Axioma Research Paper
No. 006

July, 2008

Risk Model Reliability: Daily vs. Monthly Re-Estimation

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Research demonstrates significant risk model errors are likely when risk models are not up-to-date.

Risk Model Reliability: Daily vs. Monthly Re-Estimation
Significant Risk Model Errors Are Likely When Risk Models Are Not Up-To-Date

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November 8, 2007

Introduction

Intuition tells us that up-to-date risk models should be more reliable than stale risk models. This intuition is correct. According to research conducted by Axioma, there is a 20% chance that a stale risk model will mis-estimate risk by at least 1% for models 20 days out of date, and a 10% chance for models 10 days out of date.

The more up-to-date a risk model is, the better it will be at correctly attributing market movements to the various factors underlying the risk predictions. This improves the data and analyses portfolio managers have available to respond to the market movements, whether they be corporate actions, routine changes, or times of market stress.

Historically, computational resources and the availability of the necessary underlying data forced commercial risk model vendors to update their models monthly. As these limitations have eased, commercial risk models have been updated more frequently. Axioma, for example, re-estimates and updates its ***entire*** U.S. equity risk model (covariances, exposures, and specific risks), as well as detailed asset data, at the close of every trading day.

There are three reasons why Axioma re-estimates the entire risk model daily, and why we advise our clients to use the most recent day's risk model data:

1. As analyzed below, one can expect improved risk forecasts, particularly with more concentrated portfolios.
2. If your *portfolio* or your *benchmark* contains one or two corporate actions that occurred on the prior day, your risk estimates can be seriously wrong if you are using a stale risk model.

3. Daily model updates generate useful daily factor returns and correlations. In the case of the August market turmoil, such high-resolution data can be valuable for monitoring and deciphering day-to-day market movements that monthly models miss entirely.

Risk Error Driven by Corporate Actions

What kinds of differences can one expect between a "*current*" risk model and a "*stale*" one, meaning, for example, a risk model that is two weeks or a full month old? One approach is to assess the "***worst-case" volatility difference***: what is the maximum change in any asset's predicted volatility over a given time window? Worst-case volatility differences are driven by corporate actions such as mergers, acquisitions, spin offs, and accounting restatements that cause discontinuous, one-time changes in asset risk exposures (value, growth, industry classification, and the like). These changes in risk exposure can greatly alter an asset's risk prediction.

Table 1 below lists the worst-case difference between *current* and *stale* risk models for assets over the last 12+ calendar years. The results are for a stale risk model that is 10 trading days old., This represents the average lag for a risk model that is updated monthly. These cases were identified by reviewing the asset volatility predicted for all assets in Axioma's US risk model from 1995 through 2007.

Year	Issuer	Ann. Vol.
1995	LIN BROADCASTING	110%
1996	CAM-NET COMMUNIC	151%
1997	RDM SPORTS GROUP	138%
1998	BANC COM POR SP ADR	181%
1999	BLOUNT INTL-B	145%
2000	RALSTON-RALSTON-WI	192%
2001	MS EMG MARKETS FD	154%
2002	SUPREMA SPECIALTIES	192%
2003	PCCW 200	239%
2004	AU OPT SP ADR TEMP	244%
2005	UNITED UTILITIES	215%
2006	ROYAL BANK CANADA	119%
2007	EXLSERVICE HLDG	165%

Table 1. Maximum asset annual volatility changes over a 10 trading day time difference in Axioma's US risk model, broken down by calendar year.

These worst-case differences are all large. Clearly, if one of your important holdings or a benchmark constituent has experienced a corporate action that could change its predicted risk, updating your risk model promptly is necessary for reliable risk management.

Typical Errors in Managed Portfolios

Although the worst-case errors provide an upper bound to the error caused by *stale* risk models, typical stale risk model errors are not as dramatic. A more useful metric for portfolio managers is ***"typical" volatility difference***: what is the typical change in a portfolio's predicted volatility over two weeks or one month? To answer this question, we consider an equal-weighted portfolio of 100 assets drawn from the constituents of a specified benchmark. For each risk model date from 1995 to 2007, we randomly construct 1,000,000 portfolios and compute their predicted risk using Axioma's *current* and *stale* risk models.

Figure 1 below shows the aggregated cumulative probability of ***total*** risk prediction error (*current* model prediction minus *stale* prediction) for the S&P 500 (red) and the Russell 3000 (blue) benchmarks. The solid curves are for stale risk models 10 days out of date; the dashed lines are for stale risk models 20 days out of date. The curves indicate that the *stale* risk model

will ***over-estimate*** risk by 0.5% (10 days) to 1% (20 days) or more, approximately 10% of the time (the left tail of the graph showing negative risk model error), and will ***under-estimate*** risk by 0.5% (10 days) to 1% (20 days) or more, approximately 10% of the time (the right tail showing positive risk model error). In other words, there is a 20% chance that a *20 day stale* risk model will mis-estimate risk by an absolute value of at 1%; and a 10% chance that a risk model 10 days stale will misestimate risk by at least 1%.

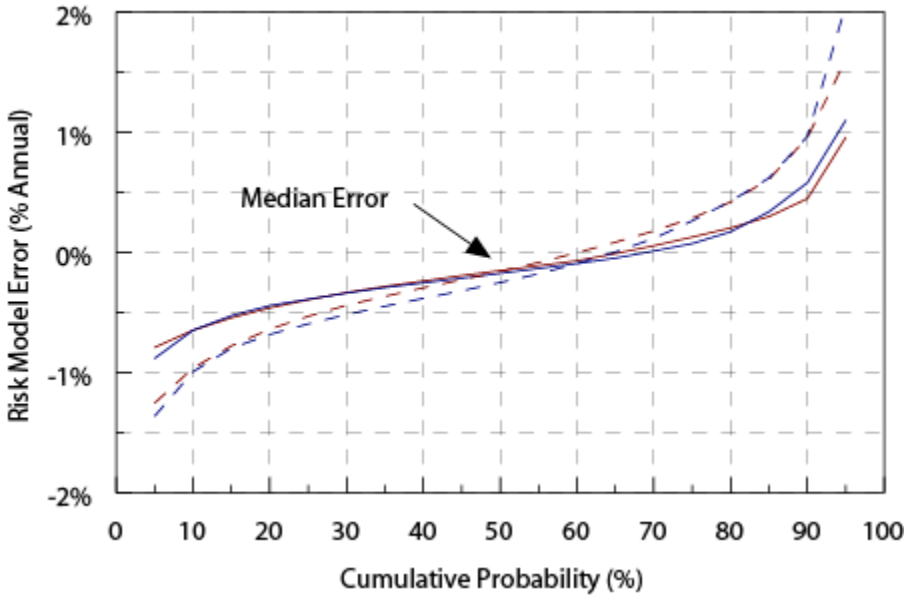

Figure 1. Error in Total Risk - Cumulative probability of stale risk model error (% annual) for random, equal-weighted portfolios of 100 securities drawn from the S&P 500 (red) and Russell 3000 (blue). Solid curves are for stale risk models 10 days old; dashed lines are for models 20 days old.

The median errors are indicated by the 50% cumulative probability values, which are approximately 0.15 to 0.2%. On average, the error produced by stale risk models is modest. However, the likelihood of substantial stale risk model error (say, greater than 1%) is surprisingly high, occurring several days a month on average.

The results in Figure 1 show the error in total portfolio risk. Figure 2 below gives comparable results for ***active*** risk, where the current benchmark weights are used in both cases.

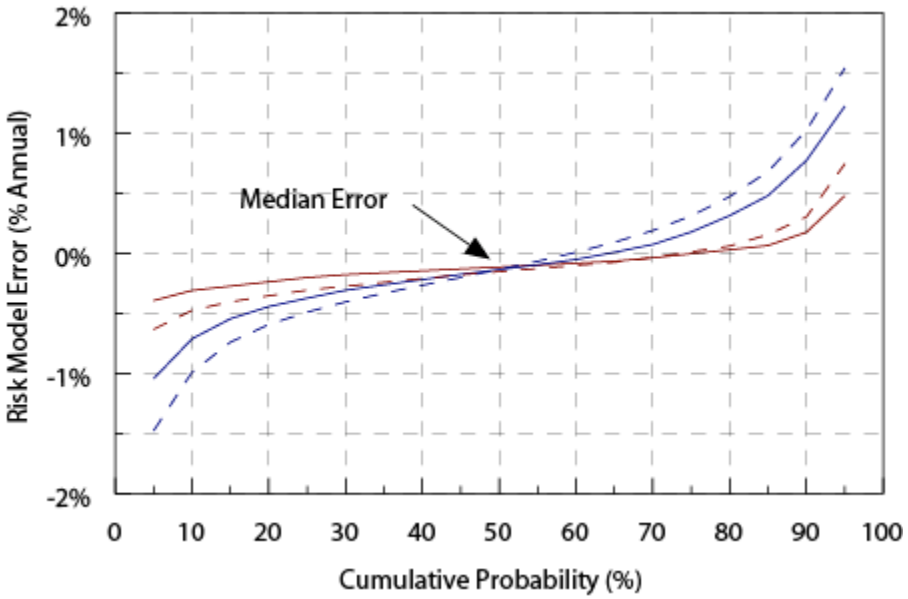

Figure 2. Error in Active Risk - Cumulative probability of stale ***active*** risk model error (% annual) for random, equal-weighted portfolios of 100 securities drawn from the S&P 500 (red) and Russell 3000 (blue). The current benchmark weights are used in for both risk estimates. Solid curves are for stale risk models 10 days old; dashed lines are for models 20 days old.

These results confirm that more concentrated portfolios (relative to the benchmark) stand a greater chance of being *different* from their benchmark (for example, lacking a corporate action that *is* in the benchmark), thus leading to relatively large active risk errors. The likelihood of error is less for the S&P 500: 20% of the time, the absolute error of the S&P 500 volatility is greater than 0.2% (10 days) or 0.4% (20 days). For the Russell 3000, the absolute volatility difference is 0.7% (10 days) or 1% (20 days) approximately 20% of the time. The errors are nearly as likely to over-estimate risk as under-estimate it, so the median volatility difference is, once again, modest. Nevertheless, significant volatility errors are surprisingly likely.

Monitoring and Responding to Market Conditions

Daily risk models allow portfolio managers to monitor and diagnose day-to-day market movements and respond to market conditions as needed. Risk models that are updated monthly will, of course, miss market movements that occur between model updates. The events of August

2007 provide a sobering example of the value of daily model re-estimation. During the four week period from 7/23/07 to 8/17/07, almost 30% of the daily factor returns were more than two standard deviations larger than historical averages. Between 1/31/05 and 7/31/07, only 2.3% of the factor returns were of this magnitude. Normally distributed returns would have had only 5% of their returns in this range. In addition, the signs and correlations of the factor returns were often substantially different from historical values. For a detailed analysis of the events of August 2007, see Axioma's white paper "The Quant Scare," available at www.axiomainc.com.

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