THE E.R. MODEL

OUR INSIGHTS IMPLEMENTED

OUR INVESTMENT PHILOSOPHY

The **behavior of price and volatility define a market environment** – these market factors capture the aggregate views and actions of all participants in the capital markets

The market environment defines whether an investor should invest in or avoid a particular market

Marketing factor exposure decisions should be absolute, not relative to other asset classes; **there exist market environments where for certain factors the best investment decision is *not investing***

OUR UNIQUE INSIGHTS

In different market environments, different information is relevant to investors when they make their capital allocation decisions

- **In** "**slow**" **markets**, investors tend to focus on a **greater horizon of information**, using multiple quarters of financial information to make their forecasts
- **In** "**fast**" **markets**, investors heavily focus on the **most recent information**. These are typically periods of uncertainty when historical forecasts break due to a market dislocation

At the soul of our models is our "***adaptive event window***" algorithm which identifies the market environment and what information our models should be using. For example, for the S&P 500,

- In **mid 2004**, the model used information from the **previous 350 trading days**
- In **late 2008**, the model used information from only the **previous 60 trading days**

KEY COMPONENTS OF THE MODEL

Adaptive

The Greek philosopher Heraclitus said, "the only constant is change," which holds especially true for market dynamics, creating a significant risk for static quantitative models. To reduce this risk, the **model constantly updates its internal metrics to stay relevant to current market environments**, allowing it to react and change to new and unforeseen market cycles

Simple

Ockham's razor was employed in the design of the model to sacrifice performance for simplicity in implementation. By **reducing the complexity of the model to the fewest necessary factors**, the risk of over-optimization to historical data is reduced

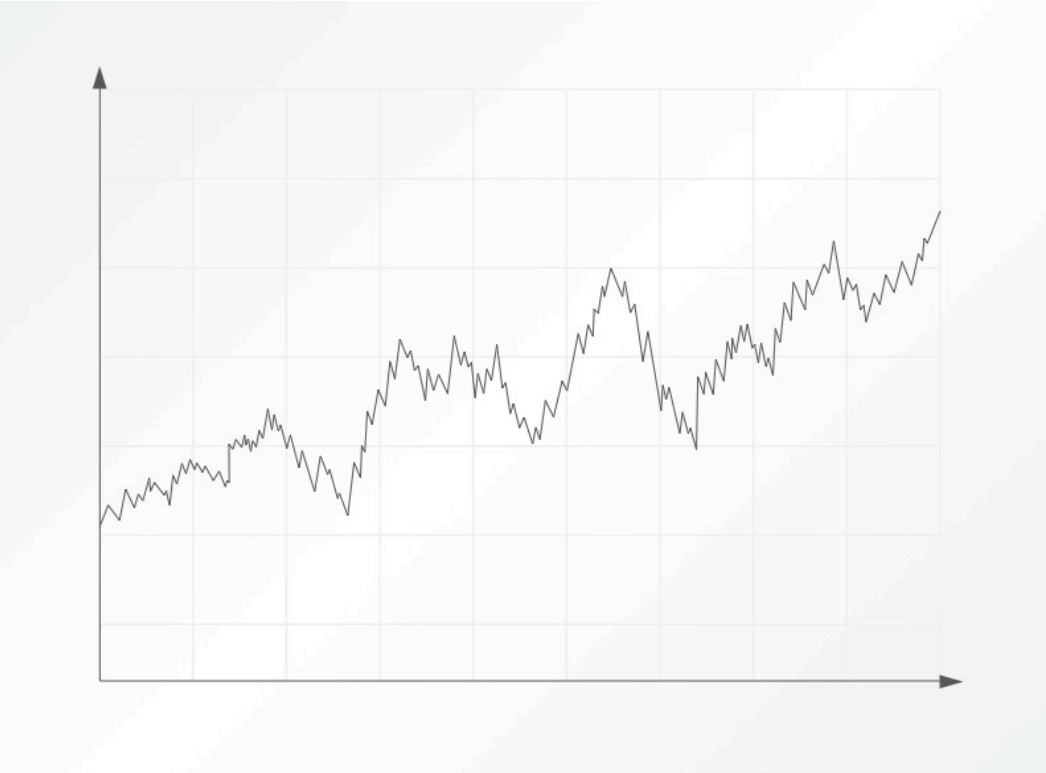
Robust

Back-testing is a necessary component of model development, and often where the finger is pointed if an over-optimized model breaks down when market dynamics change. To prevent this risk, the **model was developed to be robust over a broad range of asset classes and a great depth of time-frames** to ensure that it is not over-optimized to a specific instrument or market cycle

Reactive

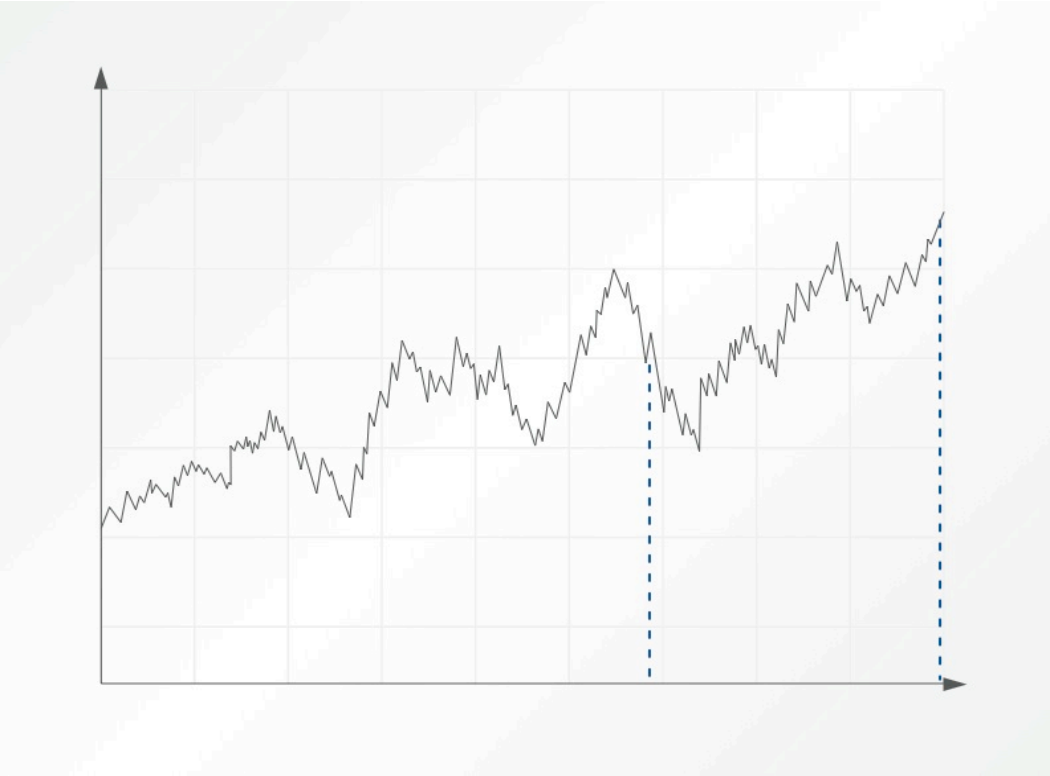
Predictive models are fundamentally restricted to being effective only when the current market data falls within the range of the historical data set the model is built on. The reality is, however, that there are exogenous events that can neither be predict nor controlled which will always fall outside of the historical data set. For this reason, our model is **reactive, allowing it to be more durable and flexible in changing markets**

HOW IT WORKS: STEP 1



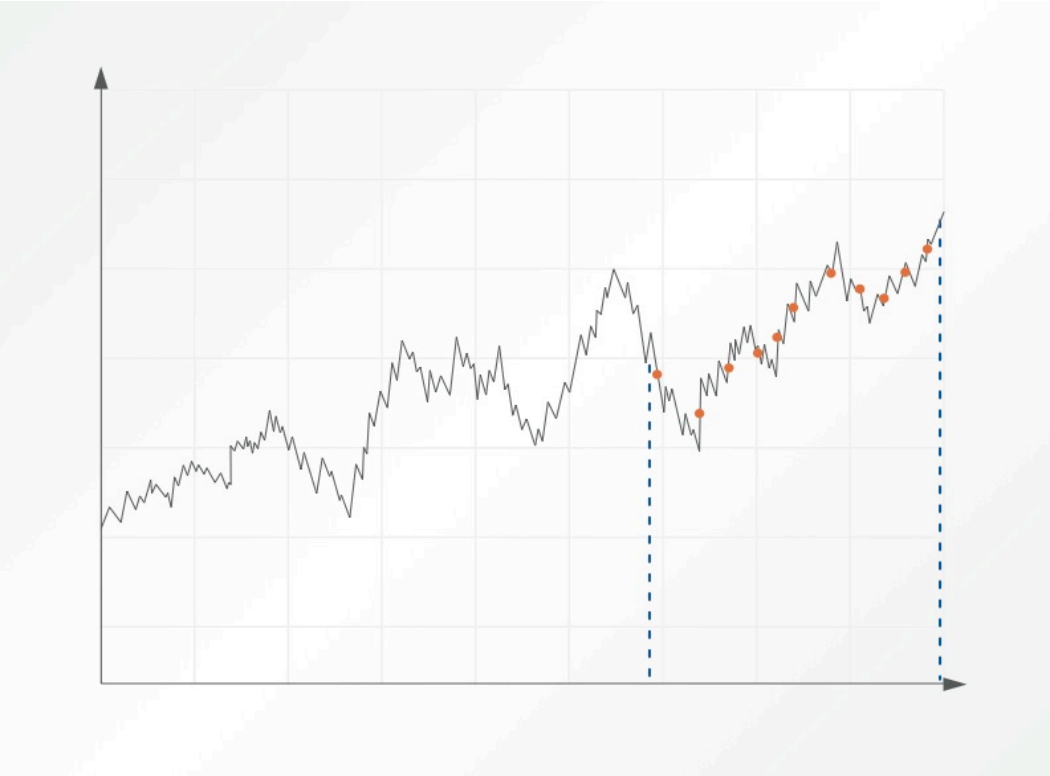
The algorithm works by analyzing a security's time series, **creating metrics** for price, price change, volatility, and change in volatility. These metrics are used **to define the current environment** and normal behavior for the security

HOW IT WORKS: STEP 2



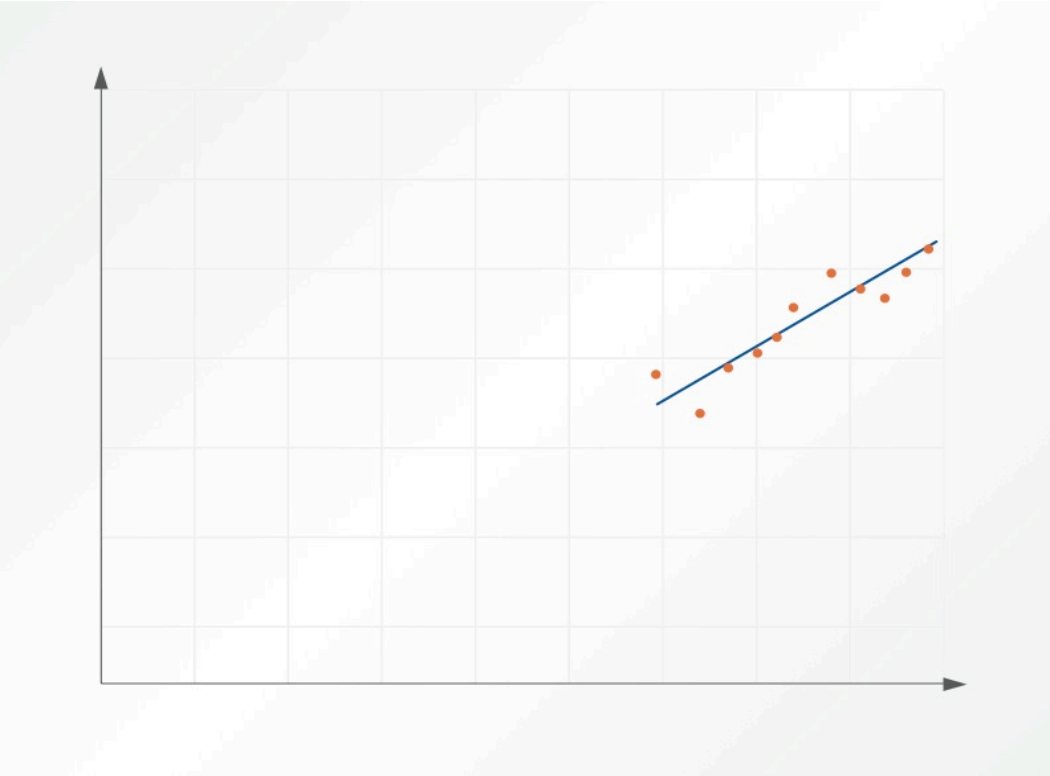
These metrics are used to construct an adaptive event window, **identifying the amount of information the model will use** to determine the true underlying trend of the security. Depending on the market environment or the current behavior model, this window will change in size

HOW IT WORKS: STEP 3



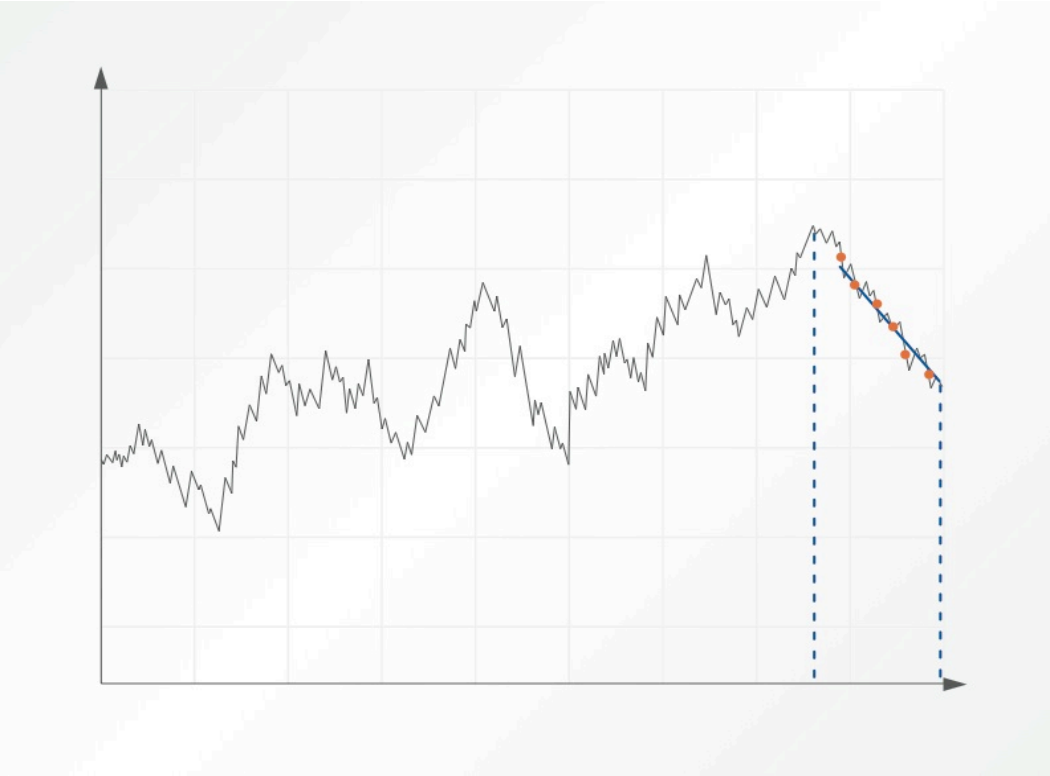
Once the adaptive event window has been constructed, the model **identifies** the **significant data points** within the window that will be used to construct the true underlying trend. These significant data points are identified to remove day-to-day noise from the time-series

HOW IT WORKS: STEP 4



Using the significant data points, a **model** of **the underlying trend** is constructed. The orientation and persistence of this underlying trend provides the ultimate signal as to whether the model recommends exposure to the security

HOW IT WORKS: REPEAT



As the time-series changes, so will the adaptive event window, the significant data points, and the resulting underlying trend

RISKS OF QUANTITATIVE MODELS

Quantitative models are exactly what their name says: models. Since they do not perfectly capture the environment around them, there will always be market environments in which a model will work better and environments in which they will not work at all. **Simply put: models can break**

While we strive to make our models as adaptive and robust as possible to minimize the likelihood of failure, we also design products to mitigate model failure risk

This means **we design portfolio strategies with the explicit expectation that our models will break**, and by doing so, work to make the portfolio robust to this risk. In doing so, we limit model risk

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