Dynamic Beta

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Abstract

The phrase “Dynamic Beta” is broad and this paper describes statistical procedure for estimating regression coefficients in a way that allows for variation across relevant subsets of the data. For example, the time axis. I describe an algorithm to structure the search for variation in sets of coefficient estimates and discuss the example of a single stock versus a stock index. In the end, I suggest that a human analyst has an important role for someone who has relevant skill in pattern recognition and subject area expertise.

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Dynamic Beta

This topic area obviously needs a lot of attention. See Engle (2014) for the method of Dynamic Conditional Beta and an example with the Fama French 3 factors dataset. The concept of Dynamic Conditional Beta is a powerful one with formal hypothesis testing and much more. I seek to establish something new in this paper here, which proceeds with a short description of an original concept of my own creation.

Data Structure

Consider the “plain vanilla” linear, univariate equation:

$Y=mX+b$

Estimate again and again for different subsets of a dataset. Specify conditions on the types of subsets to consider, for example 1-week periods in a 1-year time series.

It is important to consider size of data set when using this method for repeated estimation of parameters and non-parametric or other statistical methods for the estimates themselves.

Moving Window Concept

Introduce T as an interval of time with discrete data points, where T* denotes a subset, and there is a procedure to identify sets of T* where you intend to compare estimates for regression coefficients across different sets of T*. There are methods to produce large numbers of T* to consider, such as using “fractal dust” to identify all possible T* in a computational manner with a discrete dataset.

Another example is to identify subsets S as functions of parameter k. An example of S(k) is as follows:

$S(k)=\{T^* : |S(k)|=T-k,\ S(k) \text{ continuous in } T\}.$

This basically defines all sub-intervals of 60 seconds that are 10 seconds long.

It is possible to take this another step further by comparing results based on different values for k. For example, "who's winning on 20 second intervals of the race and 40 second intervals?" This kind of analysis is obscure, but sometimes interesting.

See this visual description for all 10-second windows in a 60-second interval.

|----------| T

|----------| Examples of S(k)

|----------|

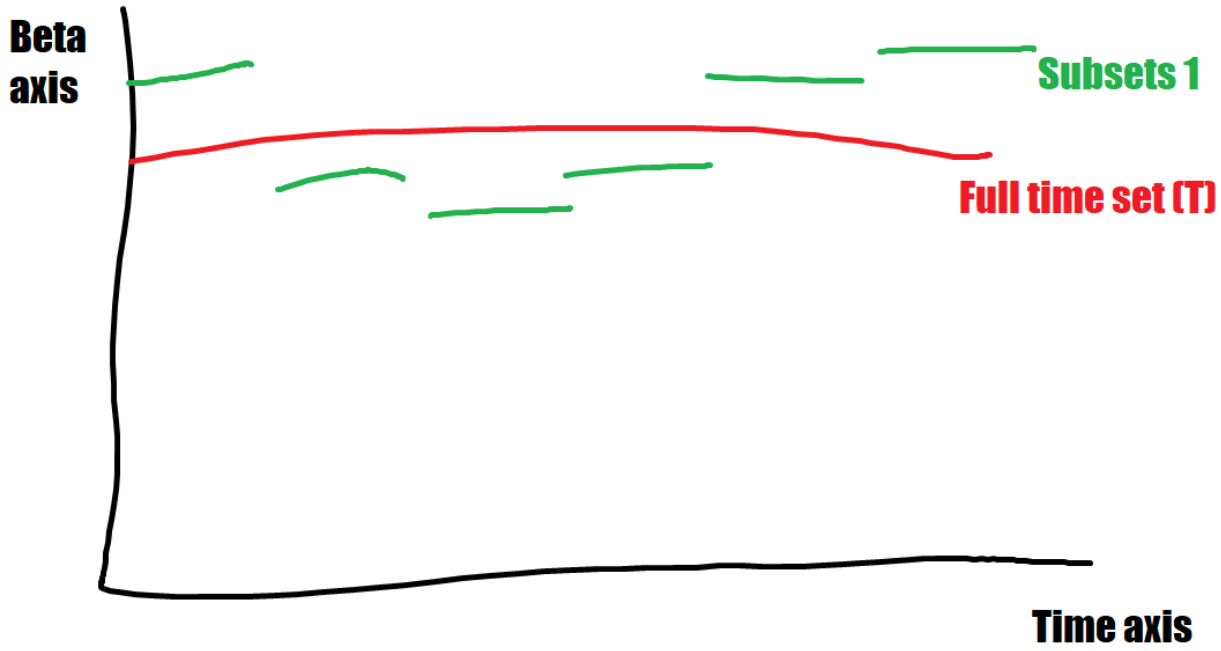
|----------|

|----------| …

I suggest referring to this computational method as a “Moving Window” calculation.

Example discussion

Consider daily prices for a single stock vs stock index over 50 years where you estimate beta for chunks of data at 1-, 5-, 10-year lengths. Compare estimates in some way that shows how estimates vary over time. What kind of things can you find?



Consider the set of all T* that are "interesting" to an analyst based on things they observe in parameter estimates over different time periods and other things going on in the world at those times. Many people have subject area expertise regarding history of financial markets and some may be able to recognize certain patterns in different parameter estimates shown in graphics, as above. The image above shows a basic example.

It is possible to drill down further into the data and see if the phenomenon of interest in different parameters is associated with anything of interest in prices themselves. There's lots of space for good computational work and human guidance here, too. Is there predictive power to coefficient estimates themselves? I would expect many spurious correlations at that level of abstraction, but it would be worth a look.

There is a databasing exercise to build data on the set of all T* that are interesting, too. Imagine laboratory exercises tracking brain activity of financial analysts as they review this information and rate interest in the process.

References

Engle, J. (February 27, 2014). *Dynamic Conditional Beta*. Retrieved from https://www.frbsf.org/economic-research/files/Thu_1340_Engle.pdf