

# Marks-to-Market in U.S. Treasury Futures and Options: Conventions for Computing Variation Margin Amounts

March 2010

Treasury futures and options routinely trade at price levels that, in theory, would lead to variation margin amounts involving fractions of cents. As a practical matter these must be rounded to the nearest penny. Anyone familiar with futures trade processing will be keenly aware that errors arising from confusion over how and when rounding occurs can, on occasion, run to hefty sums.

This note describes the conventions by which CME Clearing and its clearing member firms round fractional portions of contract prices when computing variation margin amounts on Treasury contract positions.

Section (1) establishes the basics. Sections (2) and (3) spell out details. Section (4) discusses application to 5-Year Note futures, 10-Year Note futures, "Classic" Bond futures, and Long-Term ("Ultra") Bond futures. Section (5) addresses 2-Year Note and 3-Year Note futures. Section (6) indicates how the method applies to rounding of option premium amounts.

## **(1) General Principles**

*(1.1) Rounding applies to single contracts, not to contract positions.*

To find the monetary value of a contract position, first establish the effective monetary value, appropriately rounded, of an individual contract. The monetary value of the position equals the product of (a) the single contract result times (b) the number of contracts in the position.

*(1.2) Rounding applies to contract price levels, not to contract price changes.*

Computing variation margin amounts entails three steps. First, find the monetary value of the position, appropriately rounded, at today's daily settlement price. Second, find the monetary value of the position at today's trade price (or, for maintained positions, at yesterday's daily settlement price). Third, compute the difference: Subtract the monetary value at the trade price (or yesterday's daily settlement price for maintained positions) from the monetary value at today's daily settlement price.

## **(2) Representing Treasury Futures Contract Prices**

As with prices of cash Treasury notes and bonds, Treasury futures prices are quoted in points and fractions of points. Admissible fractional increments vary among contracts:

32nds of points for Classic Bond futures and Ultra Bond futures;  
halves of 32nds for 10-Year Note futures;  
quarters of 32nds for 5-Year, 3-Year, and 2-Year Note futures.

“Par” is always 100 points. Prices greater than par appear as six digits – say, “HHH-TTF” -- and prices less than par appear as five digits – say, “HH-TTF.” The H entries represent the “handle”, the number of whole points. The T entries indicate the number of whole 32nds of a point. The F represents fractional values of a 32<sup>nd</sup>. Exhibit 1 illustrates how these fractional values are commonly expressed.

**Exhibit 1 -- Representing Fractions of 32nds in Treasury Futures Prices**

Fractional value of a 32 <sup>nd</sup>	Integer display	Fractional display
Whole 32 <sup>nd</sup>	0	0
Quarter	2	¼
Half	5	+
Three Quarters	7	¾

Examples

A price of 116 and 27/32nds will appear as either 116.270 or 116-270.

A price of 116 and 27.25/32nds will appear as either 116.272 or 116-27¼.

A price of 116 and 27.5/32nds will appear as either 116.275 or 116-27+.

**(3) Computational Details**

(3.1) Begin by calculating the effective monetary value of a single contract at its *daily settlement price* (or at its intraday marking price, if circumstances are appropriate) --

(3.1.1) Decimalize the price, to whatever degree of precision this requires. For Treasury futures and options, that means carrying the result to as many as seven decimal places.

Example

Consider the price 116.272 (or 116-27¼). To decimalize it, first separate the portion indicating number of whole price points (116) from the fractional portion (272, or 27¼). Then divide the fractional portion by 32:  $27.25/32 = 0.8515625$ . Then recombine the two portions: 116.8515625.

(3.1.2) Multiply result (3.1.1) by the contract value factor. For Classic Bond futures, Ultra Bond futures, and 10-Year and 5-Year Note futures, this is \$1,000 per point or \$31.25 per 32<sup>nd</sup>.

Example, contd

116.8515625 points x \$1,000/point = \$116,851.5625

For 2-Year and 3-Year Note futures, it is \$2,000 per point or \$62.50 per 32<sup>nd</sup>.

(3.1.3) Round result (3.1.2) to the nearest penny. If result (3.1.2) ends in a half-penny, then round **up**.

Example, contd

\$116,851.5625 rounded to the nearest penny = \$116,851.56

(3.2) For a newly entered contract position, repeat the steps in (3.1) to calculate the effective monetary value of a single contract at its *trade price*. (For a contract position that is not newly established, i.e., a position maintained from an earlier trading session, use the previous daily settlement price instead of the trade price.)

(3.3) Subtract the effective monetary value of the contract at its trade price from its effective monetary value at its daily settlement price. That is, subtract result (3.2) from result (3.1).

(3.4) Multiply result (3.3) by the number of futures contracts in the position. The number of contracts is positive if the position is long, negative if the position is short. A positive result means a gain, or a variation margin collect. A negative result means a loss, or a variation margin payment.

#### **(4) 5-Year Note, 10-Year Note, Classic Bond, and Ultra Bond Futures**

To see how this works for 5-Year Note, 10-Year Note, Classic Bond, or Ultra Bond futures, consider the following example.

Suppose you want to mark to market a newly established short position of 147 5-Year Note futures. The trade price is 115-16¾. In points and 32nds this is 115-16.75/32nds. In decimal form it is 115.5234375. Because the contract value factor is \$1,000 per point, the monetary value of a single contract at this trade price is:

$$\$1,000 \times 115.5234375 = \$115,523.4375$$

After rounding to the nearest penny, the effective monetary value is \$115,523.44.

Suppose the daily settlement price is 115-170, or 115-17/32nds. In decimal form, this is 115.53125. Thus, the monetary value of the contract at its daily settlement price equals:

$$\$1,000 \times 115.53125 = \$115,531.25$$

The variation margin per contract is the difference between the two -- effective monetary value at daily settlement price minus effective monetary value at trade price:

$$\$115,531.25 \text{ minus } \$115,523.44 = \$7.81$$

The variation margin for the entire short position of 147 contracts is the product of this single-contract result times the number of contracts in the position. The result is a variation margin payment of \$1,148.07:

$$\$7.81 \text{ per contract} \times -147 \text{ contracts} = (\$1,148.07)$$

#### Reminder

The number of contracts must be properly signed: positive for long positions, negative for short positions.

#### Remark

The calculations above would have been similar in nearly all respects had we used either of the Bond futures or the 10-Year Note futures instead of 5-Year Note futures. The chief difference is that prices of both Bond futures trade in increments of full 32nds, and 10-Year Note futures trade in increments of halves of 32nds, rather than quarters of 32nds.

Because rounding always leads to the same result for any given combination of 32nds and fractions of 32nds, there is no need to re-compute the rounded monetary value per contract after each transaction. Faster and more efficient is to use a lookup table, such as Exhibit 2.

**Exhibit 2**  
**Ultra Bond, Classic Bond, 10-Year Note, and 5-Year Note Futures:**  
**Rounded Dollar Amounts for Fractional Price Portions**  
**for Futures with \$1000 Contract Value Factors**

32nds	\$ Value	32nds	\$ Value	32nds	\$ Value	32nds	\$ Value
0	0.00	8	250.00	16	500.00	24	750.00
0.25	7.81	8.25	257.81	16.25	507.81	24.25	757.81
0.5	15.63	8.5	265.63	16.5	515.63	24.5	765.63
0.75	23.44	8.75	273.44	16.75	523.44	24.75	773.44
1	31.25	9	281.25	17	531.25	25	781.25
1.25	39.06	9.25	289.06	17.25	539.06	25.25	789.06
1.5	46.88	9.5	296.88	17.5	546.88	25.5	796.88
1.75	54.69	9.75	304.69	17.75	554.69	25.75	804.69
2	62.50	10	312.50	18	562.50	26	812.50
2.25	70.31	10.25	320.31	18.25	570.31	26.25	820.31
2.5	78.13	10.5	328.13	18.5	578.13	26.5	828.13
2.75	85.94	10.75	335.94	18.75	585.94	26.75	835.94
3	93.75	11	343.75	19	593.75	27	843.75
3.25	101.56	11.25	351.56	19.25	601.56	27.25	851.56
3.5	109.38	11.5	359.38	19.5	609.38	27.5	859.38
3.75	117.19	11.75	367.19	19.75	617.19	27.75	867.19
4	125.00	12	375.00	20	625.00	28	875.00
4.25	132.81	12.25	382.81	20.25	632.81	28.25	882.81
4.5	140.63	12.5	390.63	20.5	640.63	28.5	890.63
4.75	148.44	12.75	398.44	20.75	648.44	28.75	898.44
5	156.25	13	406.25	21	656.25	29	906.25
5.25	164.06	13.25	414.06	21.25	664.06	29.25	914.06
5.5	171.88	13.5	421.88	21.5	671.88	29.5	921.88
5.75	179.69	13.75	429.69	21.75	679.69	29.75	929.69
6	187.50	14	437.50	22	687.50	30	937.50
6.25	195.31	14.25	445.31	22.25	695.31	30.25	945.31
6.5	203.13	14.5	453.13	22.5	703.13	30.5	953.13
6.75	210.94	14.75	460.94	22.75	710.94	30.75	960.94
7	218.75	15	468.75	23	718.75	31	968.75
7.25	226.56	15.25	476.56	23.25	726.56	31.25	976.56
7.5	234.38	15.5	484.38	23.5	734.38	31.5	984.38
7.75	242.19	15.75	492.19	23.75	742.19	31.75	992.19

## (5) 2-Year and 3-Year Note Futures

2-Year and 3-Year Note futures differ from other Treasury futures in having a contract value factor of \$2,000 per point, instead of \$1,000. The following example illustrates.

Suppose you wish to mark a newly entered long position of 335 contracts. The trade price is 97-23<sup>3</sup>/<sub>4</sub>, or 97-23.75/32nds. In decimal terms, this is 97.7421875. With a contract value factor of \$2,000 per point, the monetary value per contract at this trade price is:

$$\$2,000 \times 97.7421875 = \$195,484.375$$

Rounding to the nearest penny puts the effective monetary value at \$195,484.38.

Suppose the contract's daily settlement price is 97-310, or 97-31/32nds. In decimal form, this is 97.96875, making a monetary value per contract of:

$$\$2,000 \times 97.96875 = \$195,937.50$$

As before, the variation margin per contract is just the difference between the effective monetary values at daily settlement price and at trade price:

$$\$195,937.50 \text{ minus } \$195,484.38 = \$453.12$$

The variation margin for the position is the product of this single-contract result times the number of contracts in the position –

$$335 \text{ contracts} \times \$453.12 \text{ per contract} = \$151,795.20$$

As with prices of other Treasury futures, so with prices of 2-Year or 3-Year Note futures. You will always obtain the same result for any given combination of 32nds and fractions of 32nds if you apply the prescribed rounding procedures. The lookup table in Exhibit 3 summarizes these.

**Exhibit 3**  
**2-Year and 3-Year Note Futures:**  
**Rounded Dollar Amounts for Fractional Price Portions**  
**for Futures with \$2000 Contract Value Factors**

32nds	\$ Value	32nds	\$ Value	32nds	\$ Value	32nds	\$ Value
0	0.00	8	500.00	16	1,000.00	24	1,500.00
0.25	15.63	8.25	515.63	16.25	1,015.63	24.25	1,515.63
0.5	31.25	8.5	531.25	16.5	1,031.25	24.5	1,531.25
0.75	46.88	8.75	546.88	16.75	1,046.88	24.75	1,546.88
1	62.50	9	562.50	17	1,062.50	25	1,562.50
1.25	78.13	9.25	578.13	17.25	1,078.13	25.25	1,578.13
1.5	93.75	9.5	593.75	17.5	1,093.75	25.5	1,593.75
1.75	109.38	9.75	609.38	17.75	1,109.38	25.75	1,609.38
2	125.00	10	625.00	18	1,125.00	26	1,625.00
2.25	140.63	10.25	640.63	18.25	1,140.63	26.25	1,640.63
2.5	156.25	10.5	656.25	18.5	1,156.25	26.5	1,656.25
2.75	171.88	10.75	671.88	18.75	1,171.88	26.75	1,671.88
3	187.50	11	687.50	19	1,187.50	27	1,687.50
3.25	203.13	11.25	703.13	19.25	1,203.13	27.25	1,703.13
3.5	218.75	11.5	718.75	19.5	1,218.75	27.5	1,718.75
3.75	234.38	11.75	734.38	19.75	1,234.38	27.75	1,734.38
4	250.00	12	750.00	20	1,250.00	28	1,750.00
4.25	265.63	12.25	765.63	20.25	1,265.63	28.25	1,765.63
4.5	281.25	12.5	781.25	20.5	1,281.25	28.5	1,781.25
4.75	296.88	12.75	796.88	20.75	1,296.88	28.75	1,796.88
5	312.50	13	812.50	21	1,312.50	29	1,812.50
5.25	328.13	13.25	828.13	21.25	1,328.13	29.25	1,828.13
5.5	343.75	13.5	843.75	21.5	1,343.75	29.5	1,843.75
5.75	359.38	13.75	859.38	21.75	1,359.38	29.75	1,859.38
6	375.00	14	875.00	22	1,375.00	30	1,875.00
6.25	390.63	14.25	890.63	22.25	1,390.63	30.25	1,890.63
6.5	406.25	14.5	906.25	22.5	1,406.25	30.5	1,906.25
6.75	421.88	14.75	921.88	22.75	1,421.88	30.75	1,921.88
7	437.50	15	937.50	23	1,437.50	31	1,937.50
7.25	453.13	15.25	953.13	23.25	1,453.13	31.25	1,953.13
7.5	468.75	15.5	968.75	23.5	1,468.75	31.5	1,968.75
7.75	484.38	15.75	984.38	23.75	1,484.38	31.75	1,984.38

## (6) Options on Treasury Futures

The methods described above apply not just to computation of variation margin on Treasury futures, but also to determination of premium on the purchase or sale of the companion options. The essential difference is one of labeling. For reasons dictated largely by historical custom, options on Ultra Bond, Classic Bond, and 10-Year Note futures are defined so as to trade in price increments of a 64<sup>th</sup> of a point in the underlying futures, rather than “one half of a 32<sup>nd</sup>.” Likewise, options on 5-Year and 2-Year Note futures trade in price increments of one half of a 64<sup>th</sup> of a point rather than “one quarter of a 32<sup>nd</sup>.”

Exhibits 4 and 5 show corresponding rounded dollar amounts for fractions of points.

### **Exhibit 4**

#### **Options on Ultra Bond, Classic Bond, 10-Year Note, and 5-Year Note Futures: Rounded Dollar Amounts for Fractional Portions of Option Premium on Futures with \$1000 Contract Value Factors**

64ths	\$ Value	64ths	\$ Value	64ths	\$ Value	64ths	\$ Value
0	0.00	16	250.00	32	500.00	48	750.00
0.5	7.81	16.5	257.81	32.5	507.81	48.5	757.81
1	15.63	17	265.63	33	515.63	49	765.63
1.5	23.44	17.5	273.44	33.5	523.44	49.5	773.44
2	31.25	18	281.25	34	531.25	50	781.25
2.5	39.06	18.5	289.06	34.5	539.06	50.5	789.06
3	46.88	19	296.88	35	546.88	51	796.88
3.5	54.69	19.5	304.69	35.5	554.69	51.5	804.69
4	62.50	20	312.50	36	562.50	52	812.50
4.5	70.31	20.5	320.31	36.5	570.31	52.5	820.31
5	78.13	21	328.13	37	578.13	53	828.13
5.5	85.94	21.5	335.94	37.5	585.94	53.5	835.94
6	93.75	22	343.75	38	593.75	54	843.75
6.5	101.56	22.5	351.56	38.5	601.56	54.5	851.56
7	109.38	23	359.38	39	609.38	55	859.38
7.5	117.19	23.5	367.19	39.5	617.19	55.5	867.19
8	125.00	24	375.00	40	625.00	56	875.00
8.5	132.81	24.5	382.81	40.5	632.81	56.5	882.81
9	140.63	25	390.63	41	640.63	57	890.63
9.5	148.44	25.5	398.44	41.5	648.44	57.5	898.44
10	156.25	26	406.25	42	656.25	58	906.25
10.5	164.06	26.5	414.06	42.5	664.06	58.5	914.06
11	171.88	27	421.88	43	671.88	59	921.88
11.5	179.69	27.5	429.69	43.5	679.69	59.5	929.69
12	187.50	28	437.50	44	687.50	60	937.50
12.5	195.31	28.5	445.31	44.5	695.31	60.5	945.31
13	203.13	29	453.13	45	703.13	61	953.13
13.5	210.94	29.5	460.94	45.5	710.94	61.5	960.94
14	218.75	30	468.75	46	718.75	62	968.75
14.5	226.56	30.5	476.56	46.5	726.56	62.5	976.56
15	234.38	31	484.38	47	734.38	63	984.38
15.5	242.19	31.5	492.19	47.5	742.19	63.5	992.19

**Exhibit 5**  
**Options on 2-Year Note Futures:**  
**Rounded Dollar Amounts for Fractional Portions of Option Premium**  
**on Futures with \$2000 Contract Value Factors**

64ths	\$ Value	64ths	\$ Value	64ths	\$ Value	64ths	\$ Value
0	0.00	16	500.00	32	1,000.00	48	1,500.00
0.5	15.63	16.5	515.63	32.5	1,015.63	48.5	1,515.63
1	31.25	17	531.25	33	1,031.25	49	1,531.25
1.5	46.88	17.5	546.88	33.5	1,046.88	49.5	1,546.88
2	62.50	18	562.50	34	1,062.50	50	1,562.50
2.5	78.13	18.5	578.13	34.5	1,078.13	50.5	1,578.13
3	93.75	19	593.75	35	1,093.75	51	1,593.75
3.5	109.38	19.5	609.38	35.5	1,109.38	51.5	1,609.38
4	125.00	20	625.00	36	1,125.00	52	1,625.00
4.5	140.63	20.5	640.63	36.5	1,140.63	52.5	1,640.63
5	156.25	21	656.25	37	1,156.25	53	1,656.25
5.5	171.88	21.5	671.88	37.5	1,171.88	53.5	1,671.88
6	187.50	22	687.50	38	1,187.50	54	1,687.50
6.5	203.13	22.5	703.13	38.5	1,203.13	54.5	1,703.13
7	218.75	23	718.75	39	1,218.75	55	1,718.75
7.5	234.38	23.5	734.38	39.5	1,234.38	55.5	1,734.38
8	250.00	24	750.00	40	1,250.00	56	1,750.00
8.5	265.63	24.5	765.63	40.5	1,265.63	56.5	1,765.63
9	281.25	25	781.25	41	1,281.25	57	1,781.25
9.5	296.88	25.5	796.88	41.5	1,296.88	57.5	1,796.88
10	312.50	26	812.50	42	1,312.50	58	1,812.50
10.5	328.13	26.5	828.13	42.5	1,328.13	58.5	1,828.13
11	343.75	27	843.75	43	1,343.75	59	1,843.75
11.5	359.38	27.5	859.38	43.5	1,359.38	59.5	1,859.38
12	375.00	28	875.00	44	1,375.00	60	1,875.00
12.5	390.63	28.5	890.63	44.5	1,390.63	60.5	1,890.63
13	406.25	29	906.25	45	1,406.25	61	1,906.25
13.5	421.88	29.5	921.88	45.5	1,421.88	61.5	1,921.88
14	437.50	30	937.50	46	1,437.50	62	1,937.50
14.5	453.13	30.5	953.13	46.5	1,453.13	62.5	1,953.13
15	468.75	31	968.75	47	1,468.75	63	1,968.75
15.5	484.38	31.5	984.38	47.5	1,484.38	63.5	1,984.38

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