Description of the Monkey Trading Algorithm

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This document is originally from Perlin (2007a) and Perlin (2007b). Please check those papers for a practical application of the monkey trading algorithm.

Bootstrap Method for Assessing Pairs Trading Performance

The bootstrap method represents a way to compare the trading signals of the strategy against pure chance. The basic idea is to simulate random entries in the market, save the values of a performance indicator for each simulation and count the percentage number of times that those random entries were worst than the performance obtained in the tested strategy. It should be notes that each trading strategy takes different number of long and short positions and for a different number of days. Such information is also taken in account at the random simulations. Before applying the algorithm, separately, for long and short position, it should be calculated the median number of days (*nDays_Long* and *nDays_Short*) that the strategy has been trading in the market and also the median number of assets (*nAssets_Long* and *nDays_Short*).

The steps are:

1. With the values of the *nDays* and *nAssets* for long and short, define *nDays* random entries in the market for *nAssets* number of assets. Again, making it clear, this procedure should be repeated for each type of trading position (long and short). The output from this step is a trading matrix which has, only, values 1 (long position), -1 (short position) or zero (no transaction).
2. Taking as input the trading matrix and the transaction costs, the portfolio is build with equal weights, resulting in a vector with the returns of the trading signals over time, $R_t = \sum_{i=1}^{n} R_{it} W_{it}^{RND}$, where R_{it} is the return for asset *i at* time *t*, W_{it}^{RND} is corresponding portfolio weight of asset *i* at time *t*, which is build with the random trading signals from last step. Such vector is then used for calculation of the performance indicators (eg. annualized raw return).
3. Repeat steps 1 and 2 *N* number of times, saving the performance indicator value for each simulation.

After a considerable number of simulations, for example *N=5000*, the result for the bootstrap method is going to be a distribution of performance indicators. The test here is to verify the percentage of cases that the tested strategy has beaten comparing with the use of random trading.

As an example, the next ilustraton is the histogram of the accumulated returns from the use of bootstrap algorithm for a daily database with options: *N=5.000*, *nDays_Long=400*, *nDays_Long=250*, *nAssets_Long=5*, *nAssets_Short=3* and with zero transaction cost (*C=0*).

Figure 1 – Histogram of the annualized raw returns from the Random Trading signals

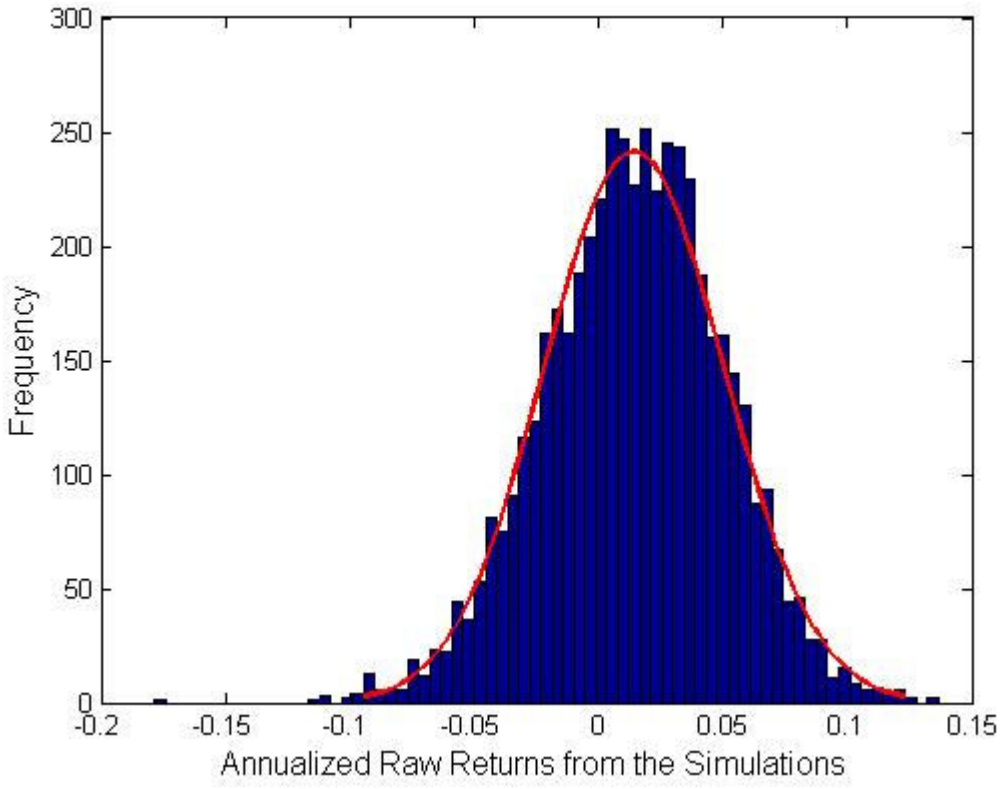

Figure 1 shows that, considering the options given to the algorithm, an out-of-skill investor would earn, in average, an annualized raw return of approximately 1.5%. The best case for the random trading signals is approximately 15% and the worst is -10%. One can also see that the distribution can be well pictured by a normal likelihood (the line).

The next step in using this bootstrap approach is to count the number of times that the performance indicator, in this case the annualized raw return, from the tested strategy is better[1] than the simulated performance indicators from the random trading signal and divide that by the number of simulations. The result is a percentage showing how many random signals the tested strategy has beaten. If such strategy has value, it would produce percentages close to 80%. If it is just a case of chance, it would give a percentage close to

[1] Better could mean higher or lower, depending of which performance indicator is being calculated. For instance, a higher annualized return is better, while a lower annualized standard deviation is preferred

50% and, if the strategy doesn't present any value, it would result in a percentage close to 20%, meaning that, in this case, it's possible to get higher returns by just using a random seed to select assets and days to trade. One way of analyzing the result of the bootstrap algorithm is that it compares the selections made by the trading strategy, that is, the days and assets to trade, against an expected value of the indicator for the same days and number of trades over the full researched data.

References

PERLIN, M. S. (2007a) "Evaluation of Pairs Trading Strategy at the Brazilian Financial Market". Available at SSRN: http://ssrn.com/abstract=952242

PERLIN, M. S. (2007b) "M of a Kind: A Multivariate Approach at Pairs Trading". Available at SSRN: http://ssrn.com/abstract=952782