means that the likelihood ratio is used, which is also the case in statistical surveillance. However, they use the likelihood within a Bayesian framework where all information is assumed to be given by the posterior distribution and no (frequentistic) error rates are of use (see the next point).

    iv. The only evaluation of their method we found is that it is considered consistent with empirical observations. We did not find any information on how often the method would give a too early (false) alarm and the manager is fired in spite of a good skill. Neither is there any information on how long the expected delay of a signal would be if the skill of the manager declines. The predictive value, which is the probability that the skill is bad when a signal is given, would also have been of interest. The relation between the posterior distribution and the predicted value is not simple at active surveillance where a signal has effect on the future process.

    v. There is an important difference between a single decision and a sequence of decisions. At a single decision the posterior distribution might give sufficient information. For a sequence of decisions, characteristics of the sequence, such as those mentioned above the, are of interest.

4.3 *Negative searches*

Searches for the following combinations of search words were made without any additional relevant papers found.

Negative hits in Web of Sience:

Search Words	Hits	Search Words	Hits
fund performance cusum	0	portfolio performance Monitoring	27
fund performance Surveillance	5	portfolio performance stopping	3
fund performance change point	1	portfolio performance surveillance	3
fund performance stopping	1	portfolio performance change point	1
Performance attribution surveillance	2	portfolio performance cusum	3
Performance attribution monitoring	35	investment performance cusum	1
Performance attribution change point	4	investment performance surveillance	18
Performance attribution stopping	1	investment performance stopping	6
Performance attribution cusum	0	investment performance change point	22
Fund manager cusum	0	investment performance monitoring	90
Fund manager surveillance	1	asset management monitoring	21
Fund manager change point	0	asset management stopping	5
Fund manager stopping	0	asset management surveillance	18
Fund manager monitoring	8	asset management change point	5
manager performance surveillance	18	asset management cusum	0
manager performance stopping	10	mutual fund cusum	0
manager performance change point	13	mutual fund surveillance	1
manager performance monitoring	167	mutual fund change point	1
manager performance cusum	2	mutual fund stopping	1
performance evaluation cusum	29	mutual fund monitoring	7
performance evaluation surveillance	44	portfolio return Monitoring	12
performance evaluation stopping	122	portfolio return surveillance	1
performance evaluation change point	95	portfolio return stopping	3
performance evaluation monitoring	278	portfolio return change point	0
active manager* monitoring	107	portfolio return cusum	0
active manager* change point	12	fund manager benchmark	17
active manager* cusum	1		
active manager* stopping	0		

Negative hits in Google Scholar:

Search Words	Hits	Search Words	Hits
active manager "stopping rule"	1	"Performance attribution" "stopping rule"	1
active manager "change point"	4	"Performance attribution" monitoring	201
"active manager" surveillance	32	"Performance attribution" surveillance	21
"performance evaluation" "change point"	42	"Performance attribution" cusum	4
"performance evaluation" cusum.	53	"manager performance" "change point"	6
"performance evaluation" "stopping rule"	48	"manager performance" "stopping rule"	0
"Fund performance" "change point"	39	"manager performance" cusum	9
"Fund performance" "stopping rule"	2	"Fund manager" "change point"	19
"Fund performance" surveillance	163	"Fund manager" "stopping rule"	7
"Performance attribution" "change point"	1	"Fund manager" cusum	19

5 Conclusions and further suggestions

While mathematics and probability theory have been of extensive use in finance for the two last decades, the statistical technique of surveillance has only been used sparsely for financial problems (see e.g. Frisén (2007)). The conclusion from this investigation is that it is seldom used in the area of performance of fund managers. One reason for this might be that surveillance is a relatively new area in statistics. A search on the Web of Science for the number of papers with titles containing "surveillance" or "quality control" reveals that in 1992 it was the same number. However, while the latter category has a nearly constant number during the period 1992–2007, the former has increased substantially (by more than 300 percent).
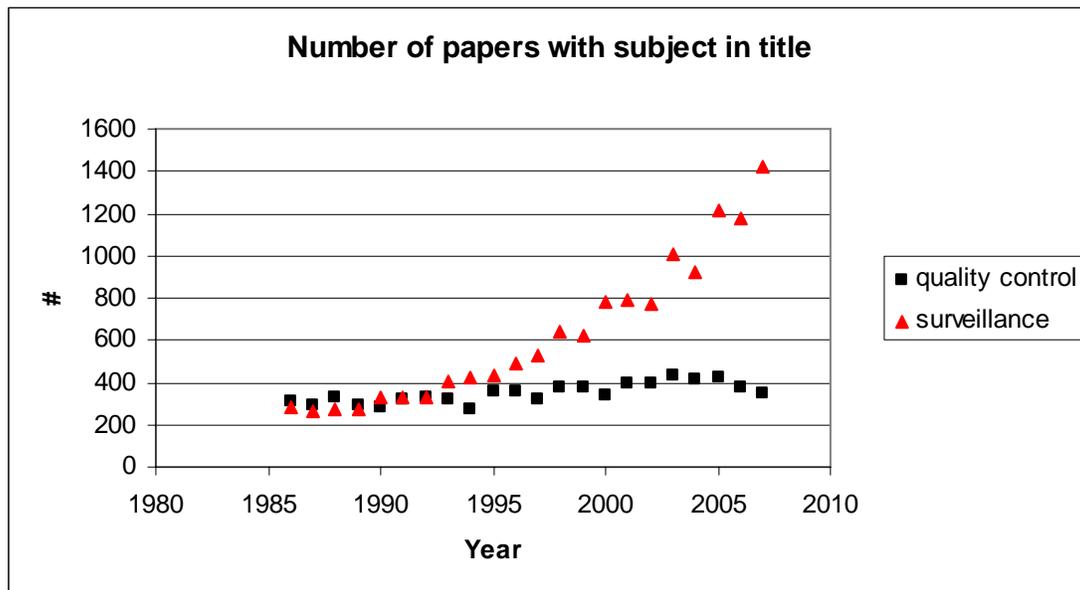
The predominant method in literature seems to be to use some financial performance measure, without considering the sequential nature of the problem. The two examples, described in Section 4.2, of papers there the aim is monitoring but there the theory of statistical surveillance is not used are quite different. One concerns an ad hoc method and the calculations are simple. The other is a mathematically advanced method and probability theory is used extensively. What is common to them is that they neglect that the theory of statistical surveillance gives optimality criteria and evaluation measures which are guides of how to make sound inference in a system of decisions.

A future project might investigate how the theory of statistical surveillance can be used to construct an optimal method for monitoring of fund managers. Starting from the papers by Yashchin et al. (1997) and Philips et al. (2003) we might investigate if the problem formulation and financial measures in that paper are the most relevant. They monitor a step change of the skill while it might be more relevant to monitor for a monotone decline of performance. Semiparametric methods for changes in monotonicity are found in e.g. Andersson, Bock and Frisén (2005) and Frisén, Andersson and Schiöler (2008). While Yashchin et al. (1997) and Philips et al. (2003) concentrate on the average run length and the CUSUM method which is minimax optimal other methods with other

optimality properties and evaluation measures (see Frisén (2003) and Frisén (2008a))might be of interest. Multivariate surveillance of the components of the portfolio might also be of interest. For such methods, see e.g. Frisén (2008b) and Andersson (2008).

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References

Andersson, E. (2008). Effect of dependency in systems for multivariate surveillance. *Communications in Statistics -Theory and Methods*, in press.

Andersson, E., Bock, D., and Frisén, M. (2005). Statistical Surveillance of Cyclical Processes with Application to Turns in Business Cycles. *Journal of Forecasting* **24**, 465-490.

Bolster, P., diBartolomeo, D., and Warrick, S. (2006). Forecasting Relative Performance of Active Managers.

Dimson, E., and Jackson, A. (2001). High-Frequency Performance Monitoring. *Journal of Portfolio Management* **28**, 33-43.

Frisén, M. (2003). Statistical surveillance. Optimality and methods. *International Statistical Review* **71**, 403-434.

Frisén, M. (ed) (2007). *Financial Surveillance*. Chichester: Wiley.

Frisén, M. (2008a). Optimal sequential surveillance for finance, public health and other areas. Editor's special invited paper. . *Sequential Analysis*, in press.

Frisén, M. (2008b). Principles for Multivariate Surveillance. In *Frontiers in Statistical Quality Control*, H.-J. Lenz, and P.-T. Wilrich (eds), to appear.

Frisén, M., Andersson, E., and Schiöler, L. (2008). Robust outbreak surveillance of epidemics in Sweden. . *Statistics in Medicine*, in press.

Philips, T. K., Yashchin, E., and Stein, D. M. (2003). Using Statistical Process Control to Monitor Active Managers. *Journal of Portfolio Management* **30**, 86.

Yashchin, E., Philips, T. K., and Stein, D. M. (1997). Monitoring active portfolios using statistical process control. In *Computational approaches to economic problems. Selected papers from the 1st conference of the Society for Computational Economics*, H. e. a. Amman (ed): Dordrecht: Kluwer Academic Publishers.

Research Report

2007:4	Frisén, M.:	Principles for Multivariate Surveillance.
2007:5	Andersson, E., Bock, D. & Frisén, M.:	Modeling influenza incidence for the purpose of on-line monitoring.
2007:6	Bock, D., Andersson, E. & Frisén, M.:	Statistical Surveillance of Epidemics: Peak Detection of Influenza in Sweden.
2007:7	Andersson, E., Kühlmann-Berenzon, S., Linde, A., Schiöler, L., Rubinova, S. & Frisén, M.:	Predictions by early indicators of the time and height of yearly influenza outbreaks in Sweden.
2007:8	Bock, D., Andersson, E. & Frisén, M.:	Similarities and differences between statistical surveillance and certain decision rules in finance.
2007:9	Bock, D.:	Evaluations of likelihood based surveillance of volatility.
2007:10	Bock, D. & Pettersson, K.	Explorative analysis of spatial aspects on the Swedish influenza data.
2007:11	Frisén, M. & Andersson, E.	Semiparametric surveillance of outbreaks.
2007:12	Frisén, M., Andersson, E. & Schiöler, L.	Robust outbreak surveillance of epidemics in Sweden.
2007:13	Frisén, M., Andersson, E. & Pettersson, K.	Semiparametric estimation of outbreak regression.
2007:14	Pettersson, K.	Unimodal regression in the two-parameter exponential family with constant or known dispersion parameter.
2007:15	Pettersson, K.	On curve estimation under order restrictions.
2008:1	Frisén, M.	Introduction to financial surveillance.
2008:2	Jonsson, R.	When does Heckman's two-step procedure for censored data work and when does it not?
2008:3	Andersson, E.	Hotelling´s T2 Method in Multivariate On-Line Surveillance. On the Delay of an Alarm.