

HiFive ELS 설명서

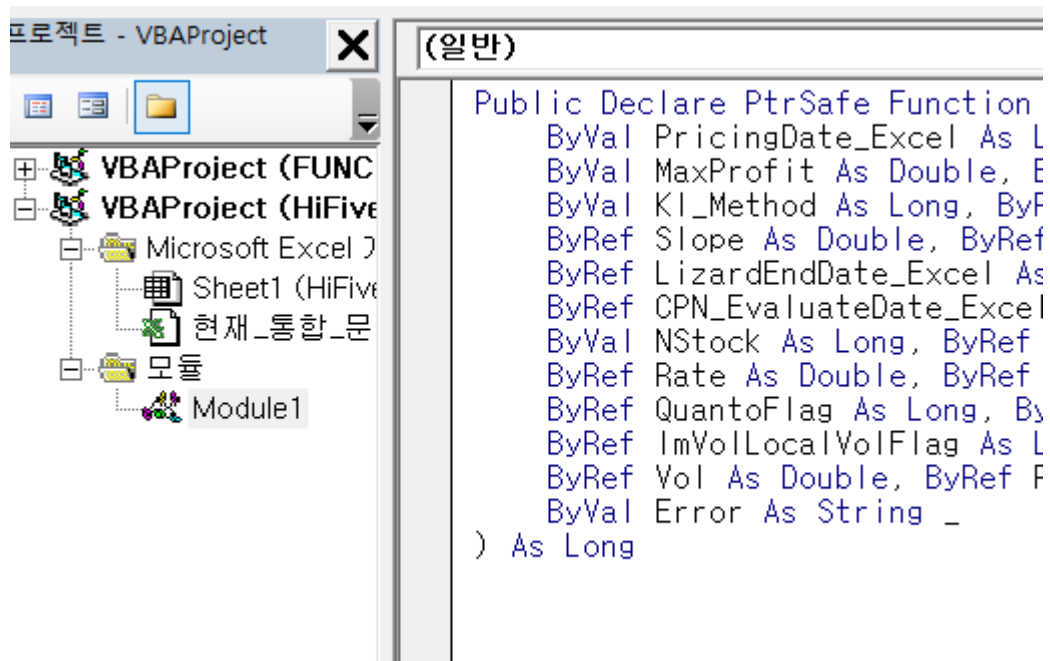
1. 자신의 엑셀 bit수 확인

파일>계정>엑셀정보



2. Alt + F11로 VBA창 키기

3. 모듈 들어가서 dll의 디렉토리 바꾸기 (현재 dll이 설치되어있는 디렉토리로 바꾸기)



```
Public Declare PtrSafe Function Excel_HiFive_ELS_MC Lib "C:\Users\Wjinds1557\git_daesun5\HiFive_ELS\Release\HiFive_ELS.dll" ( _
    ByVal PricingDate_Excel As Long, ByVal NSimul As Long, ByVal GreekFlag As Long, ByVal FaceValue As Double, ByVal FaceValueFlag As Long, _
    ByVal MaxProfit As Double, ByVal MaxLoss As Double, ByVal NEvaluate As Long, ByVal KI_Barrier_Level As Double, ByVal Now_KI_State As Long, _
    ByVal KI_Method As Long, ByVal EvalDate_Excel As Long, ByVal PayDate_Excel As Long, ByVal NStrike As Long, ByVal StrikeLevel As Double, _
    ByVal Slope As Double, ByVal FixedAmount As Double, ByVal NLizard As Long, ByVal LizardFlag As Long, ByVal LizardStartDate_Excel As Long, _
    ByVal LizardEndDate_Excel As Long, ByVal LizardBarrierLevel As Double, ByVal Now_LizardHitting As Long, ByVal LizardCoupon As Double, ByVal NCPN _
    ByVal CPN_EvaluateDate_Excel As Long, ByVal CPN_PayDate_Excel As Long, ByVal CPN_Lower_Barrier As Double, ByVal CPN_Upper_Barrier As Double, ByRef _
    ByVal NStock As Long, ByRef SOXO As Double, ByRef CorrelationReshaped As Double, ByRef NTerm As Long, ByRef TermRate As Double, _
    ByRef Rate As Double, ByRef NDivTerm As Long, ByRef DivFlag As Long, ByRef TermDiv As Double, ByRef Div As Double, _
    ByRef QuantoFlag As Long, ByRef QuantoCorr As Double, ByRef NTermQuanto As Long, ByRef TermQuanto As Double, ByRef VolQuanto As Double, _
    ByRef ImVolLocalVolFlag As Long, ByRef NParityVol As Long, ByRef ParityVol As Double, ByRef NTermVol As Long, ByRef TermVol As Double, _
    ByRef Vol As Double, ByRef ResultPrice As Double, ByRef AutocalIProb As Double, ByRef CPNProb As Double, ByRef ResultLocalVol As Double, _
    ByVal Error As String _
) As Long
```



엑셀 32비트 사용하면 32비트 폴더주소
64비트 사용하면 64비트 폴더주소 복사

```
Public Declare PtrSafe Function Excel_HiFive_ELS_MC Lib "C:\Users\Wjinds1557\git_daesun5\HiFive_ELS\Release\HiFive_ELS.dll" ( _
    ByVal PricingDate_Excel As Long, ByVal NSimul As Long, ByVal GreekFlag As Long, ByVal FaceValue As Double, ByVal FaceValueFlag As Long, _
    ByVal MaxProfit As Double, ByVal MaxLoss As Double, ByVal NEvaluate As Long, ByVal KI_Barrier_Level As Double, ByVal Now_KI_State As Long, _
    ByVal KI_Method As Long, ByVal EvalDate_Excel As Long, ByVal PayDate_Excel As Long, ByVal NStrike As Long, ByVal StrikeLevel As Double, _
    ByVal Slope As Double, ByVal FixedAmount As Double, ByVal NLizard As Long, ByVal LizardFlag As Long, ByVal LizardStartDate_Excel As Long, _
    ByVal LizardEndDate_Excel As Long, ByVal LizardBarrierLevel As Double, ByVal Now_LizardHitting As Long, ByVal LizardCoupon As Double, ByVal NCPN _
    ByVal CPN_EvaluateDate_Excel As Long, ByVal CPN_PayDate_Excel As Long, ByVal CPN_Lower_Barrier As Double, ByVal CPN_Upper_Barrier As Double, ByRef _
    ByVal NStock As Long, ByRef SOXO As Double, ByRef CorrelationReshaped As Double, ByRef NTerm As Long, ByRef TermRate As Double, _
    ByRef Rate As Double, ByRef NDivTerm As Long, ByRef DivFlag As Long, ByRef TermDiv As Double, ByRef Div As Double, _
    ByRef QuantoFlag As Long, ByRef QuantoCorr As Double, ByRef NTermQuanto As Long, ByRef TermQuanto As Double, ByRef VolQuanto As Double, _
    ByRef ImVolLocalVolFlag As Long, ByRef NParityVol As Long, ByRef ParityVol As Double, ByRef NTermVol As Long, ByRef TermVol As Double, _
    ByRef Vol As Double, ByRef ResultPrice As Double, ByRef AutocalIProb As Double, ByRef CPNProb As Double, ByRef ResultLocalVol As Double, _
    ByVal Error As String _
) As Long
```

4. ELS 발행정보 및 파라미터 입력하기

FaceValue	100	최대손실	100%
FaceValueFlag	1	시뮬레이션횟수	5000
계산일	2017-07-03	GreekFlag	2
기초자산개수	3		
조기상환 평가일수	6	현재 Knock In Hitting여부	0
		KIMethod	1
Knock In 배리어수준	50%		

	1	2	3	4	5	6	7	8
평가일	2018-01-03	2018-07-03	2019-01-03	2019-07-03	2020-01-03	2020-07-03		
지급일	2018-01-08	2018-07-06	2019-01-08	2019-07-08	2020-01-08	2020-07-08		
행사가격	90.00%	85.00%	80.00%	75.00%	70.00%	65.00%		
지급액기울기	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
지급액상수	2.50%	5.00%	7.50%	10.00%	12.50%	15.00%	15.00%	0.00%
리자드평가여부	0	0						
리자드배리어 체크시작일	2017-07-03	2018-01-03						
리자드배리어 체크종료일	2018-01-03	2018-07-03						
리자드 배리어	80.00%	75.00%						
현재 LizardBarrier Hitting상태	0	0						
리자드 쿠폰	3.500%	7.000%						
리자드개수	0							

조기상환일 개수가 6개면 표에 6까지 입력하고

7번은 조기상환 안되었지만 낙인 이벤트 없을 경우의 Payoff

8번은 조기상환 안되었지만 낙인 이벤트 발생했을 경우 Payoff (일반적으로 주가 비레해
서 손실이 나는 케이스이므로 지급액 기울기 1넣었음)

만약 리자드형 상품 아니면 리자드 개수 0넣으면 되고

쿠폰 따로 주는 상품 아니면 쿠폰개수 0넣으면 된다.

5. 변동성 관련 입력

Implied Vol 블룸버그에서 뽑아서 Implied Vol Flag 0으로 넣으면 Dupire LocalVol 산출

기초자산1									
Implied Vol/ Local Vol Flag		0							
Parity (Moneyess)	기간구조								
	0.33	0.67	1.00	1.33	1.67	2.00	2.33		
0.50	39.95%	35.43%	34.10%	31.21%	29.20%	27.84%	26.86%		
0.60	35.87%	30.50%	29.51%	26.93%	25.14%	23.85%	23.06%		
0.70	29.75%	25.95%	24.75%	23.00%	21.76%	20.73%	20.20%		
0.80	24.13%	21.80%	20.82%	19.79%	19.07%	18.40%	18.20%		
0.90	18.58%	17.76%	17.08%	16.97%	16.89%	16.62%	16.71%		
1.00	13.40%	14.10%	14.27%	14.75%	15.11%	15.18%	15.54%		
1.10	10.33%	11.41%	12.81%	13.35%	13.79%	14.17%	14.68%		
1.20	10.98%	10.83%	12.14%	12.61%	13.13%	13.70%	14.29%		
1.30	11.48%	11.39%	11.79%	12.48%	13.10%	13.55%	14.18%		

6. 가격계산 매크로 실행

[illegible]

7. 가격이랑 그릭스 LocalVolatility까지 다 계산해줌

Dupire Local Volatility

Parity (Moneyness)	기간구조					
	0.33	0.67	1.00	1.33	1.67	
0.50	49.23%	51.33%	44.75%	31.10%	28.91%	
0.60	47.54%	46.22%	44.28%	28.05%	24.73%	
0.70	40.17%	35.15%	29.87%	22.91%	20.01%	
0.80	31.89%	27.47%	24.59%	20.20%	17.70%	
0.90	22.45%	19.40%	17.61%	17.50%	16.46%	
1.00	13.87%	13.70%	13.73%	14.73%	14.75%	
1.10	10.12%	10.95%	12.94%	12.92%	13.28%	
1.20	12.17%	11.94%	12.55%	12.56%	13.52%	
1.30	13.34%	13.32%	11.88%	13.38%	14.02%	

HiFive_ELS 함수설명서 및 클래스 매핑정의

```
DLLEXPORT(long) Excel_HiFive_ELS_MC(
long PricingDate_Excel,           // 가격계산날짜 ExcelType Ex) 44201(2021년01월05일)
long NSimul,                      // 시뮬레이션개수
long GreekFlag,                  // 그릭계산할지여부
double FaceValue,                // 원금액
long FaceValueFlag,              // 원금설정여부

double MaxProfit,                 // 최대이익
double MaxLoss,                  // 최대손실
long NEvaluate,                  // 조기상환 평가일개수
double KI_Barrier_Level,         // 낙인배리어수준
long Now_KI_State,               // 현재 낙인상태

long KI_Method,                  // 낙인처리방법
long* EvalDate_Excel,            // 조기상환 ExcelType평가일 Array [ Len =NEvaluate ]
long* PayDate_Excel,             // 조기상환 ExcelType지급일 Array [ Len =NEvaluate ]
long* NStrike,                   // 조기상환 회차별 행사가격개수 Array [ Len =NEvaluate ]
double* StrikeLevel,             // 조기상환 회차별 행사가격 Array [ Len = 3 * NEvaluate ]

double* Slope,                   // 조기상환 회차별 참여율 [ Len = 3 * NEvaluate ]
double* FixedAmount,             // 조기상환 회차별 쿠폰 [ Len = 3 * NEvaluate ]
long NLizard,                    // 리자드상환 평가일 개수
long* LizardFlag,                // 조기상환 회차별 리자드상환 평가여부 Array [Len =NLizard ]
long* LizardStartDate_Excel,     // 조기상환회차별 리자드배리어 체크시작Array [Len=NLizard]

long* LizardEndDate_Excel,       // 조기상환회차별 리자드배리어 체크종료일 Array [Len=NLizard]
double* LizardBarrierLevel,      // 조기상환 회차별 리자드배리어 배리어레벨 Array
long* Now_LizardHitting,         // 조기상환 회차별 리자드배리어 현재 Hitting여부 Array
double* LizardCoupon,           // 조기상환 회차별 리자드배리어 쿠폰이자율 Array
long NCPN,                       // 일반 쿠폰 지급 개수

long* CPN_EvaluateDate_Excel,    // 일반 쿠폰 평가일 ExcelType Array [ Len = NCPN ]
long* CPN_PayDate_Excel,         // 일반 쿠폰 지급일 ExcelType Array [ Len = NCPN ]
double* CPN_Lower_Barrier,      // 일반 쿠폰 하방배리어 Array [ Len =NCPN ]
double* CPN_Upper_Barrier,      // 일반 쿠폰 하방배리어 Array [ Len =NCPN ]
double* CPN_Rate,               // 일반 쿠폰 쿠폰이자율 Array [ Len =NCPN ]

long NStock,                     // 기초자산개수
double* SOX0,                    // [자산가격,기준가격,평가일가격,Coupon기준 평가가격Array]
double* CorrelationReshaped,    // Correlation Matrix.reshape(-1)
long* NTerm,                     // 이자율 Term 개수 (Disc, Rf1, Rf2, ...) [ Len= NStock +1]
double* TermRate,               // Rate Term: append(DiscT, RfT1, RfT2 + ...),Len =sum(NTerm)

double* Rate,                    // Rate: append(DiscR,RfR1, RfR2, ..., Len= sum(NTerm)
long* NDivTerm,                  // Div Term 개수 (S1, S2, ...) [ Len = NStock ]
long* DivFlag,                   // 배당타입 (Stock1DivType, ) , Len = sum(NDivTerm)
double* TermDiv,                 // 배당Term: append(S1DivTerm, S2DivTerm,...),Len= sum(NDivTerm)
double* Div,                     // 배당Rate또는 금액:append(S1Div,S2Div,...),Len = sum(NDivTerm)

long* QuantoFlag,               // Quanto 사용여부 Array [Len =NStock ]
```

```

double* QuantoCorr,
long* NTermQuanto,
double* TermQuanto,
double* VolQuanto,

long* ImVolLocalVolFlag,
long* NParityVol,
double* ParityVol,
long* NTermVol,
double* TermVol,

double* Vol,
double* ResultPrice,
double* AutocallProb,
double* CPNProb,
double* ResultLocalVol,
)

class HiFiveInfo {
public:
double FaceValue;
long FaceValueFlag;
long NStock;

double MaxProfit;
double MaxLoss;

// KI 관련 정보
long KI_Method;
double KI_Barrier_Level;
long Now_KI_State;

// Autocall 관련 정보
long NEvaluation;
long* Days_Autocall_Eval;
long* Days_Autocall_Pay;

long nK;
double** Strike;
double** Slope;
double** FixedAmount;

// Lizard 관련 정보
long NLizard;
long* LizardFlag;
long* Days_LizardStart;
long* Days_LizardEnd;
double* Lizard_Barrier_Level;
double* Lizard_Coupon;
long* Now_Lizard_KI_State;

long NCPN;
long* Days_CPN_Eval;
long* Days_CPN_Pay;

// FX, 기초자산 Correlation Array [Len =NStock ]
// Quanto FX Vol Term 길이 Array [ Len =NStock]
// FX Vol Term Array: append(FXVolT1,...) Len =sum(NTermQuanto)
// FX Vol Array: append[FXVol1,...] Len =sum(NTermQuanto)

// Imvol/Localvol Flag Array (0:Imvol, 1:LocalVol) Len =NStock
// 기초자산별 패리티 개수 Array [ Shape = (NStock, )]
// 기초자산별 패리티 Array: append[Par1 Array, Par2 Array,...]
// 기초자산별 Volatility Term 개수 Array [ Len = NStock]
// 기초자산별 Volatility Term Array: append[VolT1, VolT2, ..]

// Vol Array: append[ReshapeVol1, ReshapeVol2,...]
// 결과가격 및 델타감마베가 Len = (1 + NStock * 3 )
// 조기상환 확률 및 조기상환 Payoff -> Len =NEvaluate * 2
// 쿠폰 확률 및 쿠폰 -> Len =NCPN * 2
// LocalVolatility 결과값

// Notional Amount
// Notional Amount 지급여부
// Underlying Asset 개수

// 최대이익
// 최대손실

// KI Method 0: 낙인적용X, 1: Continuous KI, 2: 만기에만 KI
// Kncok In Barrier
// 현재 낙인 상태

// 조기상환 평가일 개수
// 조기상환 평가일까지 날짜수 Shape = (NEvaluation, )
// 조기상환 지급일까지 날짜수 Shape = (NEvaluation, )

// 각 조기상환 평가일에 행사가격 개수(옵션개수)
// 각 조기상환 평가일에 행사가격 Shape = (3, NEvaluation )
// 각 조기상환 평가일에 참여율 Shape = (3, NEvaluation)
// 각 조기상환 평가일에 Coupon Rate Shape = (3, NEvaluation)

// 리자드 평가 개수
// 각 조기상환 평가일 리자드 평가되는지여부 Shape=(NLizard,)
// 각 조기상환 평가일 리자드배리어평가시작일Shape=(NLizard,)
// 각 조기상환 평가일 리자드배리어평가종료일Shape=(NLizard,)
// 리자드배리어 수준 Array -> Shape = (NLizard, )
// 리자드 쿠폰 Array -> Shape = (NLizard, )
// 현재 리자드 배리어 낙인상황 Array -> Shape = (NLizard, )

// 일반쿠폰평가개수
// 일반쿠폰평가일까지 날짜수 Array -> Shape = (NCPN , )
// 일반쿠폰지급일까지 날짜수 Array -> Shape = (NCPN , )

```

```

double* CPN_Lower_Barrier;      // 일반쿠폰지급의 하방배리어 Array -> Shape = (NCPN , )
double* CPN_Upper_Barrier;     // 일반쿠폰지급의 상방배리어 Array -> Shape = (NCPN , )
double* CPN_Rate;               // 일반쿠폰Rate Array -> Shape = (NCPN , )

};

```

로직설명

1. 주가 Path 생성

$$dS_n = (Rf_n - d_n - \rho(S_n, FX_n)\sigma_{S(n)}\sigma_{FX(n)}) \cdot S + \sigma_{(S_n)}\sqrt{\Delta t} \times \epsilon$$

2. 조기상환 및 리자드 상환 체크

$$\text{if } \min(S_1, S_2, \dots) > K \text{ Then Autocall}$$

3. 페이오프 할인