Interest Rate Derivatives

Price and Valuation Guide | Australia and New Zealand

The pricing conventions used for most ASX 24 interest rate futures products differ from that used in many offshore futures markets. Unlike in Europe and the United States where interest rate securities are traded in the cash market on the basis of their capital price, the convention adopted in Australia is to price such instruments on the basis of their yield to maturity. Due to this convention, ASX 24 interest rate contracts are similarly traded on the basis of yield with the futures price quoted as 100 minus the yield to maturity expressed in per cent per annum.

While the obvious advantage of pricing interest rate contracts in this fashion is that their yield is transparent and can be easily compared to yields on cash market instruments, an important by-product is that the tick value on these products does not remain constant, but rather changes in accordance with movements in the underlying interest rate. This variation is most pronounced in the 10 Year Treasury Bond Futures contract and is less substantial for the 3 Year Treasury Bond Futures and 90 Day Bank Bill Futures contracts. For all these contracts, the tick value decreases as interest rates rise, and increases as interest rates fall.

This document identifies which ASX 24 interest rate contracts have a variable tick system and details how to determine contract values, profit and loss on positions and variation margins.

ASX 24 interest rate products covered in this pricing guide

Contract	Variable or Fixed Tick System	Minimum Increment	Minimum Tick Value
30 Day Interbank Cash Rate Futures	Fixed	0.005	$12.33
90 Day Bank Bill Futures	Variable	0.01	Approx. $24.00
90 Day Bank Bill Options	Variable	0.005	Approx. $12.00
3 Year Treasury Bond Futures	Variable	0.01*	Approx. $30.00
3 Year Treasury Bond Options	Variable	0.005	Approx. $15.00
5 Year Treasury Bond Futures	Variable	0.005*	Approx. $26.00
10 Year Treasury Bond Futures	Variable	0.005*	Approx. $45.00
10 Year Treasury Bond Options	Variable	0.005	Approx. $45.00
20 Year Treasury Bond Futures	Variable	0.005*	Approx. $40.00
NZ 90 Day Bank Bill Futures	Variable	0.01	Approx. NZD $24.00
NZ 90 Day Bank Bill Options	Variable	0.01	Approx. NZD $24.00

* When using the Market Operator Defined Strategy Order – Spread Orders functionality the minimum fluctuation for quoting the Futures Price during the period 5:10 pm on the 8th of the expiry month, or the next business day if the 8th is not a business day, to 4:30 pm on the day of expiry, will be as specified in the ASX 24 Operating Rules Procedure 4022(a)(i)(f).

TABLE OF CONTENTS

ASX 30 Day Interbank Cash Rate Futures

The contract value associated with a position on the 30 Day Interbank Cash Rate Futures contract is equivalent to the interest paid on the $3,000,000 face value.

Because the 30 Day Cash Rate Futures contract has a fixed tick variation, margins are calculated by multiplying the number of price movements (in points terms) by the fixed tick dollar value of $24.66 per 0.01% move by the number of contracts traded.

For example:

Trade Price = 94.735
Number of Contracts = 100
End of Day Settlement Price = 94.750

Variation Margin on Position = $3,699.00 (1.5pts x $24.66 x 100 contracts)

ASX 90 Day Bank Accepted Bill Futures

Physical 90 Day Bank Bills

Bank Accepted Bills of Exchange are negotiable short term securities issued by trading banks used to affect short-term financing for periods typically between 30-180 days. Outstanding's in Bank Bills and other discount securities issued by banks totaled $230 billion as at June 2019 with annual turnover of $2,533 billion making these securities the largest and most liquid short-term securities issued in the Australian market.

The value of a physical 90 Day Bank Bill is calculated according to a yield to maturity formula that discounts the face value to establish the appropriate interest cost over the 90 days.

Australian convention uses simple interest to determine the interest cost. Simple Interest is where the interest rate is applied to the principal or present value. It should be noted that the US convention uses simple discount where the interest rate is applied to the future value or face value of the contract.

In addition Bank Bills are priced on an actual/365 basis.

The formula for the present value (P) of a bank bill is:

$$P = \frac{Face\ value \times 365}{365 + \left(\frac{yield \times days\ to\ maturity}{100}\right)}$$

The face value represents the bill's future value, i.e. its value at the end of its 90 day term.

Please note the Australian convention is to use a 365 rather than a 360 day year.

In order to calculate the Present Value (P) of a Bank Bill which has 90 days to maturity, a face value of $25,000,000 and is trading at a yield to maturity of 5.50%, the following calculations are performed:

$$P = \frac{25{,}000{,}000 \ \times 365}{365 + \left(\frac{5.5 \ \times 90}{100}\right)} = \$24{,}665{,}495.33$$

This same formula can be applied to value Bank Bills with varying maturities (i.e. 30, 60, 90, 180 days) and face values (i.e. $100,000, $500,000, $1,000,000). These values would simply be inserted into the formula where appropriate.

ASX 90 Day Bank Accepted Bill Futures

ASX 90 Day Bank Accepted Bill Futures contracts are the benchmark indicator for short term interest rates in Australia. Options on futures are also listed.

Products Available	Futures	Options on Futures
90 Day Bank Accepted Bills	March, June, September, December cycle up to sixteen quarter months or 4 years ahead and the nearest two non-quarterly expiry months.	Put and call options listed on futures contracts up to six quarter months ahead

ASX 90 Day Bank Bill Futures have a variable tick value of approximately $24.00, varying with the level of interest rates. ASX 90 Day Bank Bill Futures contracts are cash settled upon expiry using that days 3 month BBSW rate.

Calculating Contract Value

For ASX 90 Day Bank Bill Futures, where the contract value of one contracts is $1,000,000, and the term to maturity is exactly 90 days, the bank bill formula can be rewritten as:

$$P = \frac{1{,}000{,}000 \times 365}{365 + \left(\frac{Yield \times 90}{100}\right)}$$

Where the yield is the futures price deducted from 100. Therefore if a Bank Bill futures contract was trading at 95.00 (i.e. a yield of 5%) the value of the contract would be:

$$P = \frac{1{,}000{,}000 \times 365}{365 + \left(\frac{5.00 \times 90}{100}\right)} = \$987{,}821.38$$

Determining Variation Margins

ASX Clear (Futures) determines the variation or marked to market margin for variable tick contracts by comparing the contract value for the previous end of day price (or the trade price if the contract was bought or sold that day) and that day's end of day settlement price or exit price.

For example:

Sold ten 90 Day Bank Bill Futures at price of 94.54 (yield = 5.46%).

The contract value determined
Using the bank bill formula is $986,715.83 per contract. The contract value for ten contracts is $9,867,158.30.

End of day settlement price for 90 Day Bank Bill Futures is 94.51 (yield = 5.49%). Contract Value is $986,643.82 x ten contracts = $9,866,438.20

Variation Margin, determined by calculating the difference between the two contract values, that is, $9,867,158.30 -$9,866,438.20 = $720.10.

The margin payment received on the ten lot position is $720.10.

Determining the Tick Value

The dollar value of a 0.01% change in yield does not remain constant but rather varies in accordance with changes in the underlying interest rate.

Accordingly, to establish what the dollar value of a futures tick will be at a given price, the following calculations are made:

Use the contract valuation formula (as described above) to calculate the underlying value of the contract at the nominated futures price.

Apply the same formula to that same futures price minus 0.01 (i.e. increase the yield by 0.01%).

The difference between the two contract values represents the dollar value of the tick at the nominated futures price.

For example

To determine the dollar value of a 0.01% change in yield of a Bank Bill futures contract which is trading at a price of 95.00 (i.e. a yield of 5.00%) the following calculations are performed:

Futures contract value at 95.00 (5.00%) = $987,821.38 (rounded to two decimal places)
Futures contract value at 94.99 (5.01%) = $987,797.32 (rounded to two decimal places)
Difference (value of 0.01% move) = $24.06

Options on ASX 90 Day Bank Accepted Bill Futures

Premiums for options on 90 Day Bank Bill Futures are quoted in terms of annual percentage yield (e.g. 0.60% pa or 1.05% pa) with the value of a single point of premium (i.e. 0.01% pa) calculated by comparing its contract value at the exercise price (expressed as 100 minus annual yield) and its value at that same exercise price less one point (0.01%).

For example

A 90 Day Bank Bill Option with an exercise price of 95.00 and a premium of 0.065% pa would be valued as follows:

Futures contract value at 95.00 (5.00%) = $987,821.38 (rounded to the nearest cent)
Futures contract value at 94.99 (5.01%) = $987,797.32 (rounded to the nearest cent)
Difference (value of 0.01% of premium) = $24.06
Since we have 0.065% points of premium, the final premium in dollars is $156.39

To exactly match the premium in dollars as calculated by ASX Clear (Futures) the premium should be calculated in the following manner:

$24.06 x 0.065 = 1.5639 (rounded to four decimal places)
1.5639 x 100 = $156.39

A final important point to note is that, for an option with a particular exercise price, the value of 0.01% of premium is constant, while the tick value of the underlying futures contract is variable with the level of interest rates. To put it another way, the value of a move of a certain size in the futures market will not equate exactly in dollar terms with a move of the same size in the option premium. Investors should also be cautious about implementing conversion strategies owing to the differences in tick sizes between an option strike price and the prevailing futures price. For example, it can happen that an option appears to be priced slightly below its intrinsic value in terms of the yield when in fact, in dollar terms, the pricing is correct.

Australian Treasury Bonds

The Government of Australia is the benchmark issuer in the medium to long term debt market. Fixed coupon Commonwealth Government Bonds constitute the bulk of debt issued by the Australian federal government. As of July 2019, twenty five benchmark lines are issued out to around thirty years totalling $489 billion on issue. On average, the market turns over approximately $5.74 billion a day.

The formula for calculating the price per $100 of an Australian Treasury Bond as supplied by the Reserve Bank of Australia is:

$$P = v^{\frac{f}{d}}(c + ga_n + 100v^n)$$

where:

$v = 1/(1+i)$ where i is the annual percentage yield divided by 200

f= the number of days from the date of settlement to the next interest payment date

d = the number of days in the half year ending on the next interest payment date

c = the amount of interest payment (if any) per $100 face value at the next interest payment date

g = the fixed half-yearly interest rate payable (equal to the annual fixed rate divided by 2)

n = the number of full half-years between the next interest payment date and the date of maturity (equal to 2 times the number of years until maturity)

P = the price per $100 face value

$a_n = v + v + \dots + v^n = (1 - v^n)/i$. *Except if $i = 0$ then $a_n = n$*

The convention adopted with Treasury Bonds is that interest is paid on the fifteenth day of the appropriate month with the last interest payment made at maturity.

Using the Reserve Bank pricing formula, the calculations which would be performed to value a Commonwealth Treasury Bond with a maturity of 21 November 2029, a coupon rate of 2.75%, a market yield of 1.4089% and a settlement day of 19 July 2019 would be:

i = 0.0070445

v = 0.9930047778

f = (17/07/19 + T2 business (19/07/19) to 21/11/19 = 125

d = 184

g = 1.375

n = 20

$\frac{f}{d}$ =0.679347

c = 1.375

a_n = 18.5940837

$100v^n$ = 86.90139774

Using the above inputs, the bond would have a value of $113.302 per $100 face value (inclusive of accrued interest).

ASX 3 Year Treasury Bond Futures

Calculating Contract Value

The below formula is used to determine the contract value when i ≠ 0.

For ASX Treasury Bond futures, the Australian Office of Financial Management (AOFM) bond pricing formula can be simplified because there is always an exact number of half years to maturity and hence there is no requirement to calculate accrued interest.

The formula for the value (P) of a 3 Year Bond Futures contract on ASX is written as:

$$P = 1000 \times \left[\frac{c\,(1 - v^6)}{\mathrm{i}} + 100v^6\right]$$

where:

i = yield % pa divided by 200

v = 1/(1+i)

n = number of coupon payments. For the 3 Year contract this is 6.

c = coupon rate/2

Thus to value a 6% coupon 3 Year Treasury Bond contract which is trading at a price of 95.505 (i.e. a yield of 4.495% pa.), the inputs would be:

i = 0.022475

v = 0.97801902

n = 6

c = 3

When these inputs are included in the formula, the contract value for the above contract will be $104,180.10.

Note that the mathematical convention is that multiplication and division take precedence over, addition and subtraction. In the futures formula, this means that the division by i is performed before the addition of $100v^6$.

To exactly match the contract value as calculated by ASX Clear (Futures), steps C, D and G must be rounded to exactly eight decimal places, with 0.5 being rounded up. No other steps are rounded except K, which is rounded to two decimal places. ASX Clear (Futures) makes the calculation in the following manner:

	Futures Price	95.505
A	100 – price	4.495
B	I = A/200	0.022475
C	V = 1/(1 + B)	0.97801902
D	v^6	0.87515264
E	$1 – v^6 = 1 – D$	0.12484736
F	$3(1 – v^6) = 3 \times E$	0.37454208
G	$3(1 – v^6)/i = F/B$	16.66483115
H	$100v^6 = 100 \times D$	87.515264
I	G + H	104.18009515
J	I x 1,000	$104,180.095150
K	Rounded	$104,180.10

Calculating the contract value when the yield is equal to 0.00%

The above formula is used when ***i ≠ 0.***

*When **i= 0,** the below formula should be used to determine the contract value.*

$P = 1000 \times (c \times n) + 100{,}000$

Where:

C = Coupon rate / 2

N= the number of full half-years between the next interest payment date and the date of maturity (equal to 2 times the number of years until maturity)

For example:

6% coupon 3 year Treasury Bond contract which is trading at a price of 100.00

$P = 1000 \times (3 \times 6) + 100{,}000$

$P = 118{,}000$

Determining Variation Margins

ASX Clear (Futures) determines the variation or marked to market margin for variable tick contracts in the following by comparing the contract value for the previous end of day price (or the trade price if the contract was bought or sold that day) and that day's end of day settlement price or exit price.

For example:

Bought 10 x 3 Year Treasury Bond Futures at price of 95.505 (yield = 4.495%). The contract value determined using the bond formula is $104,180.10 per contract. The contract value for 10 contracts is $1,041,801.00

End of day settlement price for 3 Year Treasury Bond Futures is 94.490 (yield = 5.510%). The contract value is $101,338.06 x 10 contracts = $1,013,380.60

Variation Margin, determined by calculating the difference between the two contract values, that is $1,041,801.00 - $1,013,380.60 = $28,420.40.

The margin payment made on the 10 lot position is $28,420.40.

Determining the tick value

The dollar value of a 0.010% change in yield does not remain constant but rather varies in accordance with changes in the underlying interest rate.

Accordingly, to establish what the dollar value of a futures tick will be at a given price, the following calculations are made:

Use the contract valuation formula (as described above) to calculate the underlying value of the contract at the nominated futures price.

Apply the same formula to that same futures price minus 0.010 (i.e. increase the yield by 0.010%).

The difference between the two contract values represents the dollar value of the tick at the nominated Futures price.

For example

To calculate the dollar value of a 0.010% change in yield when the 6% coupon 3 Year contract is trading at a price of 94.760 (i.e. a yield of 5.240%), the following calculation is performed:

Futures contract value at 94.760 (5.240%) = $102,084.71379

Futures contract value at 94.750 (5.250%) = $102,056.93957

Difference (value 0.01% of premium) = $27.77422 which when rounded to the nearest cent gives $27.77

ASX 3 Year Bond Options

Premiums for the 3 Year Bond Options are calculated by reference to the value of a one-point move in the underlying futures contract from the exercise price to the exercise price less one point or 0.01%

To value a 6% coupon 3 Year Treasury Bond Option which has a strike price of 94.50 and a premium of 0.240 points, the following calculations are made:

Futures contract value at 94.500 = $101,365.591694

Futures contract value at 94.490 = $101,338.0571088

Difference (value 0.010% of premium) = $27.534586

Since there is 24 points of premium, the final premium in dollars is calculated as:

$27.53441 x 24 = $660.83006

When rounded to the nearest cent gives $660.83

A final important point to note is that, for an option with a particular exercise price, the value of 0.01% of premium is constant, while the tick value of the underlying futures contract is variable with the level of interest rates. To put it another way, the value of a move of a certain size in the futures market will not equate exactly in dollar terms with a move of the same size in the option premium. Investors should also be cautious about implementing conversion strategies owing to the differences in tick sizes between an option strike price and the prevailing futures price. For example, it can happen that an option appears to be priced slightly below its intrinsic value in terms of the yield when in fact, in dollar terms, the pricing is correct.

ASX 5 Year Treasury Bond Futures

Calculating Contract Value

The below formula is used to determine the contract value when i ≠ 0.

For ASX Treasury Bond Futures, the Australian Office of Financial Management (AOFM) bond pricing formula can be simplified because there is always an exact number of half years to maturity and hence there is no requirement to calculate accrued interest.

The formula for the value (P) of a 5 Year Bond Futures contract on ASX is written as:

$$P = 1000 \times \left[\frac{c\,(1 - v^{10})}{\mathrm{i}} + 100v^{10}\right]$$

where:

i = yield % pa divided by 200

v = 1/(1+i)

n = number of coupon payments. For the 5 Year contract this is 10.

c = coupon rate/2

Thus to value a 2% coupon 5 Year Treasury Bond contract which is trading at a price of 98.5050 (i.e. a yield of 1.495% pa.), the inputs would be:

i = 0.007475

v = 0.99258046

n = 10

c = 1

When these inputs are included in the formula, the contract value for the above contract will be $102,424.22.

Note that the mathematical convention is that multiplication and division take precedence over, addition and subtraction. In the futures formula, this means that the division by i is performed before the addition of $100v^{10}$.

To exactly match the contract value as calculated by ASX Clear (Futures), steps C, D and G must be rounded to exactly eight decimal places, with 0.5 being rounded up. No other steps are rounded except K, which is rounded to two decimal places. ASX Clear (Futures) makes the calculation in the following manner:

	Futures Price	98.505
A	100 – price	1.4950
B	I = A/200	0.007475
C	V = 1/(1 + B)	0.99258046
D	V^{10}	0.92823345
E	$1 – v^{10} = 1 – D$	0.07176655
F	$1(1 –v^{10}) = 1 \times E$	0.07176655
G	$1(1 – v^{10})/i = F/B$	9.60087625
H	$100v^{10} = 100 \times D$	92.823345
I	G + H	102.42422125
J	I x 1,000	$102,424.22125
K	Rounded	$102,424.22

Calculating the contract value when the yield is equal to 0.00%

The above formula is used when ***i ≠ 0.***

*When **i= 0,** the below formula should be used to determine the contract value.*

$$P = 1000 \times (c \times n) + 100{,}000$$

Where:

C = Coupon rate / 2

N= the number of full half-years between the next interest payment date and the date of maturity (equal to 2 times the number of years until maturity)

For example:

2% coupon 5 Year Treasury Bond contract which is trading at a price of 100.00

$$P = 1000 \times (1 \times 10) + 100{,}000$$

$$P = 110{,}000$$

Determining Variation Margins

ASX Clear (Futures) determines the variation or marked to market margin for variable tick contracts in the following by comparing the contract value for the previous end of day price (or the trade price if the contract was bought or sold that day) and that day's end of day settlement price or exit price.

For example:

Bought 10 x 5 Year Treasury Bond Futures at price of 98.505 (yield = 1.495%). The contract value determined using the bond formula is \$102,424.22 per contract. The contract value for 10 contracts is \$1,024,242.20

End of day settlement price for 5 Year Treasury Bond Futures is 98.420 (yield = 1.580%). The contract value is \$102,011.57 x 10 contracts = \$1,020,115.70

Variation Margin, determined by calculating the difference between the two contract values, that is \$1,024,242.20 - \$1,020,115.7 = \$4,126.50

The margin payment made on the 10 lot position is \$4,126.50

Determining the tick value

The dollar value of a 0.010% change in yield does not remain constant but rather varies in accordance with changes in the underlying interest rate.

Accordingly, to establish what the dollar value of a futures tick will be at a given price, the following calculations are made:

Use the contract valuation formula (as described above) to calculate the underlying value of the contract at the nominated futures price.

Apply the same formula to that same futures price minus 0.010 (i.e. increase the yield by 0.010%).

The difference between the two contract values represents the dollar value of the tick at the nominated Futures price.

For example

To calculate the dollar value of a 0.010% change in yield when the 2% coupon 5 Year contract is trading at a price of 98.5150 (i.e. a yield of 1.4850%), the following calculation is performed:

Futures contract value at 98.5150 (1.4850%) = \$102,472.8941

Futures contract value at 98.5050 (1.495%) = \$102,424.2213

Difference (value 0.01% of premium) = \$48.6728 which when rounded to the nearest cent gives \$48.67

ASX 10 Year Treasury Bond Futures

Calculating Contract value

*The below formula is used to determine the contract value when **i ≠ 0.***

For ASX Treasury Bond Futures, the pricing formula can be simplified because there is always an exact number of half years to maturity and hence there is no requirement to calculate accrued interest.

The formula for the value (P) of a 10 Year Bond Futures contract on ASX is written as:

$$P = 1000 \times \left[\frac{c\,(1 - v^{20})}{\mathrm{i}} + 100v^{20}\right]$$

where:

I = yield % p.a. divided by 200

$v = 1/(1+i)$

$n = 20$

c = coupon rate/2

Thus to value a 6% coupon 10 Year Treasury Bond contract which is trading at a price of 95.500 (i.e. a yield of 4.50% p.a.), the inputs would be:

$i = 0.02250000$

$v = 0.97799511$

$n = 20$

$c = 3$

When these inputs are included in the formula, the contract value for the above contract will be $111,972.78.

Note that the mathematical convention is that multiplication and division take precedence over addition and subtraction. In the futures formula, this means that the division by i is performed before the addition of 100v20.

To exactly match the contract value as calculated by ASX Clear (Futures), steps C, D and G must be rounded to exactly eight decimal places, with 0.5 being rounded up. No other steps are rounded except K, which is rounded to two decimal places. ASX Clear (Futures) makes the calculation in the following manner:

	Futures Price	95.500
A	100 – price	4.500
B	I = A/200	0.0225
C	V = 1/(1 + B)	0.97799511
D	v^{20}	0.64081647
E	1 - v^{20} = 1 – D	0.35918353
F	3(1 - v20) = 3 x E	1.07755059
G	3(1 - v^{20})/i = F/B	47.89113733
H	100 v^{20}= 100 x D	64.081647
I	G + H	111.97278433
J	I x 1,000	$111,972.78433
K	Rounded	$111,972.78

Calculating the contract value when yield is equal to 0.00

The above formula is used when ***i ≠ 0.***

*When **i= 0,** the below formula should be used to determine the contract value.*

$$P = 1000 \times (\mathrm{c} \times \mathrm{n}) + 100{,}000$$

Where:

C = Coupon rate / 2

N= the number of full half-years between the next interest payment date and the date of maturity (equal to 2 times the number of years until maturity)

For example:

6% coupon 10 year Treasury Bond contract which is trading at a price of 100.00

$$P = 1000 \times (3 \times 20) + 100{,}000$$

$$P = 160{,}000$$

Determining Variation Margins

ASX Clear (Futures) determines the variation or marked to market margin for variable tick contracts in the following by comparing the contract value for the previous end of day price (or the trade price if the contract was bought or sold that day) and that day's end of day settlement price or exit price.

For example:

Bought 10 x 10 Year Treasury Bond Futures at price of 95.500 (yield = 4.500%). The contract value determined using the bond formula is $111,972.78 per contract. The contract value for 10 contracts is $1,119,727.80

End of day settlement price for 10 Year Treasury Bond Futures is 95.350 (yield = 4.6500%). The contract value is $110,698.74 x 10 contracts = $1,106,987.40

Variation Margin, determined by calculating the difference between the two contract values, that is $1,119,727.80 - $1,106,987.40 = $12,740.40.

The margin payment made on the 10 lot position is $12,740.40.

Determining the Tick Value

The methodology used to calculate tick values for the ASX 10 Year Treasury Bond Futures is identical to that outlined in the previous example for ASX 5 Year Treasury Bond Future.

For example, to determine the dollar value of a 0.01% change in yield on a 10 Year Bond contract trading at a price of 94.360 (i.e. a yield of 5.64%), the following calculations are performed:

Futures contract value at 94.360 (5.64%) = $102,723.06023

Futures contract value at 94.350 (5.65%) = $102,646.18658

Difference (value of 0.01% of premium) = $76.87365 or $76.87 rounded to two decimal places.

ASX 10 Year Treasury Bond Options

Like ASX Bank Bill options, 10 Year bond options are quoted in terms of annual percentage yield (e.g. 0.410% or 0.525%), with the value of a single point of premium (i.e. 0.01%) calculated as the difference between the contract value at the exercise price (expressed as 100 minus the annual yield) and its value at that exercise price less one point (0.01%).

Please note that when making these calculations, contract values are not rounded to the nearest cent before calculating this difference. Accordingly, the dollar value of an option on a 10 Year Treasury Bond Option with an exercise price of 94.000 and a premium of 0.140% would be calculated as follows:

Futures contract value at 94.000 = $100,000.0000

Futures contract value at 93.990 = $99,925.6470014

Difference (value 0.01% of premium) = $74.3529986

Since there is 14 points of premium, the final premium in dollars is calculated as:

$74.3529986 x 14 = $1,040.9420

Which when rounded to the nearest cent gives $1040.94

ASX 20 Year Treasury Bond Futures

Calculating Contract Value

The below formula is used to determine the contract value when ***i ≠ 0.***

For ASX Treasury Bond Futures, the pricing formula can be simplified because there is always an exact number of half years to maturity and hence there is no requirement to calculate accrued interest.

The formula for the value (P) of a 20 Year Bond Futures contract on ASX is written as:

$$P = 650 \times \left[\frac{\mathrm{c}(1 - v^n)}{\mathrm{i}} + 100v^n\right]$$

where:

i = yield % p.a. divided by 200

v = 1/(1+i)

n = 40

c = coupon rate/2

Thus to value a 4% coupon 20 Year Treasury Bond contract which is trading at a price of 97.500 (i.e. a yield of 2.50% p.a.), the inputs would be:

i = 0.01250000

v = 0.98765432

n = 40

c = 2

When these inputs are included in the formula, the contract value for the above contract will be $80,271.89.

Note that the mathematical convention is that multiplication and division take precedence over addition and subtraction. In the futures formula, this means that the division by i is performed before the addition of 100v40.

To exactly match the contract value as calculated by ASX Clear (Futures), steps C, D and G must be rounded to exactly eight decimal places, with 0.5 being rounded up. No other steps are rounded except K, which is rounded to two decimal places. ASX Clear (Futures) makes the calculation in the following manner:

	Futures Price	97.500
A	100 – price	2.500
B	I = A/200	0.0125
C	V = 1/(1 + B)	0.98765432
D	V^{40}	0.60841331
E	$1 – V^{40} = 1 – D$	0.39158669
F	$2(1 – V^{40}) = 2 \times E$	0.78317338
G	$2(1 – V^{40})/i = F/B$	62.65387040
H	$100\ V^{40} = 100 \times D$	60.841331
I	G + H	123.4952014
J	I x 650	$80,271.88091
K	Rounded	$80,271.88

Calculating the contract value when yield is equal to 0.00

The above formula is used when ***i* ≠ 0.**

*When **i= 0,** the below formula should be used to determine the contract value.*

$$P = 650 \times (c \times n) + 65{,}000$$

Where:

C = Coupon rate / 2

N= the number of full half-years between the next interest payment date and the date of maturity (equal to 2 times the number of years until maturity)

For example:

4% coupon 20 year Treasury Bond contract which is trading at a price of 100.00

$$P = 650 \times (2 \times 40) + 65{,}000$$

$$P = 117{,}000$$

Determining Variation Margins

ASX Clear (Futures) determines the variation or marked to market margin for variable tick contracts in the following by comparing the contract value for the previous end of day price (or the trade price if the contract was bought or sold that day) and that day's end of day settlement price or exit price.

For example: Bought 10x 20 Year Treasury Bond Futures at price of 96.660 (yield = 3.340%). The contract value determined using the bond formula is $71,222.18 per contract. The contract value for 10 contracts is $712,221.80 End of day settlement price for 10 Year Treasury Bond Futures is 96.675 (yield = 3.325%). The contract value is x 10 $71,372.19 contracts = $713,721.90 Variation Margin, determined by calculating the difference between the two contract values that is $712,221.80-$713,721.90 = $1,500.10 The margin payment made on the 10 lot position is $1,500.10

Determining the Tick Value

The methodology used to calculate tick values for the ASX 20 Year Treasury Bond Futures is as follows:

For example, to determine the dollar value of a 0.01% change in yield on a 20 Year Bond contract trading at a price of 96.5600 (i.e. a yield of 3.44%), the following calculations are performed: Futures contract value at 96.560 (3.44%) = $70,232.16 Futures contract value at 96.550 (3.45%) = $70,134.16 Difference = $98.00

ASX New Zealand 90 Day Bank Bill Futures

The ASX 24 New Zealand Bank Bill Futures are the leading short term interest rate derivative product in the New Zealand Market. They are a cash settled product that's derived from either

a) 90 Day bank accepted bill of exchange complying the Bills of Exchange Act 1908 of New Zealand: or
b) A transferrable or Negotiable security with a term to maturity of 90 days which is issued by a bank which is a registered bank within the meaning of the Reserve Bank of New Zealand Act 1989.

The face value of the product is NZD $1,000,000 per contract with a variable tick value of approximately NZD $24.44 per tick.

In terms of settlement, the 90 Day New Zealand Bank Bill Futures are cash settled against the 3 month Forward Rate Agreement rate.

Contract Value

To determine the contract value for the New Zealand 90 Day Bank Bill futures, the below formula is used.

$$P = \frac{Face\ value \times 365}{365 + \left(\frac{yield \times 90}{100}\right)}$$

Where:
P= Price expressed as a yield percent per annum.
To calculate the yield, simply subtract the price from 100 (e.g.: 100-96.50)

The calculations within the brackets shall be carried out to such number of decimal places as the market operator shall determine and the values shall be rounded in the manner determined by the market operator.

For Example
To calculate the contract value if a market participant had bought 1 NZ futures bank bill future at 96.5, we use the above formula:

$$P = \frac{1{,}000{,}000 \ \times 365}{365 + \frac{(3.5 \times 90)}{100}}$$

$$P = \frac{365{,}000{,}000}{368.15}$$

$$P = \$991{,}443.71 \text{ (Rounded to the nearest cent)}$$

Determining Variation Margins

To calculate variation margin
To determine the variation margin, you calculate the contract value at the time of purchase, then recalculate the contract value at the time of settlement using the settlement price and subtract the difference.

For example
Buying 10 contracts of the NZ Bank Bill futures at 96.50. The contract value = $ $991 443.705
As at close of business, NZ Bank Bill futures settled at 96.55 which equates to a contract value of $991 564.906
Therefore, the Variation margin per contract = $121.20
The variation margin required for the position = $121.20 x 10 contracts =$1212.01

With reference to the NZ bank bill futures spread market, margins are calculated on a tiered basis. These margin parameters are located on page 4 of the document ASX Clear (Futures) Margin Parameters available on our website. Note, these margin parameters can change

Determining Tick Value

The dollar value of a 0.01% change in yield does not remain constant but rather varies in accordance with changes in the underlying interest rate.

Accordingly, to establish what the dollar value of a futures tick will be at a given price, the following calculations are made:

Use the contract valuation formula (*as described above*) to calculate the underlying value of the contract at the nominated futures price.

Apply the same formula to that same futures price minus 0.01 (i.e. increase the yield by 0.01%).

The difference between the two contract values represents the dollar value of the tick at the nominated futures price

For example

Futures contract value: 3.45% (96.55) = $991 564.91

Futures contract value: 3.46% (96.54) = $991 540.66

Therefore, the tick value = NZD $24.24

Options on ASX New Zealand 90 day Bank Bill Futures

Premiums for options on NZ 90 Day Bank Bill Futures are quoted in terms of annual percentage yield (e.g. 0.60% pa or 1.00% pa) with the value of a single point of premium (i.e. 0.01% pa) calculated by comparing its contract value at the exercise price (expressed as 100 minus annual yield) and its value at that same exercise price less one point (0.01%).

For example, a NZ 90 Day Bank Bill Option with an exercise price of 95.00 and a premium of 0.060% pa would be valued as follows: Futures contract value at 95.00 (5.00%) = $987,821.38 (rounded to two decimal places) Futures contract value at 94.99 (5.01%) = $987,797.32 (rounded to two decimal places) Difference (value of 0.01% of premium) = $24.06 Since we have 6 points of premium, the final premium in dollars is $ 144.36 To exactly match the premium in dollars as calculated by ASX Clear (Futures) the premium should be calculated in the following manner: $24.06 x 0.060 = 1.4436(rounded to four decimal places) 1.4436 x 100 = $144.36

A final important point to note is that, for an option with a particular exercise price, the value of 0.01% of premium is constant, while the tick value of the underlying futures contract is variable with the level of interest rates. To put it another way, the value of a move of a certain size in the futures market will not equate exactly in dollar terms with a move of the same size in the option premium. Investors should also be cautious about implementing conversion strategies owing to the differences in tick sizes between an option strike price and the prevailing futures price. For example, it can happen that an option appears to be priced slightly below its intrinsic value in terms of the yield when in fact, in dollar terms, the pricing is correct.

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