INTRODUCTION

This appendix describes the calculation algorithm of the Portfolio Risk Margining System of HKEX (PRiME) -- the margining technique that will be used by SEOCH (for a detailed description, please refer to the PRiME Margining Guide). The process is run each day, after the close of trading or whenever it is required on an intra-day basis. It consists of the following steps.

Step 1: Marginable Positions - Identify what is to be margined

The first stage in the process is to identify, within each SEOCH Participant's portfolio, which open option positions are marginable. The marginable positions are broken down by option class[1] and, within each option class, by each DCASS account. If the account is margined gross, the long option positions are eliminated from the marginable position. The marginable positions for these accounts therefore consist of short option positions only.

Steps 2 to 8 below are then carried out separately for each account within each option class i.e.

Perform steps 2 to 8 below for option class 1, account 1, then
Perform steps 2 to 8 below for option class 2, account 1, then
•
•
Perform steps 2 to 8 below for option class n, account 1, then
Perform steps 2 to 8 below for option class 1, account 2, then
Perform steps 2 to 8 below for option class 2, account 2, then
•
•
Perform steps 2 to 8 below for option class n, account 2, then
•
•
Perform steps 2 to 8 below for option class 1, account k, then
Perform steps 2 to 8 below for option class 2, account k, then
•
•
Perform steps 2 to 8 below for option class n, account k, then

Step 2: Calculate Mark-to-Market Margin for each option class

PRiME marks the marginable positions to market with the market closing price (or known as the fixing price) of each option series determined by SEOCH (market closing price * contract size * size of marginable positions) to calculate the Mark-to-Market Margin. The resulting value of the Mark-to-Market Margin for a long option position will be a credit (i.e. it will have a negative value) whereas that for a short option position will be a debit (i.e. it will have a positive value). The Mark-to-Market Margins of all option series within the same option class are then aggregated to produce the Mark-to-Market Margin of that option class. This identifies the cost of liquidating the entire portfolio for this account within this option class at the fixing price.

Step 3: Create Risk Array for each option series

The specific set of the risk scenarios are defined in terms of (a) how much the price of the underlying instrument is expected to change over one trading day which is defined as the Price Scan Range, and (b) how much the volatility of that underlying price is expected to change over one trading day which is defined as the Volatility Scan Range. The amount by which the stock option contract will gain or lose value over one trading day under a risk scenario is called the Risk Array value for that scenario. The set of Risk Array values for that option contract under the full set of risk scenarios constitutes the Risk Array.

The set of risk scenarios are as follows:

Scenario	**Underlying Price Change**	**Volatility Change**
1.	Unchanged	Up
2.	Unchanged	Down
3.	Up 1/3 the Price Scan Range	Up
4.	Up 1/3 the Price Scan Range	Down
5.	Down 1/3 the Price Scan Range	Up
6.	Down 1/3 the Price Scan Range	Down

[1] *An option class consists of all the options on one particular underlying stock.*

7.	Up 2/3 the Price Scan Range	Up
8.	Up 2/3 the Price Scan Range	Down
9.	Down 2/3 the Price Scan Range	Up
10.	Down 2/3 the Price Scan Range	Down
11.	Up 3/3 the Price Scan Range	Up
12.	Up 3/3 the Price Scan Range	Down
13.	Down 3/3 the Price Scan Range	Up
14.	Down 3/3 the Price Scan Range	Down
15.	Up by a multiple of the Price Scan Range (Under this scenario, only a fraction of the loss, known as the cover fraction, will be considered. The multiple and the cover fraction are governed by the Extreme Move Multiplier and the Extreme Move Coverage Fraction respectively)	Unchanged
16.	Down by a multiple of the Price Scan Range (Under this scenario, only a fraction of the loss, known as the cover fraction, will be considered. The multiple and the cover fraction are governed by the Extreme Move Multiplier and the Extreme Move Coverage Fraction respectively)	Unchanged

Step 4: Calculate Scan Risk for each option class

For net margined account, multiply the value gain (-ve) or loss (+ve) under each scenario by the corresponding position size to find the Scan Risk, which is the largest total loss of this option class among the 16 scenarios. If there are only value gains and no value loss under the scenarios, the Scan Risk will be set to zero.

For gross margined account, the loss is determined on a series level. The value gain (-ve) or loss (+ve) under each scenario is multiplied by the corresponding position size to find the largest total loss of this option series among the 16 scenarios. The Scan Risk is calculated by the summation of the largest total loss of each individual option series.

Step 5: Calculate Intra-commodity (Intermonth) Spread Charge for each option class

As PRiME scans underlying prices within a single underlying instrument, it assumes that price movement correlates perfectly across contract months. Since the price movement across contract months does not generally exhibit perfect correlation, PRiME adds an Intra-commodity Spread Charge to the Scan Risk associated with each underlying instrument under net margining. No Intra-commodity Spread Charge will be applied for gross margined accounts.

There may be different deltas calculated for an option series under different scenarios in the risk array. However, PRiME employs only one delta value per option series, called the "Composite Delta". It is derived as the weighted average of the deltas associated with each scenario. The weighting associated with each scenario is based upon the probability of the associated price movement. The more likely the price movement, the higher is the weighting applied.

The Composite Delta for each option series is calculated by multiplying the series Composite Delta by the corresponding position size. The Composite Delta for each contract month is then calculated by the summation of the Composite Delta values of all the option series of the same contract month. From the Composite Delta values obtained for all contract months, the total net long and net short Composite Delta values are identified. The absolute value of the total net long Composite Delta value is then compared with the absolute value of the total net short Composite Delta value and the smaller absolute value is selected. The Intra-commodity Spread Charge can then be calculated by multiplying the smaller absolute value by the Intra-commodity Spread Charge Rate for this option class.

Step 6: Calculate Commodity Risk (Risk Margin) of each option class

The Commodity Risk of the option class for each account can be obtained by the addition of the Scan Risk and the Intra-commodity Spread Charge.

Step 7: Compare Commodity Risk with the Short Option Minimum Charge for each option class

The Short Option Minimum Charge is calculated by taking the number of short call or short put options, whichever is higher, and multiplying it by the Short Option Minimum Charge Rate. If such charge is greater than the Commodity Risk as calculated in Step 6, such Short Option Minimum Charge will become the Commodity Risk of this option class.

Step 8: Calculate Total Margin Requirement of each DCASS account

The Mark-to-Market Margin and the Commodity Risk of each option class are aggregated to produce the Total Margin Requirement for each option class in each DCASS account. This results in a margin credit or margin debit for each option class in each net margined account and a margin debit in each option class in each gross margined account. There cannot be a margin credit for a gross margined account because long positions are excluded from the marginable positions.

The Total Margin Requirements of all option classes with the same Currency of the Contract within the same account are then aggregated to produce the Total Margin Requirement in that currency for that account. During the aggregation process for a net margined account, any margin credit of an option class will be used to offset the margin debits of the other option classes with the same Currency of the Contract within the same account. This will result in a margin credit or margin debit for each Currency of the Contract in each net margined account and a margin debit for each Currency of the Contract in each gross margined account.

After the aggregation, if there remains a margin credit for any Currency of the Contract in a net margined account and a margin debit for any other Currency of the Contract within the same net margined account, such margin credit will be used to offset the margin debit. Before the offset, the margin credit will be converted into the Currency of the Contract in which the margin debit is denominated at such exchange rate as may be determined by SEOCH.

The Total Margin Requirement for each of the accounts will then be converted from the Currency of the Contract to the Settlement Currency at such exchange rate as may be determined by SEOCH if the Currency of the Contract and the Settlement Currency are not the same.

Step 9: Evaluate Total Margin Requirement of each CCMS Collateral Account

a) Settlement through House CCMS Collateral Account

The Total Margin Requirement in each Settlement Currency to be settled through the House CCMS Collateral Account will be the summation of the individual Total Margin Requirements in that Settlement Currency for all DCASS accounts settled through the House CCMS Collateral Account. Where the Total Margin Requirement for a DCASS account is a margin credit, it will be set to zero before the summation.

b) Settlement through Client CCMS Collateral Account

The Total Margin Requirement in each Settlement Currency to be settled through the Client CCMS Collateral Account will be the summation of the individual Total Margin Requirements in that Settlement Currency for all DCASS accounts settled through the Client CCMS Collateral Account. Where the Total Margin Requirement for a DCASS account is a margin credit, it will be set to zero before the summation.

The Total Margin Requirement in a Settlement Currency for the SEOCH Participant is the sum of the Total Margin Requirements in that Settlement Currency settled through the House and Client CCMS Collateral Accounts.

Step 10: Calculate amount to be collected for each CCMS Collateral Account

The actual amounts of margin in each Settlement Currency demanded each day by SEOCH (the margin call) will be equal to the Total Margin Requirements to be settled through CCMS, minus any collateral currently provided. The margin may be payable in cash or in an acceptable form of collateral as prescribed by SEOCH. The margin call for the House CCMS Collateral Account and the Client CCMS Collateral Account will be calculated separately.

If the Total Margin Requirements to be settled through CCMS are **less** than the total amount of collateral which the SEOCH Participant has currently provided to SEOCH, SEOCH will not automatically return the excess to the SEOCH Participant unless upon request.

Following is an example of how the method works on an imaginary option portfolio:

EXAMPLE OF PRiME MARGINING

Assume there are two option classes (HKZ with Currency of the Contract and Settlement Currency in HK$ and RMZ with Currency of the Contract and Settlement Currency in RMB) in the market and a SEOCH Participant has the following positions:

In the Omnibus Client Account (margined gross and its obligation will be settled through the Client CCMS Collateral Account):

1. Short 20 HKZ DEC 95 Calls
2. Long 10 HKZ JAN 100 Puts
3. Short 50 HKZ JAN 100 Puts
4. Short 50 RMZ JAN 90 Puts

In the Individual Client Account 001 (margined net and its obligation will be settled through the Client CCMS Collateral Account):

5. Long 5 HKZ DEC 95 Calls

In the Client Offset Claim Account (margined net and its obligation will be settled through the Client CCMS Collateral Account):

6. Short 30 HKZ DEC 95 Calls
7. Short 30 HKZ JAN 100 Puts

In the House Account (margined net and its obligation will be settled through the House CCMS Collateral Account):

8. Short 5 HKZ DEC 95 Calls
9. Long 10 HKZ JAN 100 Puts
10. Short 50 HKZ JAN 100 Puts
11. Long 30 RMZ JAN 90 Puts

A) Identify Marginable Positions

Contract	Underlying Closing	Account	Long	Short	Marginable Position
HKZ DEC 95 C	HK$100.00	Omnibus Client	0	20	20S
		Individual Client 001	5	0	5L
		Client Offset Claim	0	30	30S
		House	0	5	5S
HKZ JAN 100 P	HK$100.00	Omnibus Client	10	50	50S
		Client Offset Claim	0	30	30S
		House	10	50	40S
RMZ JAN 90 P	RMB 90.00	Omnibus Client	0	50	50S
		House	30	0	30L

L: Long; S: Short

Note that the 10 long HKZ JAN 100 puts in the Omnibus Client Account are not netted against the 50 short positions. This is what is meant by "gross" margining. If the 10 long positions were to be netted, it would mean that the client(s) holding the long positions were partly covering the risk of the client(s) with short positions.

B) Calculate Mark-to-Market Margin for each option class

The process is clearer if we re-order the positions by account type.

Contract	Contract Size	Mark to Market Price	Marginable Position	Mark-to-Market Margin (HK$) [a]	Mark-to-Market Margin (RMB) [a]
Omnibus Client Positions:					
HKZ DEC 95 C	400	6.00	20S	48,000	
HKZ JAN 100 P	400	4.00	50S	80,000	
RMZ JAN 90 P	400	4.00	50S		80,000
				128,000	80,000

Client Offset Claim Positions:					
HKZ DEC 95 C	400	6.00	30S	72,000	
HKZ JAN 100 P	400	4.00	30S	48,000	
				120,000	
Individual Client 001 Positions:					
HKZ DEC 95 C	400	6.00	5L	-12,000	
				-12,000	
House Positions:					
HKZ DEC 95 C	400	6.00	5S	12,000	
HKZ JAN 100 P	400	4.00	40S	64,000	
RMZ JAN 90 P	400	4.00	30L		-48,000
				76,000	-48,000

(a) Mark-to-Market Margin for an option series = option market value * no. of contracts held * contract size.

C) Create Risk Array and Calculate Scan Risk for each option class

The following Risk Arrays are created to calculate the Scan Risk of each option class in each account. Please note that gross and net margined accounts will be evaluated on a series and portfolio level basis respectively.

Risk Arrays of HKZ (HK$)

Scenario	DEC 95 C	JAN 100 P	Omnibus Client (DEC 95C) [b]	Omnibus Client (JAN 100 P) [b]	Individual Client 001 [b]	Client Offset Claim [b]	House [b]
1	0	0	0	0	0	0	0
2	+100	0	-2,000	0	500	-3,000	-500
3	-600	+700	12,000	-35,000	-3,000	-3,000	-25,000
4	-600	+600	12,000	-30,000	-3,000	0	-21,000
5	+600	-600	-12,000	30,000	3,000	0	21,000
6	+600	-500	-12,000	25,000	3,000	-3,000	17,000
7	-1,200	+1,300	24,000	-65,000	-6,000	-3,000	-46,000
8	-1,200	+1,300	24,000	-65,000	-6,000	-3,000	-46,000
9	+1,300	-1,200	-26,000	60,000	6,500	-3,000	41,500
10	+1,300	-1,100	-26,000	55,000	6,500	-6,000	37,500
11	-2,000	+2,100	40,000	-105,000	-10,000	-3,000	-74,000
12	-1,900	+2,000	38,000	-100,000	-9,500	-3,000	-70,500
13	+2,100	-2,000	-42,000	**100,000**	**10,500**	-3,000	**69,500**
14	+1,900	-1,800	-38,000	90,000	9,500	-3,000	62,500
15	-1,500	+1,400	**30,000**	-70,000	-7,500	**3,000**	-48,500
16	+1,300	-1,200	-26,000	60,000	6,500	-3,000	41,500

Scan Risk of
Omnibus Client Account, DEC 95 C = HK$40,000
Omnibus Client Account, JAN 100 P = HK$100,000
Individual Client Account = HK$10,500
Client Offset Claim Account = HK$3,000
House Account = HK$69,500

Risk Arrays of RMZ (RMB)

Scenario	JAN 90 P	Omnibus Client (JAN 90 P) [b]	House [b]
1	0	0	0
2	0	0	0
3	+490	-24,500	14,700
4	+420	-21,000	12,600
5	-420	21,000	-12,600
6	-350	17,500	-10,500
7	+910	-45,500	27,300

8	+910	-45,500	27,300
9	-840	42,000	-25,200
10	-770	38,500	-23,100
11	+1,470	-73,500	**44,100**
12	+1,400	-70,000	42,000
13	-1,400	**70,000**	-42,000
14	-1,260	63,000	-37,800
15	+980	-49,000	29,400
16	-840	42,000	-25,200

Scan Risk of
Omnibus Client Account = RMB70,000
House Account = RMB44,100

(b) Scan Risk under each scenario = summation of (gain or loss * size of marginable positions) for each series

D) Calculate Intra-commodity (intermonth) Spread Charge for each option class

Assume the Composite Deltas of the series and the Intra-commodity Spread Charge Rates are as follows:

Option Class	Series	Composite Delta	Spread Charge Rate for each Composite Delta
HKZ	HKZ DEC 95 C	0.45	HK$900
	HKZ JAN 100 P	-0.52	
RMZ	RMZ JAN 90 P	-0.50	RMB720

Composite Delta for each contract month and Intra-commodity Spread Charge of HKZ for each account:

Contract Month	Omnibus Client	Individual Client 001	Client Offset Claim	House
DEC	NA	2.25	-13.5	-2.25
JAN	NA	0	15.6	20.8
Net Long	NA	2.25	15.6	20.8
Net Short	NA	0	-13.5	-2.25
Minimum of absolute value of Net Long and absolute value of Net Short	NA	0	13.5	2.25
Intra-commodity Spread Charge [c]	NA	0	HK$12,150	2,025

Composite Delta for each contract month and Intra-commodity Spread Charge of RMZ for each account:

Contract Month	Omnibus Client	House
JAN	NA	-15
Net Long	NA	0
Net Short	NA	-15
Minimum of absolute value of Net Long and absolute value of Net Short	NA	0
Intra-commodity Spread Charge [c]	NA	0

(c) Intra-commodity Spread Charge = Minimum (| net long | , | net short |) * Spread Charge Rate for each Composite Delta

E) Calculate Commodity Risk for each option class

The Commodity Risk of each option class for each account is calculated by the addition of the Scan Risk and the Intra-commodity Spread Charge.

Commodity Risk of HKZ (HK$):

	Omnibus Client (DEC 95 C)	Omnibus Client (JAN 100 P)	Individual Client 001	Client Offset Claim	House
Scan Risk	40,000	100,000	10,500	3,000	69,500
Intra-commodity Spread Charge	NA	NA	0	12,150	2,025
Commodity Risk	40,000	100,000	10,500	15,150	71,525

Commodity Risk of RMZ (RMB):

	Omnibus Client (JAN 90 P)	House
Scan Risk	70,000	44,100
Intra-commodity Spread Charge	NA	0
Commodity Risk	70,000	44,100

F) Compare Commodity Risk with Short Option Minimum Charge for each option class

Compare the Commodity Risk with the Short Option Minimum Charge for each option class for each account, assuming that the Short Option Minimum Charges per contract for HKZ and RMZ are HK$200 and RMB100 respectively.

Commodity Risk of HKZ (HK$):

	Omnibus Client (DEC 95 C)	Omnibus Client (JAN 100 P)	Individual Client 001	Client Offset Claim	House
Commodity Risk	40,000	100,000	10,500	15,150	71,525
Maximum (short call, short put)	20	50	0	30	40
Short Option Minimum Charge	4,000	10,000	0	6,000	8,000
Commodity Risk after comparison of Short Option Minimum Charge	40,000	100,000	10,500	15,150	71,525

Commodity Risk of RMZ (RMB):

	Omnibus Client (JAN 90 P)	House
Commodity Risk	70,000	44,100
Maximum (short call, short put)	50	0
Short Option Minimum Charge	5,000	0
Commodity Risk after comparison of Short Option Minimum Charge	70,000	44,100

For gross margined account such as the Omnibus Client Account, the Commodity Risk for an option class is calculated by the summation of the individual Commodity Risk (after comparison with the Short Option Minimum Charge) of each series in that option class.

For the Omnibus Client Account,
The Commodity Risk of HKZ (HK$) =HK$100,000 + HK$40,000 = HK$140,000
The Commodity Risk of RMZ (RMB) = RMB70,000

G) Calculate Total Margin Requirement for each DCASS account

i) The Total Margin Requirement of each option class in each DCASS account is calculated by the addition of the Mark-to-Market Margin and the Commodity Risk of that option class in that account.

Total Margin Requirement of HKZ (HK$):

	Omnibus Client	Individual Client 001	Client Offset Claim	House
Mark-to-Market Margin	128,000	-12,000	120,000	76,000
Commodity Risk	140,000	10,500	15,150	71,525
Total Margin Requirement	268,000	-1,500	135,150	147,525

Total Margin Requirement of RMZ (RMB):

	Omnibus Client	House
Mark-to-Market Margin	80,000	-48,000
Commodity Risk	70,000	44,100
Total Margin Requirement	150,000	-3,900

For a net margined account, any margin credit of an option class will be used to offset the margin debits of the other option classes with the same Currency of the Contract within the same account.

Since there is only one option class for each of the currencies (HK$ and RMB) within the net margined accounts (Individual Client 001, Client Offset Claim and House Accounts), no margin offset will be applied.

ii) The Total Margin Requirement in each Currency of the Contract for each DCASS account is the sum of the Total Margin Requirements of all option classes with that Currency of the Contract within that account.

Total Margin Requirement in each Currency of the Contract:

	Omnibus Client	Individual Client 001	Client Offset Claim	House
Total Margin Requirement (HK$)	268,000	-1,500	135,150	147,525
Total Margin Requirement (RMB)	150,000	0	0	-3,900

For the net margined House account, there is a margin credit in RMB and a margin debit in HK$. The margin credit in RMB will be converted into HK$ before it is used to offset the margin debit in HK$.

Total Margin Requirement (HK$) for House Account after the offset
= – (RMB 3,900 x HK$1.2 per RMB [d]) + HK$147,525
= HK$142,845

No currency conversion is required because the Currency of the Contract and the Settlement Currency of the Total Margin Requirements of all accounts are the same.

(d) assuming exchange rate = HK$1.2 per RMB

H) Evaluate Total Margin Requirement for each CCMS Collateral Account

Omnibus Client, Individual Client 001 and Client Offset Claim Accounts' obligations are settled through the Client CCMS Collateral Account while House Account's obligations are settled through the House CCMS Collateral Account. The Total Margin Requirements settled through the CCMS Collateral Accounts are as follows:

Client CCMS Collateral Account :
Total Margin Requirement (HK$) = HK$268,000 + HK$0[e] + HK$135,150 = HK$403,150
Total Margin Requirement (RMB) = RMB150,000

House CCMS Collateral Account :
Total Margin Requirement (HK$) = HK$142,845
Total Margin Requirement (RMB) = RMB0

(e) Any margin credit of an account will be set to zero before summation and will not be used to offset the margin debits of the other accounts.

I) Calculate amount to be collected for each CCMS Collateral Account

Suppose the collateral delivered is HK$100,000 in cash for each of the Client and House CCMS Collateral Accounts.

Client CCMS Collateral Account:
In this case, the amount (in HK$)[f] to be collected = HK$403,150 – HK$100,000 = HK$303,150
The amount (in RMB)[f] to be collected = RMB150,000 – RMB0 = RMB150,000

House CCMS Collateral Account:
The amount (in HK$)[f] to be collected = HK$142,845 - HK$100,000 = HK$42,845
The amount (in RMB)[f] to be collected = RMB0

(f) Amount to be collected = Total Margin Requirement settled through CCMS Collateral Account minus collateral delivered