CHARTA LEARNING · LESSON NOTES

Exchange rate quotes: spreads, arbitrage, forwards and marking to market

Economics

1 A story: one firm, two currencies

- Halden Foods earns Marlins, pays costs in Dorens
- The bank gives two prices, never one
- Four skills: spread, arbitrage, forward, mark to market
- All currencies and rates here are made up

IN THE LESSON

- Meet Imani Brooks, a treasury analyst at a fictional firm called Halden Foods.
- Halden makes cheese in a country whose money is the Doren.
- Its customers live across the border and pay in Marlins.
- So every month Imani must turn Marlins into Dorens, and she never gets one clean price.
- The bank gives her two prices, one for buying and one for selling, and the gap between them is the bank's pay.
- All the currencies in this lesson are made up, and so are all the rates.
- We will use them to practise four skills, starting with reading a quote.

2 A quote has two prices

- Bid 2.0440
- Mid 2.0443
- Offer 2.0446

IN THE LESSON

- Here is a quote on a line.
- The bank quotes the Doren price of one Marlin.
- Written D R N per M R L, the Marlin is the base currency, the thing being priced, and the Doren is the price currency, the money used to pay.
- The bid is two point zero four four zero.
- That is what the bank pays when it buys a Marlin, so it is the price at which Imani sells.
- The offer is two point zero four four six.
- That is what the bank charges when it sells a Marlin, so it is the price at which Imani buys.
- The mid-rate, two point zero four four three, sits halfway between, and nobody can actually deal there.
- The client always deals at the worse price.

3 The spread

Spread = offer − bid
Spread % = (offer − bid) ÷ mid-rate

Bid	Where the client sells base
Offer	Where the client buys base
Mid-rate	Halfway between the two
Spread	The dealer's margin

IN THE LESSON

- The spread is the dealer's margin, and it is simply the offer minus the bid.
- We can state it in pips, a pip being the last decimal place of the quote, which is one ten thousandth for most pairs.
- Or we can state it as a percentage of the mid-rate, which lets us compare pairs that are priced very differently.
- Here the offer minus the bid is zero point zero zero zero six, which is six pips.
- Divided by the mid-rate, that is zero point zero two nine per cent.
- It looks tiny, but a spread is paid on every single trade.

4 Example 1: what the spread costs Imani

DRN/MRL spot 2.0440 / 2.0446; sell MRL 3,000,000

Sell at the bid	3,000,000 × 2.0440	**DRN 6,132,000**
Buy back at the offer	3,000,000 × 2.0446	**DRN 6,133,800**
Round trip cost	6,133,800 − 6,132,000	**DRN 1,800**
Spread in pips	2.0446 − 2.0440	**6 pips**
Spread as % of mid	0.0006 ÷ 2.0443	**0.0293%**

IN THE LESSON

- Imani has received three million Marlins and sells them at the bid.
- three million times two point zero four four zero gives six million one hundred and thirty two thousand Dorens.
- Now imagine she changed her mind and bought the same Marlins straight back at the offer.
- three million times two point zero four four six is six million one hundred and thirty three thousand eight hundred Dorens.
- She would be one thousand eight hundred Dorens poorer for doing nothing at all.
- That round trip cost is the spread in money.
- In pips it is six, and as a share of the mid-rate it is zero point zero two nine three per cent.

5 What makes a spread wider or narrower

- Wider: large trade, illiquid pair, volatile market
- Wider: outside main hours, weaker client relationship
- Narrower: small trade, busy pair, calm market
- The spread is the price of the dealer's risk

IN THE LESSON

- A dealer who quotes a price is taking a risk: the market may move before the dealer can trade the other way.
- So the spread is a price for that risk, and anything that raises the risk widens it.
- A large trade is harder to offset, so it gets a wider spread.
- A pair that rarely trades is illiquid, so the dealer may wait a long time to unwind.
- A volatile market means prices can jump while the dealer holds the position.
- Trading outside the main hours for the pair means few other dealers are around.
- And a weaker relationship with the client leaves the dealer less sure of the business.
- The opposite conditions narrow the spread.

6 Longer forwards, wider spreads

Spread (pips)

Spot	**6**
1 month	**7**
3 months	**9**
1 year	**14**

Illustration only: the longer the forward, the wider the spread

IN THE LESSON

- A forward is a deal to exchange currencies on a future date.
- Its quote is the spot quote plus forward points, and the points have their own bid and offer.
- So the forward spread is the spot spread plus the spread on the points.
- Look at the bars, which are an illustration, not market data.
- The first bar is spot, at six pips.
- The next bars are one month, three months and one year.
- Each is a little wider, because the longer the contract, the longer the dealer carries credit risk and interest rate risk, and the less often such contracts trade.
- The three month bar is nine pips, a number we will build in a moment.

7 Example 2: an all-in forward quote

3-month points: 29.0 bid, 32.0 offer (pips)

Forward bid	2.0440 + 0.0029	**2.0469**
Forward offer	2.0446 + 0.0032	**2.0478**
Forward spread	2.0478 − 2.0469	**9 pips**
Spread on the points	32.0 − 29.0	**3 pips**
Spot spread + points spread	6 + 3	**9 pips**

Bid to bid, offer to offer: never crossed

IN THE LESSON

- Imani asks for a three month forward.
- The bank quotes forward points of twenty nine point zero bid and thirty two point zero offer, in pips.
- The all-in forward bid is the spot bid plus the bid points: two point zero four four zero plus zero point zero zero two nine makes two point zero four six nine.
- The all-in forward offer is the spot offer plus the offer points: two point zero four four six plus zero point zero zero three two makes two point zero four seven eight.
- Always add bid to bid and offer to offer, never across.
- The forward spread is zero point zero zero zero nine, which is nine pips.
- That equals the spot spread of six pips plus the spread on the points, which is three pips.
- Longer maturity, wider spread.

8 Example 3: the inversion trap

Invert DRN/MRL 2.0440 / 2.0446 into MRL/DRN

New bid: from the old offer	1 ÷ 2.0446	**0.48909**
New offer: from the old bid	1 ÷ 2.0440	**0.48924**
Spread of the new quote	same dealer margin	**1.4 pips**
Check: 1 ÷ new bid	back to the old offer	**2.0446**

Inversion swaps the sides

IN THE LESSON

- Now the classic trap.
- Imani's Marlin supplier quotes the opposite way round, Marlins per Doren.
- To get that quote we invert, and the sides swap.
- A dealer's bid for Dorens is the fewest Marlins the dealer will pay out, and that corresponds to the highest Doren price of a Marlin, the original offer.
- So the new bid is one divided by two point zero four four six, which is zero point four eight nine zero nine.
- The new offer is one divided by two point zero four four zero, which is zero point four eight nine two four.
- If you wrongly took one over the original bid as the new bid, you would show the client a better price than any dealer would give.

9 A story: two routes to the same Marlin

- Kestrel is the third currency, KST
- Direct route: Kestrels straight to Marlins
- Long route: Kestrels to Dorens to Marlins
- If the two prices disagree, trade round the triangle

IN THE LESSON

- Suppose a market trader notices that a Marlin costs fewer Kestrels if she goes the long way round.
- Instead of buying Marlins directly with Kestrels, she first buys Dorens with Kestrels, and then buys Marlins with those Dorens.
- If the long way is cheaper than the direct price, she can buy through the long route and sell the Marlins to the direct dealer for more.
- Nothing about the Marlin has changed.
- Only the three quotes disagree.
- That is a triangular arbitrage: a risk free profit made by trading round three currencies and ending where you began.
- To find it, we first build the price the other two quotes imply.

10 Building the cross rate

Multiply so the common currency cancels

Kestrels per Doren → times Dorens per Marlin → Kestrels per Marlin

Combine the sides

Doren cancels → Bid times bid is implied bid → Offer times offer is implied offer

IN THE LESSON

- Here is how the cross is built.
- Along the top are the two quotes we have.
- Kestrels per Doren, then Dorens per Marlin.
- When we multiply them, the Doren appears once on the top and once on the bottom, so it cancels, and what is left is Kestrels per Marlin.
- That is the price of a Marlin in Kestrels through the Doren.
- Along the bottom is how the sides combine.
- The implied bid is the bid times the bid.
- The implied offer is the offer times the offer.
- This makes sense, because the lowest price you can sell at through the long route uses the lowest price at each stage.

11 The implied cross and the arbitrage test

Implied bid = bid × bid
Implied offer = offer × offer
Arbitrage if dealer bid > implied offer, or dealer offer < implied bid

Implied bid	Bid times bid
Implied offer	Offer times offer
Dealer's bid	Above implied offer: buy long way
Dealer's offer	Below implied bid: buy from dealer

IN THE LESSON

- Here is the rule written down.
- The implied bid is the first quote's bid times the second quote's bid.
- The implied offer is offer times offer.
- These two numbers form a range, the dealer's cross rate should sit inside, or at least overlap.
- If the dealer quotes a bid that is higher than our implied offer, the dealer is paying more for Marlins than it costs us to build them, so we buy the long way and sell to the dealer.
- If the dealer's offer is lower than our implied bid, the dealer is selling Marlins cheaply, so we buy from the dealer and sell the long way.
- If the ranges overlap, there is nothing to exploit.

12 Example 4: building the implied cross

KST/DRN 0.7500 / 0.7504; DRN/MRL 2.0440 / 2.0446

Implied bid, KST/MRL	0.7500 × 2.0440	**1.5330**
Implied offer, KST/MRL	0.7504 × 2.0446	**1.5343**
Third dealer's KST/MRL	bid 1.5350, offer 1.5355	**1.5350 / 1.5355**
Dealer bid above implied offer?	1.5350 against 1.5343	**Yes**

IN THE LESSON

- Imani's colleague sees Kestrels per Doren quoted at zero point seven five zero zero bid and zero point seven five zero four offer.
- The Doren price of a Marlin is the quote we know, two point zero four four zero and two point zero four four six.
- The implied bid for a Marlin in Kestrels is zero point seven five zero zero times two point zero four four zero, which is one point five three three zero.
- The implied offer is zero point seven five zero four times two point zero four four six, which is about one point five three four three.
- A third dealer quotes Kestrels per Marlin directly at one point five three five zero bid and one point five three five five offer.
- Is the dealer's bid above our implied offer?
- One point five three five zero against one point five three four three.
- Yes, by seven pips.

13 The ranges that do not overlap

- Implied bid 1.5330
- Implied offer 1.5343
- Dealer bid 1.5350
- Dealer offer 1.5355

IN THE LESSON

- Here are the two ranges on one line, with the price of a Marlin in Kestrels increasing to the right.
- In green is the range we built: the implied bid, one point five three three zero, and the implied offer, one point five three four three.
- Everything between them is what it costs to deal at the long route.
- In red is the third dealer's quote: a bid of one point five three five zero and an offer of one point five three five five.
- The red range sits entirely to the right of the green one.
- There is a gap between our offer and the dealer's bid, and the gap is the profit.
- If the ranges touched or overlapped, the spreads would swallow it.

14 Example 5: trading round the triangle

Start with KST 1,000,000; pay every offer, sell at the bid

Buy DRN at 0.7504	1,000,000 ÷ 0.7504	**DRN 1,332,622**
Buy MRL at 2.0446	1,332,622 ÷ 2.0446	**MRL 651,776**
Sell MRL to dealer at 1.5350	651,776 × 1.5350	**KST 1,000,476**
Profit	1,000,476 − 1,000,000	**KST 476**

Whole units at each step; ends in the currency it began with

IN THE LESSON

- Now collect the profit.
- Imani starts with one million Kestrels, and pays the offer at every purchase.
- First she buys Dorens, paying the Kestrel per Doren offer of zero point seven five zero four: one million divided by zero point seven five zero four is one million three hundred and thirty two thousand six hundred and twenty two Dorens.
- Then she buys Marlins with those Dorens at the Doren per Marlin offer of two point zero four four six, which gives six hundred and fifty one thousand seven hundred and seventy six Marlins.
- Finally she sells the Marlins to the third dealer at its bid of one point five three five zero, receiving one million four hundred and seventy six Kestrels.
- She started and finished in Kestrels, and she is four hundred and seventy six Kestrels richer.
- Every leg used the side that works against her, so the profit survives.

15 Example 6: when the common currency is in the same place

Given DRN/KST 1.3326 / 1.3333 and DRN/MRL 2.0440 / 2.0446

Invert DRN/KST: new bid	1 ÷ 1.3333	**0.7500**
Invert DRN/KST: new offer	1 ÷ 1.3326	**0.7504**
Implied KST/MRL bid	0.7500 × 2.0440	**1.5330**
Implied KST/MRL offer	0.7504 × 2.0446	**1.5343**

Invert first, then multiply: bid times bid, offer times offer

IN THE LESSON

- Sometimes the quotes are written so that the shared currency does not cancel.
- Suppose instead the Kestrel quote is given as Dorens per Kestrel: one point three three two six bid and one point three three three three offer.
- Dorens appear on top in both quotes, so multiplying would leave Dorens squared.
- We invert one of them first, and inversion swaps the sides.
- The new bid is one divided by the old offer, one over one point three three three three, which is zero point seven five zero zero.
- The new offer is one over one point three three two six, which is zero point seven five zero four.
- We are back to the Kestrels per Doren quote of before, so the implied cross is the same, one point five three three zero and one point five three four three.

16 Example 7: three dealers, three verdicts

Our implied range is 1.5330 to 1.5343

Dealer's KST/MRL quote	Verdict
1.5350 / 1.5355	Bid above 1.5343: arbitrage
1.5332 / 1.5339	Ranges overlap: none
1.5310 / 1.5325	Offer below 1.5330: arbitrage

IN THE LESSON

- Let's test three different quotes for Kestrels per Marlin against our implied range of one point five three three zero to one point five three four three.
- The first dealer quotes one point five three five zero and one point five three five five.
- The bid is above our implied offer, so there is an arbitrage.
- The second dealer quotes one point five three three two and one point five three three nine.
- Neither test is met, so the ranges overlap and there is nothing to exploit.
- The third dealer quotes one point five three one zero and one point five three two five.
- The dealer's offer is below our implied bid, so we buy Marlins from the dealer, and sell them through the long route, which earns about three hundred and twenty six Kestrels per million.

17 Mistakes to avoid so far

- Inverted bid is 1 ÷ old offer, not old bid
- Forward points: bid to bid, offer to offer
- Test bid against implied offer, offer against implied bid
- Common currency must cancel
- Start and end in the same currency

IN THE LESSON

- Let's collect the traps from the first half.
- One.
- Inverting a quote and keeping the sides: the inverted bid is one over the original offer, not the original bid.
- Two.
- Crossing the forward points, adding bid points to the offer or the other way round.
- Three.
- Comparing mid-rates in a triangular arbitrage and finding a profit that the spreads then wipe out.
- Always test the dealer's bid against the implied offer, and the dealer's offer against the implied bid.
- Four.
- Multiplying two quotes without checking that the common currency cancels.
- And five.
- Starting the triangle in one currency and ending in another, so the profit is not really a profit.

18 A story: locking in today's price for later

- Sell Marlins forward: fix the rate today
- Settle on a future date, such as 90 days
- The forward rate is not a forecast
- It follows from the two interest rates

IN THE LESSON

- Imani now knows that Halden will receive four million Marlins in ninety days.
- She does not want to wait and hope the rate stays put.
- So she sells those Marlins forward: she agrees today the rate at which she will exchange them on the future date.
- Many people assume that forward rate is the bank's forecast of where the spot rate will be.
- It is not.
- The forward rate is set by arbitrage between interest rates in the two countries.
- Think of it as a price tag that makes it equally good to hold either money until the settlement date.
- Let's see why, step by step.

19 Why the forward must be what it is

Route one: stay in Dorens

Lend Dorens at the Doren rate → Dorens grow → Dorens at the end

Route two: through Marlins

Swap to Marlins at spot → Lend Marlins at the Marlin rate → Swap back at the forward rate

IN THE LESSON

- Look at the two routes.
- Both begin with Dorens and end with Dorens on the same date.
- Along the top is the home route: lend the Dorens at the Doren interest rate, and they grow.
- Along the bottom is the route through Marlins: swap the Dorens into Marlins at the spot rate, lend the Marlins at the Marlin interest rate, then swap back into Dorens at the forward rate, which was fixed at the start so there is no currency risk.
- If the routes finished with different amounts, anyone could borrow on the worse one, lend on the better one, and take a free profit.
- So the forward rate must make the two routes end at the same amount.

20 The forward rate formula

F = S × (1 + i price × days ÷ 360) ÷ (1 + i base × days ÷ 360)

F: forward rate	Rate agreed today
S: spot rate	Price per unit of base today
Price-currency rate	Rate on the price currency
Base-currency rate	Rate on the base currency
Days	Days to settlement

IN THE LESSON

- Setting the two routes equal gives the formula.
- The forward rate equals the spot rate, times one plus the price currency's interest rate times days over three hundred and sixty, all divided by one plus the base currency's interest rate times days over three hundred and sixty.
- Here the price currency is the Doren, because the quote is Dorens per Marlin, so the Doren rate goes on top.
- Two points of care.
- The interest rates must be de-annualised: an annual rate is scaled to the number of days in the contract.
- And the day count in the money market is three hundred and sixty.
- A forward rate above spot means the base currency is at a forward premium.

21 Example 8: a ninety day forward

S = 2.0443; DRN 3.4%, MRL 2.8% a year; 90 days

Doren factor	1 + 0.034 × 90 ÷ 360	**1.0085**
Marlin factor	1 + 0.028 × 90 ÷ 360	**1.0070**
Forward	2.0443 × 1.0085 ÷ 1.0070	**2.0473**
Forward points	(F − S) × 10,000	**30.5**
Marlin premium	(F − S) ÷ S	**+0.149%**

IN THE LESSON

- Take the mid spot of two point zero four four three Dorens per Marlin.
- The ninety day Doren rate is three point four per cent a year and the ninety day Marlin rate is two point eight per cent.
- First de-annualise: the Doren factor is one plus zero point zero three four times ninety over three hundred and sixty, which is one point zero zero eight five.
- The Marlin factor is one point zero zero seven zero.
- The forward is two point zero four four three times one point zero zero eight five divided by one point zero zero seven zero, which is two point zero four seven three.
- That is above spot, so the Marlin is at a forward premium.
- The forward points are the difference scaled by ten thousand, about thirty point five points, and the premium is zero point one four nine per cent.

22 Forward points grow with time

Chart: Forward points (pips) vs Days to settlement (fraction of a year)

- 90 days: about 30
- 360 days: about 119

IN THE LESSON

- Here is how the forward points grow with the length of the contract, for the same two interest rates.
- Along the bottom is the number of days to settlement, from nothing to a full year.
- Up the side are the forward points, in pips.
- The line starts at zero, because a forward for today is just spot.
- Then it climbs steadily.
- The reason is that the interest differential, the Doren rate over the Marlin rate, has longer to work.
- At ninety days we are at about thirty points, which is our example.
- At a full year the points reach about one hundred and nineteen.

23 Example 9: flip the pair, flip the label

Same facts, pair written MRL/DRN: S = 0.48916

Spot, MRL per DRN	1 ÷ 2.0443	**0.48916**
Forward	0.48916 × 1.0070 ÷ 1.0085	**0.48844**
Forward points	(F − S) × 10,000	**−7.3**
Doren premium or discount	(F − S) ÷ S	**−0.149%**
Check: 1 ÷ 2.04735	the first forward, flipped	**0.48844**

High interest rate on the base: forward below spot

IN THE LESSON

- Now write the same pair the other way round, as Marlins per Doren.
- The Doren is now the base currency.
- Spot is one divided by two point zero four four three, which is zero point four eight nine one six.
- The Doren has the higher interest rate, so its rate goes below the line, and the forward is lower than spot: zero point four eight nine one six times one point zero zero seven zero divided by one point zero zero eight five gives zero point four eight eight four four.
- The points are minus seven point three, and the Doren is at a forward discount of zero point one four nine per cent.
- This confirms the rule.
- The Marlin is at a premium, so the Doren is at a discount.
- The percentages are close but not identical, because each is measured against a different spot.

24 Reading a forward: points and traps

- Points = (F − S) scaled: ×10,000, or ×100 for a yen pair
- Forward above spot: base currency at a premium
- Premium on base means discount on the price currency
- A premium is arithmetic, not a forecast

IN THE LESSON

- Let's pin down how forward points are read.
- The points are the forward minus spot, scaled to the last decimal of the quote.
- For a pair quoted to four decimals, you multiply by ten thousand.
- For a pair such as the yen, quoted to two decimals, you multiply by one hundred.
- A positive number of points means the forward is above spot, so the base currency is at a premium.
- Three traps appear often.
- First, forgetting to de-annualise, which makes the answer about four times too large for a three month contract.
- Second, putting the interest rates in the wrong places, with the base rate on top.
- Third, treating a forward premium as a forecast.
- It only reflects the interest rate gap.

25 A story: a promise that changes in value

- Halden sold MRL 4,000,000 forward at 2.0560
- Rates have moved since the contract was signed
- Ask what it would cost to close the deal today
- The locked-in difference is the contract's value

IN THE LESSON

- Three months ago, Halden agreed to sell four million Marlins forward at a fixed rate.
- Today the market has moved.
- The rate Halden locked in may now look generous or poor, and the firm's accountants, and its risk managers, want to know what that promise is worth right now.
- This is marking to market.
- The trick is to ask a simple question: if Halden wanted out today, what would it cost?
- Not by cancelling, but by doing the opposite deal for the same settlement date.
- The two deals together lock in a fixed difference, and we can value that difference.

26 The mark to market chain

Build the offsetting deal

Hold: sell MRL at the old forward →
Close: buy MRL at today's forward offer →
Gap in DRN at settlement

Value it today

Use days remaining, not original →
Discount at the DRN rate →
Value today in DRN

IN THE LESSON

- Here is the chain.
- Along the top, step one: Halden holds a contract to sell Marlins at the old forward rate.
- Step two: to close out, Halden imagines buying Marlins at today's forward rate for the same settlement date.
- Because Halden is the one buying, it pays the dealer's offer: the spot offer plus the offer points.
- Step three: the Marlins cancel out, and what is left is a gap in Dorens, the old rate minus today's rate, times the notional.
- That gap is paid on the settlement date.
- Along the bottom, step four is the discounting, because a sum arriving later is worth less today, using the Doren rate for the days that remain.

27 The value of a forward

Seller: V = (F0 − Ft) × notional ÷ (1 + i price × days left ÷ 360)
Buyer: V = (Ft − F0) × notional ÷ (1 + i price × days left ÷ 360)

F0: rate in contract	Rate in the contract
Ft: today's forward	Today's forward, right side
Notional	Size in base currency
Price-currency rate	Rate on the price currency
Days left	Days remaining

IN THE LESSON

- Here is the formula.
- For a contract that sells the base currency, the value per unit is the original forward rate minus today's forward rate, taken on the right side of the quote.
- That is the offer, because the seller closes by buying.
- For a contract that buys the base currency, the value per unit is today's forward rate minus the original, and today's forward is taken at the bid, because the buyer closes by selling.
- Multiply by the notional.
- The result is in the price currency and arrives at settlement, so divide by one plus the price currency's rate times the days remaining over three hundred and sixty.
- The remaining days, never the original maturity.

28 Example 10: the seller's contract

Sold MRL 4,000,000 at 2.0560; 90 days left; DRN 3.4%

Offset: buy at forward offer	2.0446 + 0.0032	**2.0478**
Gain per Marlin	2.0560 − 2.0478	**0.0082 DRN**
Gain at settlement	0.0082 × 4,000,000	**DRN 32,800**
Discount 90 days	32,800 ÷ 1.0085	**DRN 32,524**

IN THE LESSON

- Halden sold four million Marlins forward at two point zero five six zero.
- With ninety days left, spot is two point zero four four zero bid and two point zero four four six offer, and the ninety day points are twenty nine bid and thirty two offer.
- Halden sold, so it closes by buying, at the forward offer.
- That is two point zero four four six plus zero point zero zero three two, which is two point zero four seven eight.
- The gain per Marlin is two point zero five six zero minus two point zero four seven eight, which is zero point zero zero eight two Dorens.
- Times four million, that is thirty two thousand eight hundred Dorens at settlement.
- Now discount over the ninety days that remain at the Doren rate of three point four per cent: divide by one point zero zero eight five.
- The contract is worth about thirty two thousand five hundred and twenty four Dorens to Halden today.

29 Example 11: a buyer's contract

Bought MRL 2,000,000 at 2.0390; 90 days left

Offset: sell at forward bid	2.0440 + 0.0029	**2.0469**
Gain per Marlin	2.0469 − 2.0390	**0.0079 DRN**
Gain at settlement	0.0079 × 2,000,000	**DRN 15,800**
Discount 90 days	15,800 ÷ 1.0085	**DRN 15,667**

IN THE LESSON

- Halden also has a second contract, from a different deal.
- It bought two million Marlins forward at two point zero three nine zero, to pay a Marlin supplier.
- Ninety days remain, and the market is as before.
- Halden bought, so it closes by selling, at the forward bid.
- That is two point zero four four zero plus zero point zero zero two nine, which is two point zero four six nine.
- The gain per Marlin is today's rate minus the original: two point zero four six nine minus two point zero three nine zero, which is zero point zero zero seven nine.
- Times two million that is fifteen thousand eight hundred Dorens at settlement.
- Discounting over ninety days gives fifteen thousand six hundred and sixty seven Dorens.

30 The right answer and three wrong ones

Seller's contract: four ways to answer

Method	Value, DRN
Right: offer side, 90 days, discounted	32,524
Wrong side: forward bid	36,093
No discounting	32,800
Original 180 days used	32,252

IN THE LESSON

- Let's see how far the usual errors miss.
- Back to the seller's contract.
- The right answer is thirty two thousand five hundred and twenty four Dorens.
- Mistake one is using the wrong side, the forward bid of two point zero four six nine instead of the offer.
- Then the gain per Marlin looks like zero point zero zero nine one and the value jumps to thirty six thousand and ninety three Dorens.
- That overstates the value by more than three thousand Dorens.
- Mistake two is forgetting to discount, which leaves thirty two thousand eight hundred.
- Mistake three is discounting over the original one hundred and eighty days instead of the ninety that remain, which gives thirty two thousand two hundred and fifty two.

31 Recap

- Quote: bid, offer, spread; client gets the worse price
- Cross: bid × bid, offer × offer; test the ranges
- Forward: S × (1 + i price t) ÷ (1 + i base t)
- Mark to market: right side, days left, discount

IN THE LESSON

- Let's pull it together.
- A quote has a bid and an offer, and the client deals at the worse price.
- The spread is offer minus bid, in pips or as a share of the mid, and it widens with size, illiquidity, volatility, odd hours and weak relationships.
- A forward spread is the spot spread plus the spread on the points.
- A triangular arbitrage exists when the dealer's bid is above the implied offer or the dealer's offer is below the implied bid.
- The forward comes from interest rates, not forecasts, and the base is at a premium when the price currency pays more.
- And a forward is marked to market on the opposite side, with the days remaining, and discounted.

32 Try three quick questions

1. A/B 1.2000/1.2004, B/C 0.8000/0.8005. Implied A/C?
   Answer: 0.9600 / 0.9609
2. Spot 1.2000, price 5%, base 2%, 180 days. Forward?
   Answer: 1.2178: base at a premium
3. Sold 1m at 1.2400; fwd offer 1.2350; 4%; 90 days
   Answer: 5,000 ÷ 1.01 = 4,950

IN THE LESSON

- Question one.
- A over B is one point two zero zero zero to one point two zero zero four.
- B over C is zero point eight zero zero zero to zero point eight zero zero five.
- The implied bid and offer for A over C are bid times bid, zero point nine six zero zero, and offer times offer, zero point nine six zero nine.
- Question two.
- Spot is one point two zero zero zero, the price rate five per cent, the base rate two per cent, for one hundred and eighty days.
- The forward is one point two zero zero zero times one point zero two five over one point zero one, which is one point two one seven eight.
- Question three.
- A sale of the base at one point two four zero zero, with today's forward offer at one point two three five zero, notional one million, rate four per cent, ninety days left.
- The gain is five thousand, which discounts to four thousand nine hundred and fifty.