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A filter for unreliable model results

This document contains an approach for identifying assets for which the model is particularly ineffective. Model analysis for such assets should not be shown on the Architect platform.

Motivation and Discussion

- The tests start from the principle of permissivness. The tests err on the side of providing information on risks that might not exist, on the presumption that such errors are less costly than failing to inform about an existing risk.
- The model currently provides the following important information to clients and advisors.
  - Return predictions (via the back-cast)
  - Factor exposures
- Determining if the model provides "valuable enough" inference about an asset entails assessing an asset's goodness of fit and the significance of exposures. If the model's inferences on an asset fail both the goodness of fit test and the exposure test, the model is unlikely to provide enough valuable insights to be worth showing on the platform. However due to the permissive principle above, passing these tests is only weak evidence that the model's inferences are generally reliable. Rather, passing one of these tests indicates that it is more likely than not that some information that the model is providing is of value.

Methodology

To show model results, an asset must pass at least one of the following two tests:

1. Goodness of fit test
   - Define the model's capacity to provide useful predictions as its efficacy relative to the mean model.
     - Measuring efficacy in terms of tracking error, the goal is to assess if

$$\sum_{s\in 1:S} \left(y_s - \Phi\left(F\beta + r\right)\right)^2 \geq \sum_{s\in 1:S} \left(y_s - \overline{y}\right)^2$$

       where y is the data, Φ is the transformation matrix that forms quarterly predicted returns from monthly desmoothed returns, β is the exposure vector (including the intercept), $\overline{y}$ is the average reported return, F is the matrix of factor returns over the backcast, and r is the risk free rate over the back-cast.
     - Consider a two part goodness of fit test utilizing the following test statistic. While motivated by the above tracking error, the calculation for the test statistic coincides with that of $R^2_{ESS} \in (-\infty, 1]$ calculated using the residual methodology:

$$R^2_{ESS} = 1 - \frac{\sum_{s\in 1:S}\left(y_s - \Phi\left(F\beta + r\right)\right)^2}{\sum_{s\in 1:S}\left(y_s - \overline{y}\right)^2}$$

- As an initial permissive gate, insist that the actual values used on the platform are additive over the mean model. In other words, for all assets for which Architect displays analytics, impose the requirement

$$freqR^2 = 1 - \frac{\sum_{s \in 1:S} \left(y_s - \mathbb{E}\left[\Phi\right]\left(F\mathbb{E}\left[\beta\right] + r\right)\right)^2}{\sum_{s \in 1:S} \left(y_s - \overline{y}\right)^2}$$

  where all expectations are taken with respect to the posterior distribution $p\left(\Theta|D\right)$. This metric does not have an obvious Bayesian interpretation, but serves as a starting point and is representative of the analytics shown on the MVP platform. For this reason, any asset for which $freqR^2 < 0$ automatically fails the goodness of fit test.

- A more rigorous test incorporates the full distribution of outcomes predicted by the model. From a Bayesian perspective, the this distribution of outcomes is implied by the data and the priors. The test statistic specifically computes the probability that a particular draw from the posterior is valuable, with value defined as performance better than the mean model:

$$p\left(R^2_{ESS} > 0\right) = \int_{\Theta} \iota \left[1 - \frac{\sum_{s \in 1:S} \left(y_s - \Phi\left(F\beta + r\right)\right)^2}{\sum_{s \in 1:S} \left(y_s - \overline{y}\right)^2} > 0\right] p\left(\Theta|D\right) d\Theta$$

  where ι is an indicator function. High values indicate that the model is likely to impart useful information over a large portion of the parameter distribution. An asset's analysis is considered valuable enough to show on the platform if $p\left(R^2_{ESS} > 0\right) > c_{ESS}$, where c_{ESS} is the minimum cutoff probability (tentatively 80%). As this test is generally much more restrictive than the previously described test, any asset that passes this test and fails the previous should be flagged for further analysis.

2. Exposure signficance test

   - A model that fails to produce useful predictive returns may still provide useful information on exposures. For instance, the model might fail to capture the moving average components, or certain parameters may have very high plausible ranges given the data.
   - A second-pass test for significant exposures determines if the exposure information, in-of-itself, is valuable enough to warrant showing the analysis to clients. The test statistic checks if the data implies a high probability that the exposure is greater (less than) zero. Specifically, show the fund if, for any exposure k excluding the intercept, $\max\left[p\left(\beta_k > 0\right), 1 - p\left(\beta_k > 0\right)\right] \geq c_{exp}$

$$p\left(\beta_k > 0\right) \equiv \int \iota\left[\beta_k > 0\right] p\left(\Theta|D\right) d\Theta$$

     and c_{exp} is a cutoff value (tentatively 80%).

- Due to the permissive and coarse nature of the tests, Architect should maintain the ability to override this criteria on an exception basis.

Sample Application

The methodology was applied within the research POC to the following assets.

Research POC Label	Quarterly?	Rsq_ESS	p(Rsq_ESS)	Passes GOF?	max(p(beta<>0))	Passes exp?	**Display?**
amgpantheonfundllc	No	0.19	0.92	yes	0.98	yes	**yes**
aresindustrialreitclasst	No	(0.28)	0.00	no	0.71	no	**no**
aresprivatemarketsclassi	No	0.17	0.62	no	0.60	no	**no**
aresrealestateincometrustinc	No	0.02	0.24	no	0.74	no	**no**
atlasenhancedfundlp	No	0.29	1.00	yes	1.00	yes	**yes**
blackstoneprivatecreditfund	No	0.67	0.94	yes	0.93	yes	**yes**
blackstonerealestateincometrustinc	No	0.16	0.87	yes	0.84	yes	**yes**
brookfieldreiticapitaloffshoreaccess...	No	0.38	0.86	yes	0.96	yes	**yes**
canyonbalancedhedgefocusfundltd	No	0.72	1.00	yes	1.00	yes	**yes**
carlyletacticalprivatecreditfund	No	0.56	1.00	yes	0.94	yes	**yes**
icapitalcampbellabsolutereturnaccess...	No	0.91	1.00	yes	1.00	yes	**yes**
icapitalcoopersquareaccessfundlp	No	0.85	1.00	yes	1.00	yes	**yes**
icapitaldoublelineopportunisticfundltd	No	0.35	1.00	yes	1.00	yes	**yes**
icapitalhgvoraaccessfundlp	No	0.67	1.00	yes	1.00	yes	**yes**
icapitalincomeopportunitiesfundlp	No	0.42	1.00	yes	1.00	yes	**yes**
icapitalkingstreetcapitalaccessfundlp	No	0.36	1.00	yes	1.00	yes	**yes**
icapitalkkrprivatemarketsfund	No	0.26	1.00	yes	1.00	yes	**yes**
icapitalmillenniumfundltd	No	0.30	1.00	yes	1.00	yes	**yes**
icapitalmultistrategyfundltd	No	0.04	0.67	no	1.00	yes	**yes**
icapitalnewalphaaccessfunduslp	No	0.74	1.00	yes	1.00	yes	**yes**
icapitaloffshorestrategieshoneycomb...	No	0.59	1.00	yes	1.00	yes	**yes**
icapitalrenaissanceidgefundltd	No	0.23	0.96	yes	0.97	yes	**yes**
icapitalrenaissanceiefundltd	No	0.37	1.00	yes	1.00	yes	**yes**
icapitalsegpartnersfundlp	No	0.65	1.00	yes	1.00	yes	**yes**
icapitalshaccessfundlp	No	0.73	1.00	yes	1.00	yes	**yes**
icapitalsorobanopportunitiesfundlp	No	0.80	1.00	yes	1.00	yes	**yes**
icapitalthirdpointfundltd	No	0.66	1.00	yes	1.00	yes	**yes**
icapitalworldquantmillenniumsealslp	No	0.42	0.75	no	0.60	no	**no**
nuveenglobalcitiesreitinc	No	0.44	0.95	yes	0.99	yes	**yes**
owlrockcoreincomecorp	No	0.61	0.89	yes	0.86	yes	**yes**
ozdpiihedgefocusfundlp	No	0.85	1.00	yes	0.99	yes	**yes**
spfhedgefocusfundltd	No	0.30	1.00	yes	0.99	yes	**yes**
steelecreekcapitalcorporation	No	0.19	0.83	yes	0.78	no	**yes**
stepstoneprivatemarketssprim	No	(0.17)	0.06	no	0.70	no	**no**
wmasystematicequityalphalongshort...	No	0.90	0.95	yes	0.68	no	**yes**
worldquantmillenniumwmqsgeae...	No	0.97	1.00	yes	1.00	yes	**yes**
blackrockprivateinvestmentsfund	Yes	0.65	0.43	no	0.87	yes	**yes**
carlylecreditsolutionscars	Yes	0.89	1.00	yes	0.91	yes	**yes**
hlsfvicapitalaccessfundlp	Yes	0.72	0.75	no	0.98	yes	**yes**
hlsfvicapitaloffshoreaccessfundlp	Yes	0.80	0.78	no	0.96	yes	**yes**
icapitalbcpviiiaccessfundlp	Yes	0.91	0.87	yes	0.92	yes	**yes**

icapitalblackstonegrowthaccessfundlp	Yes	0.99	1.00	yes	1.00	yes	**yes**
icapitalpofivaccessfundlp	Yes	0.55	0.88	yes	0.97	yes	**yes**
icapitalspreviiaccessfundlp	Yes	0.51	0.53	no	0.91	yes	**yes**
icapitalvintageivaccessfund...	Yes	0.96	0.98	yes	1.00	yes	**yes**
icapitalvintagevaccessfunduslp	Yes	0.96	0.96	yes	1.00	yes	**yes**