INTER IIT TECH CAMP 2023

PAIRS TRADING

AND COINTIGRATION STRATEGY

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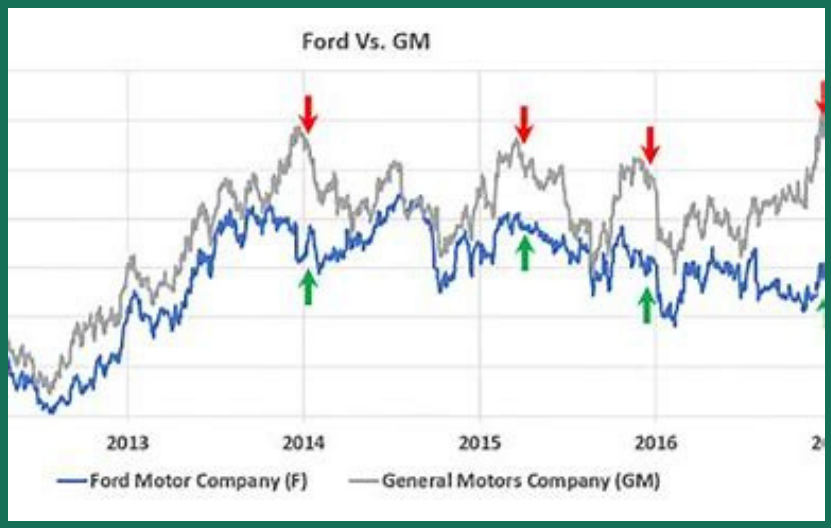
#PAIR TRADING

IN A PAIRS TRADING STRATEGY, USUALLY, A PAIR OF STOCKS IS TRADED IN A MARKET-NEUTRAL STRATEGY, THAT IS, IT DOES NOT MATTER WHETHER THE MARKET IS TRENDING UPWARDS OR DOWNWARDS AS ONE OF THE STOCKS WOULD ALWAYS BE IN AN ANTISYMMETRIC POSITION TO THE OTHER, THEREBY OPENING A WINDOW WHERE TAKING A SHORT POSITION ON A STOCK AND LONG POSITION ON THE OTHER OPENS A WINDOW FOR PROFIT.



THE TWO STOCKS OR THE FINANCIAL INSTRUMENTS NEED TO BE TRENDING AT A SIMILAR MEAN PRICE AND REMAIN CLOSE TO EACH OTHER. BUT, ON CERTAIN OCCASIONS, ONE OF THE INSTRUMENTS MAY GO THROUGH A SHORT PERIOD OF DEVIATION FROM ANOTHER IN TERMS OF PRICE. IT IS IN THIS WINDOW THAT THE TRADER SHOULD EXPLOIT THE ARBITRAGE OPPORTUNITY BY SHORTING THE HIGHER PERFORMING STOCK AND BUYING THE LOWER PERFORMING STOCK AS BY THE MEAN REVERSION PRINCIPLE, THE PRICES OF THE STOCK WOULD REVERT CLOSER TO THE MEAN IN THE NEAR FUTURE.

STATISTICAL ARBITRAGE

STAT ARB WORKS WHEN THE SECURITIES SUCH AS STOCKS TEND TO TRADE IN UPWARD AND DOWNWARD CYCLES AND A QUANTITATIVE METHOD SEEKS TO CAPITALISE ON THOSE TRENDS. TRENDS UNCOVERED ARE BASED ON THE VOLUME, FREQUENCY AND THE PRICE OF A SECURITY AT WHICH IT IS TRADED. GENERALLY, THE STOCKS ARE PRICED QUITE CLOSE TO EACH OTHER, HOWEVER, IN THE EVENT OF THERE BEING A DIFFERENCE, AN ARBITRAGE OPPORTUNITY ARISES BASED ON THE ASSUMPTION THAT THE STOCK PRICES WILL MOVE CLOSER AGAIN. FOR INSTANCE, IF PEPSI STOCK RISES CONSIDERABLY COMPARED TO THAT OF COCA-COLA, THEN ONE MIGHT SHORT THE PEPSI STOCK AND LONG THE COCA-COLA STOCK IN ANTICIPATION OF FAVOURABLE RETURNS.

#PAIR IDENTIFICATION & SELECTION

FOR PAIR SELECTION WE PERFORM CERTAIN TESTS SO THAT THE PAIR TRADE COMES OUT TO BE PROFITABLE

1)ASSET UNIVERSE:

BEGIN BY SELECTING A GROUP OF ASSETS OR SECURITIES TO CHOOSE PAIRS FROM. THESE ASSETS SHOULD HAVE A HIGH DEGREE OF CORRELATION.

2)COINTIGRATION TEST:

WE APPLIED COINTEGRATION TESTS SUCH AS THE JOHANSEN TEST, TO CONFIRM THE LONG-TERM RELATIONSHIP BETWEEN THE SELECTED PAIR.

WE HAVE IMPLIMENTED ADF AS WELL AS ENGLE GRANGER TEST FOR IT.

CORRELATION

THE CORRELATION COEFFICIENT INDICATES THE DEGREE OF CORRELATION BETWEEN THE TWO VARIABLES. IT IS EVALUATED AS THE RATIO OF COVARIANCE OF TWO VARIABLES TO THE PRODUCT OF THEIR STANDARD DEVIATIONS. TAKING CORRELATION TO BE A BASIS OF PAIRS TRADING MAY BE TEMPTING BUT IS A DUBIOUS CHOICE AS MAINTAINING CORRELATION WITH RESPECT TO THE RETURNS MAY LEAD TO A DIVERGENT DATASET WITH THE SPREAD INCREASING CONTINUOUSLY WHILE DOING SO WITH RESPECT TO THE SPREAD MAY RESULT IN A CONTINUOUSLY INCREASING SEQUENCE THAT MAINTAINS THE SPREAD. THE LATTER CASE VIOLATES THE ASSUMPTION THAT THE DATA WOULD REVERT BACK TO THE MEAN.

$$\rho = \frac{Cov(X,Y)}{\sigma(X) * \sigma(Y)}$$

COINTEGRATION

COINTEGRATION IS A STATISTICAL PROPERTY OF TWO OR MORE TIME-SERIES VARIABLES WHICH INDICATES IF A LINEAR COMBINATION OF THE VARIABLES IS STATIONARY. IT IS A MORE USEFUL FEATURE FOR PAIRS TRADING AS COMPARED TO CORRELATION. THE ENGLE-GRANGER TWO-STEP METHOD STARTS BY CREATING RESIDUALS BASED ON THE STATIC REGRESSION AND THEN TESTING THE RESIDUALS FOR THE PRESENCE OF UNIT-ROOTS. IT USES THE AUGMENTED DICKEY-FULLER TEST (ADF) TO TEST FOR STATIONARITY UNITS IN TIME SERIES. IF THE TIME SERIES IS COINTEGRATED, THE ENGLE-GRANGER METHOD WILL SHOW THE STATIONARITY OF THE RESIDUALS. AN AUGMENTED DICKEY–FULLER TEST (ADF) IS A STATISTICAL TEST FOR COINTEGRATION THAT DETERMINES WHETHER THE RATIO OR SPREAD BETWEEN STOCKS MUST CONVERGE TO THE MEAN OVER TIME FOR PAIRS TRADING TO WORK.

$$y_t = c + \beta t + \alpha y_{t-1} + \phi_1 \Delta Y_{t-1} + \phi_2 \Delta Y_{t-2} .. + \phi_p \Delta Y_{t-p} + e_t$$

(EXPRESSION FOR THE ADF TEST, ADF(0) RETURNS THE COINTEGRATION)

FURTHER, WE USE AN I(D) SERIES TO COMPUTE COINTEGRATION WHERE I(D) DENOTES INTEGRATION SERIES OF THE ORDER D. THE DATASETS OF THE STOCK RETURNS VARY WITH TIME AND FORM AN I(1) SERIES WHILE THE COINTEGRATION IS COMPUTED AS AN I(0) SERIES AND IT IS WEAK-SENSE STATIONARY SO CAN BE USED EFFICIENTLY.

A TIME SERIES IS STATIONARY IF ITS PROPERTIES ARE INDEPENDENT OF THE TIMES AT WHICH THE TIME SERIES IS OBSERVED. THE MEAN AND VARIANCE OF A STATIONARY SERIES IS INVARIANT WHILE ITS COVARIANCE VARIES WITH THE TIME LAPSE.

$$E[r_t] = \mu$$

$$\mathrm{Cov}(r_t, r_{r-l}) = \gamma_l$$

(T DENOTES A GIVEN TIME INSTANT, L DENOTES THE TIME LAPSE)
COMPUTATION OF COINTEGRATION:-

$$a = \frac{\sum_{i=1}^{n} y_i \sum_{i=1}^{n} x_i^2 - \sum_{i=1}^{n} x_i \sum_{i=1}^{n} x_i y_i}{n \sum_{i=1}^{n} x_i^2 - (\sum_{i=1}^{n} x_i)^2}$$

(SLOPE USING LINEAR REGRESSION)

$$z_i = y_i - a * x_i$$

(x_i denotes the returns for stock1)

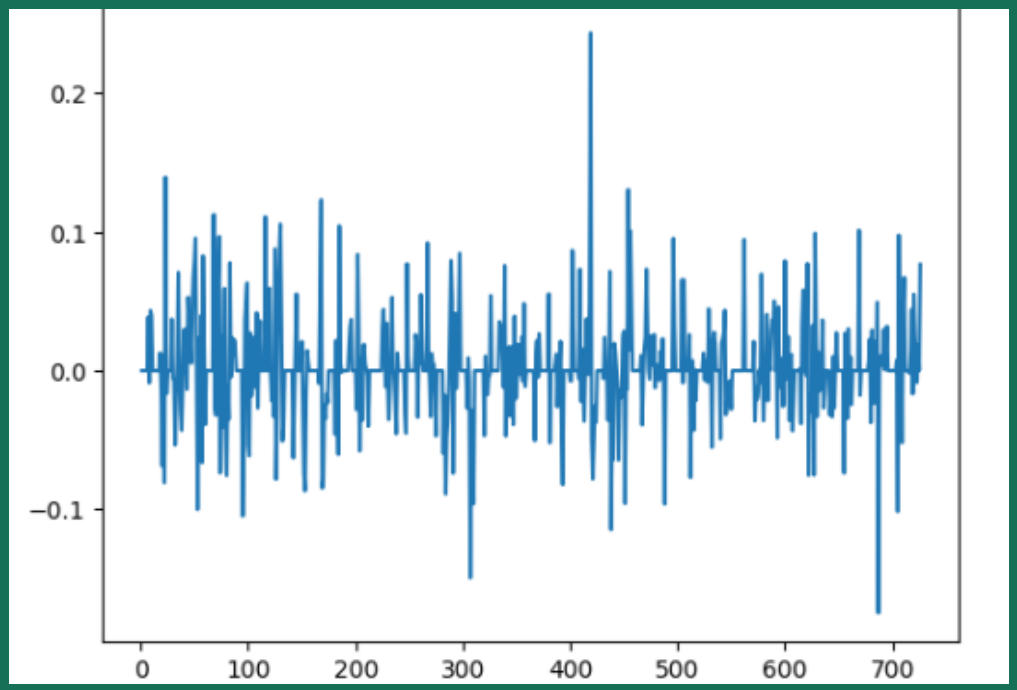
(y_i denotes returns for stock2)

(a denotes slope)

#TRADING STRATEGY & SIGNAL GENERATION

MEAN REVERSAL STRATEGY

WE MONITOR THE SPREAD (PRICE DIFFERENCE) BETWEEN THE ASSETS. WHEN THE SPREAD DEVIATES FROM ITS HISTORICAL MEAN BY A SPECIFIC NUMBER OF STANDARD DEVIATIONS, TRADERS MAY INITIATE TRADING POSITIONS. IF THE SPREAD WIDENS SIGNIFICANTLY BEYOND THE MEAN, THEY MIGHT BUY THE UNDERVALUED ASSET AND SHORT THE OVERVALUED ONE, ANTICIPATING A REVERSION TO THE MEAN. CONVERSELY, IF THE SPREAD NARROWS SUBSTANTIALLY, TRADERS MAY REVERSE THEIR POSITIONS. THE GOAL IS TO PROFIT FROM THE TENDENCY OF ASSET PRICES TO REVERT TO THEIR HISTORICAL AVERAGES, BUT IT REQUIRES CAREFUL ANALYSIS AND RISK MANAGEMENT.



#RISK MANAGEMENT MEASURES

RISK MANAGEMENT

THE TARGET STOCK EXPERIENCES HIGHER VOLATILITY RELATIVE TO THE BIDDER STOCK. THE COMMON STRATEGY UNDER THESE CIRCUMSTANCES IS TO PURCHASE A PUT ON THE TARGET STOCK, THUS PROTECTING AGAINST A STEEP DROP IN THE PRICE OF THE TARGET WHICH SHALL BE ACHIEVED BY A STOP LOSS STRATEGY. STOP LOSS ORDERS ARE ORDERS SET ON AN OPEN POSITION WHICH WILL CLOSE A TRADE AT A PREDEFINED RATE THAT IS LESS FAVOURABLE THAN THE CURRENT MARKET PRICE. THE PURPOSE OF USING A STOP LOSS ORDER IS TO LIMIT POSSIBLE LOSSES ON A TRADE.
TIMING OF THE TRADE IS EXECUTED IN A FILL OR KILL (FOK) MANNER. BY DEFINITION, FOK ORDERS WILL EITHER EXECUTE IMMEDIATELY OR ARE CANCELLED IF CONDITIONS ARE NOT MET. THEREFORE, WE SHALL EXECUTE OUR FOK FOR ENTRY AT THE CUT-OFF OF (SIGMA +MUE) AND FOR EXIT AT 0.

BUDGET MANAGEMENT STRATEGIES:-

1.POSITION SIZING: POSITION SIZING REFERS TO THE RATIO OF A SINGLE POSITION SIZE TO THE TOTAL CAPITAL. SUCCESSFUL TRADERS ADOPT THE 1% RULE, WHICH SUGGESTS THAT THE SIZE OF A POSITION SHOULD NEVER EXCEED 1% OF THE TOTAL CAPITAL. FOR EXAMPLE, IF YOU HAVE $10,000 CAPITAL, THE MARGIN YOU ALLOCATE TO A POSITION SHOULD BE LESS THAN $100. THE REMAINING CAPITAL SERVES AS A BUFFER AGAINST THE FLOATING PROFITS AND LOSSES (P/L) AND PROTECT YOU FROM A CLOSE-OUT.

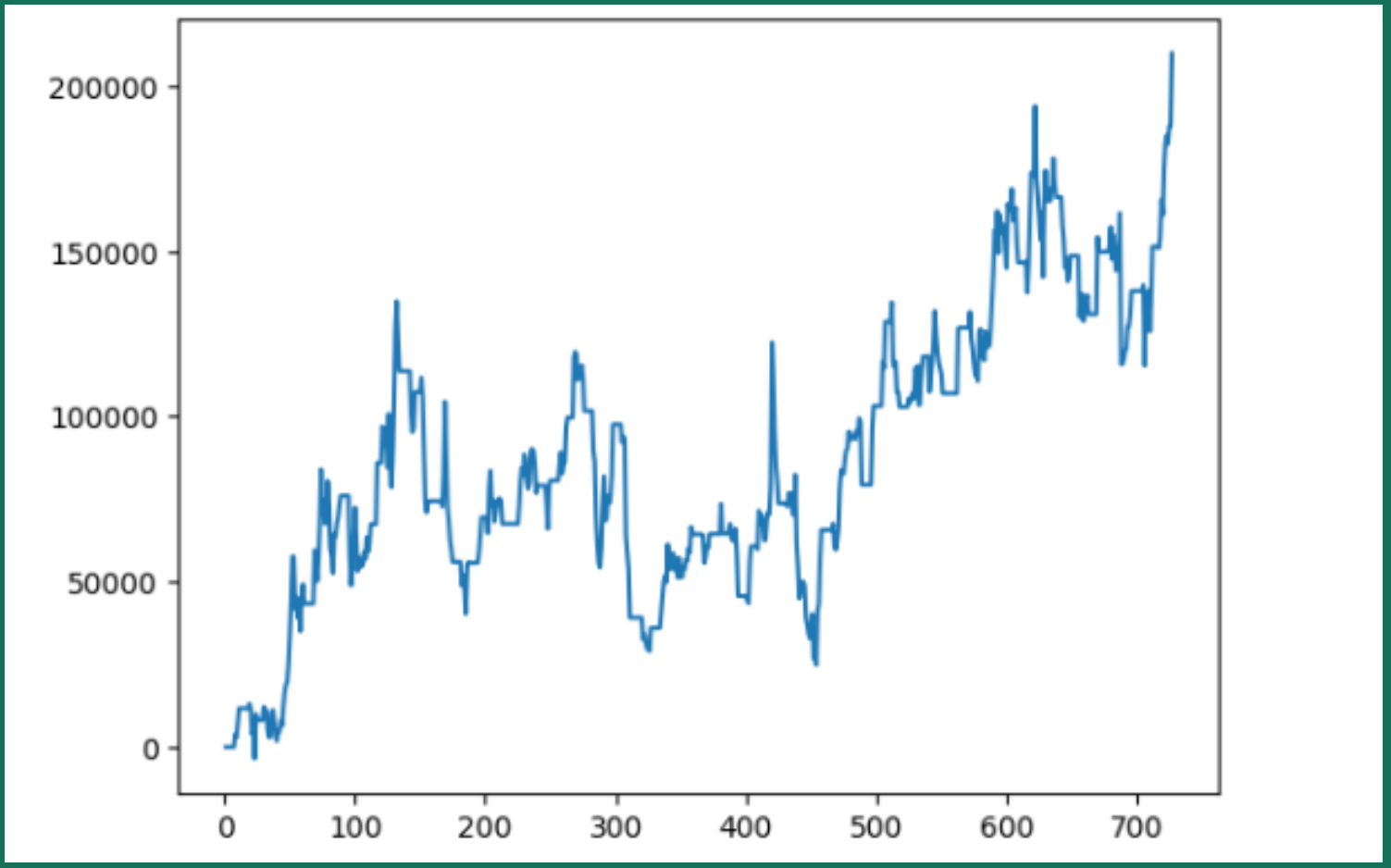
2.P/L RATIO: P/L RATIO REFERS TO THE WIN RATE OF YOUR CLOSED POSITIONS. A REWARD/RISK RATIO (RRR) IS MAINTAINED TO INTERPRET P/L RATIO.

3.PRICE TARGETS: KNOWING WHEN TO EXIT A POSITION IS JUST AS IMPORTANT AS KNOWING WHEN TO ENTER IT, AND IT CAN BE EMPHASISED AS ONE OF THE MOST FUNDAMENTAL RISK CONTROL STRATEGIES. KEEPING A WINNING POSITION OPEN TO ACCUMULATE PROFITS CAN END UP WITH A MARKET REVERSAL THAT ERASES ALL GAINS.

PORTFOLIO PNL

P&L IS THE DAY-OVER-DAY CHANGE IN THE VALUE OF A PORTFOLIO OF TRADES TYPICALLY CALCULATED USING THE FOLLOWING FORMULA: PNL = VALUE TODAY – VALUE FROM PRIOR DAY

WE WERE ABLE TO ACHIEVE A CUMULATIVE RETURNS OF 126% AFTER 3 YEARS ON THE BACKTESTING PHASE BETWEEN JULY 2020 TO 2023



PERFORMANCE METRICS

THE SHARPE RATIO COMPARES THE RETURN OF AN INVESTMENT WITH ITS RISK. IT'S A MATHEMATICAL EXPRESSION OF THE INSIGHT THAT EXCESS RETURNS OVER A PERIOD OF TIME MAY SIGNIFY MORE VOLATILITY AND RISK, RATHER THAN INVESTING SKILL.

A DRAWDOWN REFERS TO HOW MUCH AN INVESTMENT OR TRADING ACCOUNT IS DOWN FROM THE PEAK BEFORE IT RECOVERS BACK TO THE PEAK.

CUMULATIVE RETURNS, IN FINANCIAL TERMS, REPRESENT THE TOTAL AMOUNT AN INVESTMENT HAS GAINED OR LOST OVER A GIVEN TIME FRAME, TAKING INTO ACCOUNT ALL PRICE CHANGES AND COMPOUNDING. IT IS CALCULATED BY SUMMING THE PERIODIC RETURNS (E.G., DAILY, MONTHLY) OVER THE SPECIFIED PERIOD, MAKING IT A VALUABLE METRIC FOR ASSESSING THE OVERALL PERFORMANCE AND GROWTH OF AN INVESTMENT, ALLOWING INVESTORS TO SEE THE NET EFFECT OF THEIR RETURNS AND BETTER UNDERSTAND THE LONG-TERM PROFITABILITY OR LOSSES ASSOCIATED WITH THEIR ASSETS.

SHARPE : 1.5509
DRAWDOWN: 3.53%
CUMULATIVE RETURNS FOR 3 YEARS: 123 %

THANKING YOU