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

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, "Ultra" 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 and Ultra Bond futures;
halves of 32nds for 10-Year and Ultra 10-Year Note futures;
quarters of 32nds for 5-Year and 3-Year Note futures;
eighths of 32nds for 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 32nd. Exhibit 1 illustrates how these fractional values are commonly expressed.

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

Fractional tick	Decimal tick	Integer display	Fractional display
Whole 32nd	0.00	0	0
Eighth	.**1**25	1	⅛
Quarter	.**2**50	2	¼
Three Eighths	.**3**75	3	⅜
Half	.**5**00	5	+
Five Eighths	.**6**25	6	⅝
Three Quarters	.**7**50	7	¾
Seven Eighths	.**8**25	8	⅞

Examples
A price of 116 and 27/32nds will appear as either 116.27**0** or 116-270.
A price of 116 and 27.125/32nds will appear as either 116.27**1** or 116-27⅛.
A price of 116 and 27.25/32nds will appear as either 116.27**2** or 116-27¼.
A price of 116 and 27.5/32nds will appear as either 116.27**5** 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 = 0.85156250. Then recombine the two portions: 116.85156250.

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

Example, contd
116.85156250 points x $1,000/point = $116,851.56250

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

(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
$116,851.56250 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, Ultra 10-Year Note, Classic Bond, Ultra Bond Futures

To see how this works for 5-Year Note, 10-Year Note, Ultra 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 115.52343750. Because the contract value factor is $1,000 per point, the monetary value of a single contract at this trade price is:

$1,000 x 115.52343750 = $115,523.43750

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 115.531250. Thus, the monetary value of the contract at its daily settlement price equals:

$1,000 x 115.531250 = $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 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 per contract x -147 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 or Ultra 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 both 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, Ultra 10-Year Note, 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 97-23¾, or 97-23.75/32nds. In decimal terms, this is 97.74218750. With a contract value factor of $2,000 per point, the monetary value per contract at this trade price is:

$2,000 x 97.74218750 = $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 97.96875000, making a monetary value per contract of:

$2,000 x 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 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 contracts x $453.12 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 tables in Exhibit 3 and 4 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	1000.00	24	1500.00
0.125	7.81	8.125	507.81	16.125	1007.81	24.125	1507.81
0.25	15.63	8.25	515.63	16.25	1015.63	24.25	1515.63
0.375	23.44	8.375	523.44	16.375	1023.44	24.375	1523.44
0.5	31.25	8.5	531.25	16.5	1031.25	24.5	1531.25
0.625	39.06	8.625	539.06	16.625	1039.06	24.625	1539.06
0.75	46.88	8.75	546.88	16.75	1046.88	24.75	1546.88
0.875	54.69	8.875	554.69	16.875	1054.69	24.875	1554.69
1	62.50	9	562.50	17	1062.50	25	1562.50
1.125	70.31	9.125	570.31	17.125	1070.31	25.125	1570.31
1.25	78.13	9.25	578.13	17.25	1078.13	25.25	1578.13
1.375	85.94	9.375	585.94	17.375	1085.94	25.375	1585.94
1.5	93.75	9.5	593.75	17.5	1093.75	25.5	1593.75
1.625	101.56	9.625	601.56	17.625	1101.56	25.625	1601.56

1.75	109.38	9.75	609.38	17.75	1109.38	25.75	1609.38
1.875	117.19	9.875	617.19	17.875	1117.19	25.875	1617.19
2	125.00	10	625.00	18	1125.00	26	1625.00
2.125	132.81	10.125	632.81	18.125	1132.81	26.125	1632.81
2.25	140.63	10.25	640.63	18.25	1140.63	26.25	1640.63
2.375	148.44	10.375	648.44	18.375	1148.44	26.375	1648.44
2.5	156.25	10.5	656.25	18.5	1156.25	26.5	1656.25
2.625	164.06	10.625	664.06	18.625	1164.06	26.625	1664.06
2.75	171.88	10.75	671.88	18.75	1171.88	26.75	1671.88
2.875	179.69	10.875	679.69	18.875	1179.69	26.875	1679.69
3	187.50	11	687.50	19	1187.50	27	1687.50
3.125	195.31	11.125	695.31	19.125	1195.31	27.125	1695.31
3.25	203.13	11.25	703.13	19.25	1203.13	27.25	1703.13
3.375	210.94	11.375	710.94	19.375	1210.94	27.375	1710.94
3.5	218.75	11.5	718.75	19.5	1218.75	27.5	1718.75
3.625	226.56	11.625	726.56	19.625	1226.56	27.625	1726.56
3.75	234.38	11.75	734.38	19.75	1234.38	27.75	1734.38
3.875	242.19	11.875	742.19	19.875	1242.19	27.875	1742.19
4	250.00	12	750.00	20	1250.00	28	1750.00
4.125	257.81	12.125	757.81	20.125	1257.81	28.125	1757.81
4.25	265.63	12.25	765.63	20.25	1265.63	28.25	1765.63
4.375	273.44	12.375	773.44	20.375	1273.44	28.375	1773.44
4.5	281.25	12.5	781.25	20.5	1281.25	28.5	1781.25
4.625	289.06	12.625	789.06	20.625	1289.06	28.625	1789.06
4.75	296.88	12.75	796.88	20.75	1296.88	28.75	1796.88
4.875	304.69	12.875	804.69	20.875	1304.69	28.875	1804.69
5	312.50	13	812.50	21	1312.50	29	1812.50
5.125	320.31	13.125	820.31	21.125	1320.31	29.125	1820.31
5.25	328.13	13.25	828.13	21.25	1328.13	29.25	1828.13
5.375	335.94	13.375	835.94	21.375	1335.94	29.375	1835.94
5.5	343.75	13.5	843.75	21.5	1343.75	29.5	1843.75
5.625	351.56	13.625	851.56	21.625	1351.56	29.625	1851.56
5.75	359.38	13.75	859.38	21.75	1359.38	29.75	1859.38
5.875	367.19	13.875	867.19	21.875	1367.19	29.875	1867.19
6	375.00	14	875.00	22	1375.00	30	1875.00
6.125	382.81	14.125	882.81	22.125	1382.81	30.125	1882.81
6.25	390.63	14.25	890.63	22.25	1390.63	30.25	1890.63
6.375	398.44	14.375	898.44	22.375	1398.44	30.375	1898.44
6.5	406.25	14.5	906.25	22.5	1406.25	30.5	1906.25
6.625	414.06	14.625	914.06	22.625	1414.06	30.625	1914.06
6.75	421.88	14.75	921.88	22.75	1421.88	30.75	1921.88
6.875	429.69	14.875	929.69	22.875	1429.69	30.875	1929.69
7	437.50	15	937.50	23	1437.50	31	1937.50
7.125	445.31	15.125	945.31	23.125	1445.31	31.125	1945.31
7.25	453.13	15.25	953.13	23.25	1453.13	31.25	1953.13

7.375	460.94		15.375	960.94		23.375	1460.94		31.375	1960.94
7.5	468.75		15.5	968.75		23.5	1468.75		31.5	1968.75
7.625	476.56		15.625	976.56		23.625	1476.56		31.625	1976.56
7.75	484.38		15.75	984.38		23.75	1484.38		31.75	1984.38
7.875	492.19		15.875	992.19		23.875	1492.19		31.875	1992.19

(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, Ultra10-Year Note, and 10-Year Note futures are defined so as to trade in price increments of a 64th of a point in the underlying futures, rather than "one half of a 32nd." Likewise, options on 5-Year and 2-Year Note futures trade in price increments of one half of a 64th of a point rather than "one quarter of a 32nd."

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

Exhibit 4
Options on Ultra Bond, Classic Bond, Ultra 10-Year, 10-Year, 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	1000.00	48	1500.00
0.5	15.63	16.5	515.63	32.5	1015.63	48.5	1515.63
1	31.25	17	531.25	33	1031.25	49	1531.25
1.5	46.88	17.5	546.88	33.5	1046.88	49.5	1546.88
2	62.50	18	562.50	34	1062.50	50	1562.50
2.5	78.13	18.5	578.13	34.5	1078.13	50.5	1578.13
3	93.75	19	593.75	35	1093.75	51	1593.75
3.5	109.38	19.5	609.38	35.5	1109.38	51.5	1609.38
4	125.00	20	625.00	36	1125.00	52	1625.00
4.5	140.63	20.5	640.63	36.5	1140.63	52.5	1640.63
5	156.25	21	656.25	37	1156.25	53	1656.25
5.5	171.88	21.5	671.88	37.5	1171.88	53.5	1671.88
6	187.50	22	687.50	38	1187.50	54	1687.50
6.5	203.13	22.5	703.13	38.5	1203.13	54.5	1703.13
7	218.75	23	718.75	39	1218.75	55	1718.75
7.5	234.38	23.5	734.38	39.5	1234.38	55.5	1734.38
8	250.00	24	750.00	40	1250.00	56	1750.00
8.5	265.63	24.5	765.63	40.5	1265.63	56.5	1765.63
9	281.25	25	781.25	41	1281.25	57	1781.25
9.5	296.88	25.5	796.88	41.5	1296.88	57.5	1796.88
10	312.50	26	812.50	42	1312.50	58	1812.50
10.5	328.13	26.5	828.13	42.5	1328.13	58.5	1828.13
11	343.75	27	843.75	43	1343.75	59	1843.75
11.5	359.38	27.5	859.38	43.5	1359.38	59.5	1859.38
12	375.00	28	875.00	44	1375.00	60	1875.00
12.5	390.63	28.5	890.63	44.5	1390.63	60.5	1890.63
13	406.25	29	906.25	45	1406.25	61	1906.25
13.5	421.88	29.5	921.88	45.5	1421.88	61.5	1921.88

14	437.50	30	937.50	46	1437.50	62	1937.50
14.5	453.13	30.5	953.13	46.5	1453.13	62.5	1953.13
15	468.75	31	968.75	47	1468.75	63	1968.75
15.5	484.38	31.5	984.38	47.5	1484.38	63.5	1984.38

Neither futures trading nor swaps trading are suitable for all investors, and each involves the risk of loss. Swaps trading should only be undertaken by investors who are Eligible Contract Participants (ECPs) within the meaning of Section 1a(18) of the Commodity Exchange Act. Futures and swaps each are leveraged investments and, because only a percentage of a contract's value is required to trade, it is possible to lose more than the amount of money deposited for either a futures or swaps position. Therefore, traders should only use funds that they can afford to lose without affecting their lifestyles and only a portion of those funds should be devoted to any one trade because traders cannot expect to profit on every trade. All references to options refer to options on futures.

Any research views expressed those of the individual author and do not necessarily represent the views of the CME Group or its affiliates. The information within this presentation has been compiled by CME Group for general purposes only. CME Group assumes no responsibility for any errors or omissions. All examples are hypothetical situations, used for explanation purposes only, and should not be considered investment advice or the results of actual market experience.

All matters pertaining to rules and specifications herein are made subject to and are superseded by official rulebook of the organizations. Current rules should be consulted in all cases concerning contract specifications