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THE USE OF COPULAS IN SPREAD TRADING

Introduction
Spread trading is the simultaneous sale of one security and the purchase of a related security. One who is involved in spread trading will desire to have an ideal entry point into and exit point out of the market using the technique which is developed based on the dependence of the two securities. It is widely acknowledged that stock prices are rarely normally distributed in reality. Yet most people are still using linear correlation as a measure of dependency due to the lack of alternatives. As copula methodology emerge in the recent decade, many suggest copula as an alternative to normality. The use of copulas is essential but relatively new to the spread trading. The copula methodology captures non-linear dependencies, making the model robust and this leads to an outcome that is more superior, and therefore better decision. The objective of this study is to develop an equity trading technique for spread trading by using the emerging copula methodology.

Copulas
Copulas combine individual marginal distributions to form a joint distribution function that describes dependency between variables. Using copulas to construct joint distributions allows us to specify the distributions of individual variables separately from the dependence structure. Unlike the traditional methods of modeling techniques which assumes all variables to be normally distributed, copulas allow great flexibility for the distribution functions of variables and do not restrict the type of marginal distributions considered. It is also invariant under strictly monotone transformations of random variables. Hence, copulas help to accurately describe (linear and/or non-linear) dependencies among the input variables without rigid assumptions.

Equity Technique
1. Transform the data set to log-returns.
2. Obtain the marginal distributions and parameters using standard statistical analysis software.
3. Identify the relevant copula function and parameters.
Specifically Archimedean copulas, due to certain requirements of the technique.
4. Evaluate conditional probability functions.
By definition, conditional probabilities are derivatives of the copula formula.

5. Obtain conditional values of u and v.
Setting conditional copula functions as 0.5, the daily conditional values of u and v can then be obtained by solving the conditional functions for each given value of u and v respectively.

6. Calculate conditional log return values
Inverse of cumulative distributions are applied using the conditional u and v values obtained.

7. Evaluate conditional price for indication of relative positions.
Trivial upon obtaining conditional returns. If the market price of stock is lower than the conditional price, the stock is relatively undervalued. Same applies for converse.

Application
[Refer to table above]
Observe that FTSE is relatively undervalued on Dec 1, suggesting to long FTSE and short STI. Subsequently, the change in positions on Dec 9 indicates otherwise.

Note that the higher the value of conditional probabilities, the more certain it is regarding the position of the stock. Hence this specifies the entry and exit points for the trade execution between the two stocks.

In addition to the ideal entry and exit point, another important issue to consider is the amount of stocks to buy or sell. One of ways to go about this is through the hedge ratio defined as follow:

$$\Delta = \frac{(\text{Conditional Price of STI given FTSE at time } t)}{(\text{Conditional Price of FTSE given STI at time } t)}$$

With the information obtained, the net profit will be $310482.86.

Conclusion
The equity trading technique is tremendously useful when the optimal copula is applied. It utilizes information obtained from the dependency between two stocks to predict the future development. This allows us to have a clear view of the relative positions of the stocks. In turn, it provides information for its users to make wise and sensible executions, resulting in greater profits.

Hence, the equity technique does not only provide us the relative positions between the pair of stocks. It provides us with a holistic strategy of the trade execution.

Reference