COMP226: Slides 16

Mean-reversion strategies

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Overview

- **Types of trading strategy**
- **Indicators** as strategy building blocks
- **Spreads**
- **Example spread mean-reversion strategy**
- **Commonly traded spreads**

Types of trading strategy

There are two fundamentally different types of trading strategy:

1. **mean reversion**/ **contrarian** / **overbought-oversold**
2. **trend following** / **momentum**

We will give examples of both types of trading strategy.

- We have already studied a **Bollinger Bands Overbought-Oversold (OBOS)** strategy
- In this lecture we will look at an example of a **mean reversion strategy** that uses **spreads**
- In the next set of slides we will look at several simple examples of momentum strategies

Indicators are not strategies

- `bbands.R` that we saw earlier has a **mean-reversion**-type trading rule:
    - **buy if below lower band**
    - **sell if above upper band**
- **Swapping buy and sell completely changes strategy**
- Thus, **Bollinger Bands**, like most indicators, can be used for **either mean-reversion or** a **trend-following** strategies

Spreads

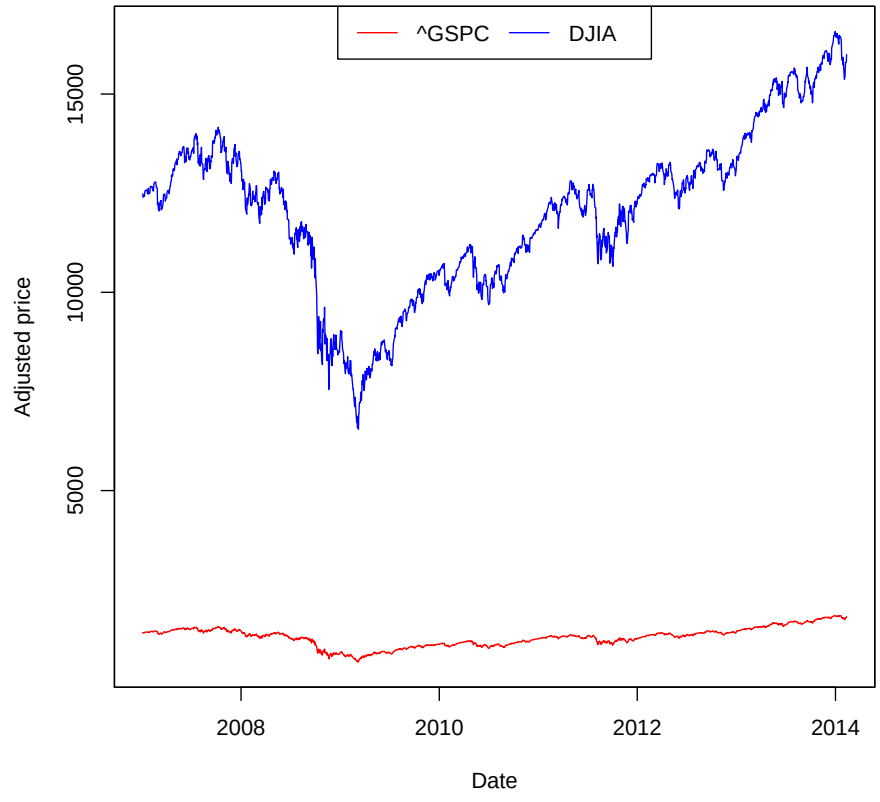
- **Weighted linear combination** (usually difference) of two series
- Strategy can try to **exploit mean-reversion in a spread**; for a pair of equities this is known as **pairs trading**, known more generally as **statistical arbitrage**
- Related to the theory of **cointegration**, which is an important topic within time series analysis. We will not cover this theory in this module...

Spread example

We will look at the S&P 500 and Dow Jones Industrial Average

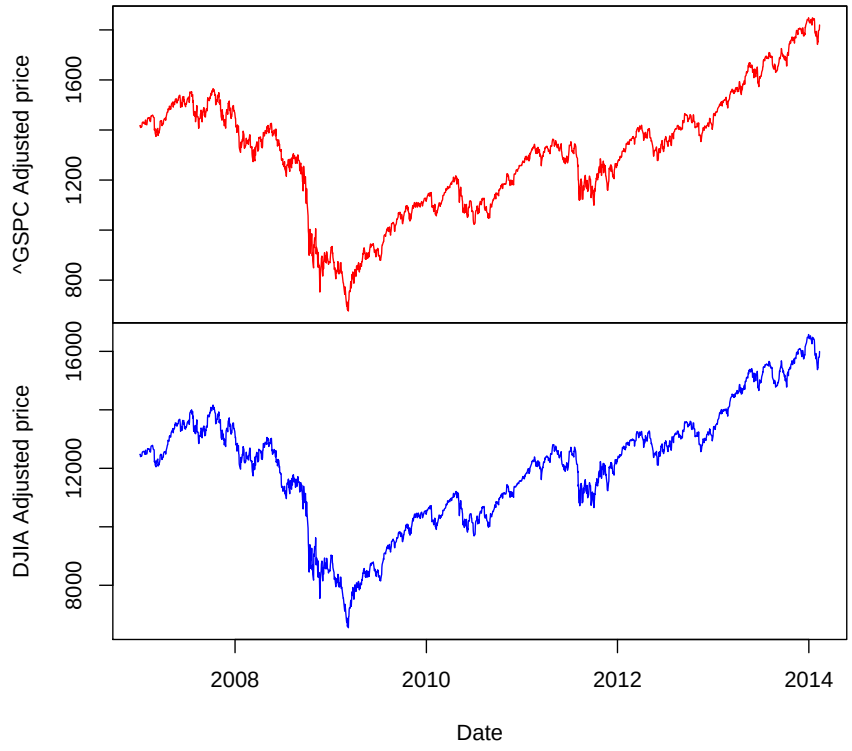
```
library(quantmod)
tickers <- c("^GSPC","^DJI")
getSymbols(tickers)
prices <- merge(Ad(GSPC),Ad(DJI))
cols <- c("red","blue"); ylab <- "Adjusted price"; xlab <- "Date"
# first plot them both in same screen
pdf('same_screen.pdf')
plot.zoo(prices,screen=c(1,1),col=cols,xlab=xlab,ylab=ylab)
legend("top",horiz=T,legend=tickers,col=cols,lty=1)
dev.off()
# now in different screens
pdf('different_screens.pdf')
plot.zoo(prices,col=cols,xlab=xlab,ylab=paste(tickers,ylab),main="")
dev.off()
####
```

Same screen



Almost impossible to compare the two time series like this

Different screens



Now the striking similarity is apparent

Position sizing

- For any trading strategy, position sizing is very important
- Any spread has an **implicit position ratio**, sometimes called the **hedge ratio** - it is the **ratio of the weights in the linear combination**
- Essentially, in very loose terms, the position sizing should "make the two graphs look the same"
- We would like this ratio to capture the ratio between expected price moves of the constituent price series - as an example, sometimes this ratio is derived via **via linear regression**
- Next, we will derive it as a ratio of moving averages of prices

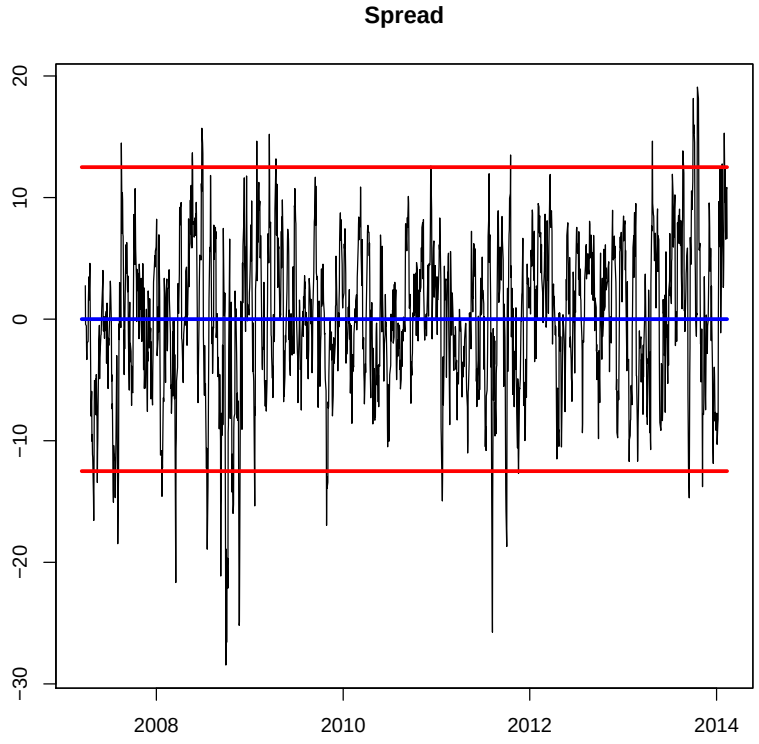
Spread example: finding weights

```
lookback <- 50

close1 <- close1[lookback:nDays]
close2 <- close2[lookback:nDays]

positionRatio <- lag(SMA(close1/close2),n=lookback)
spread <- close1 - positionRatio*close2
```

- **Spread = x - positionRatio * y**
- Buy one unit of `x` when we sell `positionRatio` units of `y`

Spread example

```
plot.zoo(cbind(spread,0,0.5,-0.5),screen=c(2,2,2,2),main="Spread")
```



A spread strategy

- The goal of creating a spread is to create a **stationary time series**, that is one with a constant mean and standard deviation
- If we succeed we can then **buy the spread** (long the cheap product and short the expensive one) whenever **the spread drops far below its mean** and **sell the spread** whenever it goes too **high above its mean**
- The theory of **cointegration** deals exactly with linear combinations of time series that are stationary - we will not go into the maths though..
- Next we will see a simple Bollinger Bands-based trading strategy idea for spreads. It is left as an exercise for you to implement it!

Exercise

Create a **spread trading strategy**. When spread

s1 - positionRatio * s2

crosses above (below) it's upper (lower) Bollinger Band:

s1 is expensive (cheap) and s2 is cheap (expensive)

- Sell (buy) **1 unit** of s1; and
- Buy (sell) **positionRatio** units of s2.

Commonly traded spreads

Here are some example. A spread can be established:

- Between different months of the same commodity (called an **interdelivery spread/ calendar spread**)
- Between the same or related commodities, usually for the same month (**intercommodity spread**)
- Between the same or related commodities traded on two different exchanges (**intermarket spread**).
- Pairs of equities (**pairs trading**)

Summary on spreads

Spreads are a common way to look for **mean reversion**

The two parts of the spread are called **legs**: Note that if we have a universe of k assets, there are

$$\binom{k}{2} = \frac{1}{2}(k-1)\cdot k$$

possible pairs, e.g., for 10 assets there are 45 possible pairs

In practice, trades with **more that two legs** exist, for example trades with three legs are not uncommon

Good mean-reverting spreads are typically comprised of two **cointegrated time series**

Next we will next look at momentum strategies