

```
SetDirectory["D:\ToBeSaved\MathStudies\RiskEngine"];
Get["A_Control.m"];
```

```
***** Low level Primitives *****
```

```
***** High level Instruments *****
```

```
***** Risk and Hedge Tools *****
```

```
InitializeData[{usd, dem, frf}]
```

```
Ref.Cur.=Currency[usd]
```

```
File read :usd.zero 15 lines
```

```
File read :usd.index 31 lines
```

```
File read :dem.zero 15 lines
```

```
File read :dem.index 31 lines
```

```
File read :frf.zero 15 lines
```

```
File read :frf.index 31 lines
```

```
File read :PrimeRate 15 lines
```

```
File read :USTreasury 15 lines
```

```
File read :Gold.index 31 lines
```

```
File read :Oil.index 31 lines
```

```
Ref.Cur.=Currency[usd]
```

```
1 dim for the exchange rate :1
```

```
+ 1 dim for the volatility of the exchange rate :1
```

```
+ 1 dim for the index :1
```

```
+ 1 dim for the volatility of the index :1
```

```
+ NbMaturities=16
```

```
+ NbVolatilities=3
```

```
= Total NbDimPerC=23
```

```
X NbCurrencies=3
```

```
= NbDim=69
```

```
Created Tables
```

```
Reading MATH_VOL
```

```
143 lines read
```

```
SD Currency Currency[usd] handled
```

```
SD Currency Currency[dem] handled
```

```
SD Currency Currency[frf] handled
```

```
SD rates and currencies handled
```

```
standard deviations OK
```

```
Reading MATH_CORR
```

```
10296 lines read
```

```

1000 lines handled
2000 lines handled
3000 lines handled
4000 lines handled
5000 lines handled
6000 lines handled
7000 lines handled
8000 lines handled
9000 lines handled
10000 lines handled
Correlations handled
Multiplying SD by correlations to get covariances
Covariances Computation Ended
Checking the definiteness of the covariance matrix
Computing the square root of the covariance matrix

```

```

EvaluationDate = "6-Mar-98";
EvaluationDate2 = "3/06/1998";

```

```

inst = FxOption[buy, call, 100 mm, usd,
  TT["30-Mar-98"], currencybase → dem, strike → 1.5]

```

```
forward=1.4413 k=1.5
```

```
vo=0.0546863
```

```

Inst[Option[Call[1.5], 1.4413 × 108,
  Index[ExchangeRate[0.0657534, Currency[usd], Currency[dem]]],
  Volatility1[Index[ExchangeRate[0.0657534, Currency[usd], Currency[dem]]],
    0.0657534, 0.], 0.0657534, 0, Currency[dem]]]

```

```
Value[inst]
```

```
1.08875 × 106
```

NS1[inst]

```
-4.8401 × 107 S1[Index[ExchangeRate[Currency[dem], Currency[usd]]]] -
2.3288 × 106 S1[Index[Rate[0.0657534, Currency[dem]]]] +
2.27969 × 106 S1[Index[Rate[0.0657534, Currency[usd]]]] + 1.01817 × 107
S1[Volatility[Index[ExchangeRate[Currency[dem], Currency[usd]]], 0.0657534]] +
1031.86 S1[Volatility[Index[Rate[0.0194444, Currency[dem]]], 0.0657534]] -
1624.03 S1[Volatility[Index[Rate[0.0194444, Currency[usd]]], 0.0657534]] +
399.195 S1[Volatility[Index[Rate[0.0833333, Currency[dem]]], 0.0657534]] -
455.48 S1[Volatility[Index[Rate[0.0833333, Currency[usd]]], 0.0657534]] +
3.69593 × 106 S1S[Index[ExchangeRate[Currency[dem], Currency[usd]]], 2] +
63824.7 S1S[Index[Rate[0.0194444, Currency[dem]]], 2, 2] -
63662.9 S1S[Index[Rate[0.0194444, Currency[usd]]], 2, 1] +
31966.6 S1S[Index[Rate[0.0833333, Currency[dem]]], 3, 2] -
32002.1 S1S[Index[Rate[0.0833333, Currency[usd]]], 3, 1]
```

z = inst[[1]][[4]]

```
Volatility1[
Index[ExchangeRate[0.0657534, Currency[usd], Currency[dem]]], 0.0657534, 0.]
```

NS1[z]

```
0.227212 S1[Volatility[Index[ExchangeRate[Currency[dem], Currency[usd]]], 0.0657534]] +
0.000230267 S1[Volatility[Index[Rate[0.0194444, Currency[dem]]], 0.0657534]] -
0.000362414 S1[Volatility[Index[Rate[0.0194444, Currency[usd]]], 0.0657534]] +
8.90832 × 10-6 S1[Volatility[Index[Rate[0.0833333, Currency[dem]]], 0.0657534]] -
0.000101643 S1[Volatility[Index[Rate[0.0833333, Currency[usd]]], 0.0657534]] +
0.0824772 S1S[Index[ExchangeRate[Currency[dem], Currency[usd]]], 2] +
0.00142429 S1S[Index[Rate[0.0194444, Currency[dem]]], 2, 2] -
0.00142068 S1S[Index[Rate[0.0194444, Currency[usd]]], 2, 1] +
0.000713356 S1S[Index[Rate[0.0833333, Currency[dem]]], 3, 2] -
0.000714149 S1S[Index[Rate[0.0833333, Currency[usd]]], 3, 1]
```

NS1[z, 4 / 365.]

```
0.207415 S1[Volatility[Index[ExchangeRate[Currency[dem], Currency[usd]]], 0.0657534]] +
0.000210204 S1[Volatility[Index[Rate[0.0194444, Currency[dem]]], 0.0657534]] -
0.000330837 S1[Volatility[Index[Rate[0.0194444, Currency[usd]]], 0.0657534]] +
8.13215 × 10-6 S1[Volatility[Index[Rate[0.0833333, Currency[dem]]], 0.0657534]] -
9.27874 × 10-6 S1[Volatility[Index[Rate[0.0833333, Currency[usd]]], 0.0657534]] +
0.0752912 S1S[Index[ExchangeRate[Currency[dem], Currency[usd]]], 2] +
0.00121491 S1S[Index[Rate[0.0194444, Currency[dem]]], 2, 2] -
0.00121175 S1S[Index[Rate[0.0194444, Currency[usd]]], 2, 1] +
0.000608417 S1S[Index[Rate[0.0833333, Currency[dem]]], 3, 2] -
0.000608975 S1S[Index[Rate[0.0833333, Currency[usd]]], 3, 1]
```

NS1[z, 1.]

0



[illegible]

[illegible]

[illegible]

[illegible]





```

RQ0 = Timing[QR[cum0, 0.05]]
{14.34 Second, 486384.}

RQ0[[2]] / R0
0.837583

RQ0[[2]] / RQ1[[2]]
7.19283

inst

(*----- Scenarios based computation -----*)

SSValue[inst, Rate[dem] → +0.01] - Value[inst]
-513.076

SSValue[inst, ExchangeRate[dem] → +0.0001] - Value[inst]
-5184.1

SSValue[hedgedinst, ExchangeRate[dem] → +0.0001] - Value[hedgedinst]
-756.311

SSValue[inst,
          RateAfter[usd, 1.5] → +0.01,
          RateBetween[dem, 0.001, 4] → -0.01,
          RateVolatilityBetween[dem, 1, 5] → -0.05,
          ExchangeRateVolatility[dem] → 0.1
        ]
1.08926 × 106

SFValue[inst, 5 / 365.,
          RateAfter[usd, 1.5] → +0.01,
          RateBetween[dem, 0.001, 4] → -0.01,
          RateVolatilityBetween[dem, 1, 5] → -0.05,
          ExchangeRateVolatility[dem] → 0.1
        ]
828148.

```

```

SFNS1[inst, 5 / 365.,
      RateAfter[usd, 1.5] → +0.01,
      RateBetween[dem, 0.001, 4] → -0.01,
      RateVolatilityBetween[dem, 1, 5] → -0.05,
      ExchangeRateVolatility[dem] → 0.1
]

-4.2988 × 107 S1[Index[ExchangeRate[Currency[dem], Currency[usd]]]] +
7774.53 S1[Index[Rate[0.0136986, Currency[dem]]]] -
2.05292 × 106 S1[Index[Rate[0.0657534, Currency[dem]]]] +
2.0156 × 106 S1[Index[Rate[0.0657534, Currency[usd]]]] + 8.45515 × 106
S1[Volatility[Index[ExchangeRate[Currency[dem], Currency[usd]]], 0.0657534]] +
856.884 S1[Volatility[Index[Rate[0.0194444, Currency[dem]]], 0.0657534]] -
1348.64 S1[Volatility[Index[Rate[0.0194444, Currency[usd]]], 0.0657534]] +
331.502 S1[Volatility[Index[Rate[0.0833333, Currency[dem]]], 0.0657534]] -
378.242 S1[Volatility[Index[Rate[0.0833333, Currency[usd]]], 0.0657534]] +
3.0692 × 106 S1S[Index[ExchangeRate[Currency[dem], Currency[usd]]], 2] +
48469. S1S[Index[Rate[0.0194444, Currency[dem]]], 2, 2] -
48341.8 S1S[Index[Rate[0.0194444, Currency[usd]]], 2, 1] +
24271.9 S1S[Index[Rate[0.0833333, Currency[dem]]], 3, 2] -
24292.6 S1S[Index[Rate[0.0833333, Currency[usd]]], 3, 1]

CM[inst]
{1.24637 × 1011, 3.59892 × 1016, 1.39444 × 1022}

cmf = SFCM[inst, 4, 5 / 365.,
           RateAfter[usd, 1.5] → +0.01,
           RateBetween[dem, 0.001, 4] → -0.01,
           RateVolatilityBetween[dem, 1, 5] → -0.05,
           ExchangeRateVolatility[dem] → 0.1
]

{1.00892 × 1011, 3.06338 × 1016, 1.25109 × 1022}

NR[cmf, 0.05]
522462.

```

```

ScenarioSet1 = {
  {RateAfter[usd, 1.5] → +0.01,
    RateBetween[dem, 0.001, 4] → -0.01,
    RateVolatilityBetween[dem, 1, 5] → -0.05,
    ExchangeRateVolatility[dem] → 0.1},
  {RateAfter[usd, 1.5] → +0.02,
    RateBetween[dem, 0.001, 4] → -0.02,
    RateVolatilityBetween[dem, 1, 5] → -0.05,
    ExchangeRateVolatility[dem] → 0.1},
  {RateAfter[usd, 1.5] → +0.03,
    RateBetween[dem, 0.001, 4] → -0.03,
    RateVolatilityBetween[dem, 1, 5] → -0.05,
    ExchangeRateVolatility[dem] → 0.1},
  {RateAfter[usd, 1.5] → -0.01,
    RateBetween[dem, 0.001, 4] → 0.01,
    RateVolatilityBetween[dem, 1, 5] → -0.05,
    ExchangeRateVolatility[dem] → 0.1},
  {RateAfter[usd, 1.5] → -0.02,
    RateBetween[dem, 0.001, 4] → 0.02,
    RateVolatilityBetween[dem, 1, 5] → -0.05,
    ExchangeRateVolatility[dem] → 0.1},
  {RateAfter[usd, 1.5] → -0.03,
    RateBetween[dem, 0.001, 4] → 0.03,
    RateVolatilityBetween[dem, 1, 5] → -0.05,
    ExchangeRateVolatility[dem] → 0.1}
};

```

```
SSValue[inst, 5 / 365., ScenarioSet1]
```

```
{828148., 828538., 828928., 827369., 826979., 826589.}
```

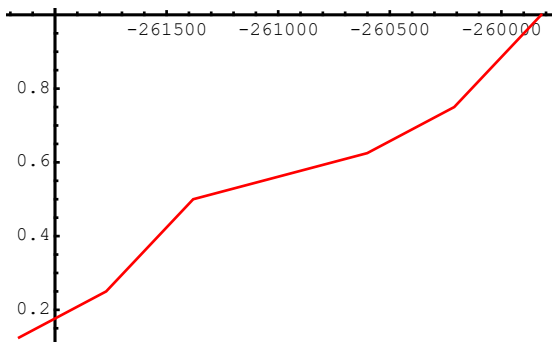
```
fss = ScenarioD[inst, 5 / 365., ScenarioSet1,
  weightlist → {1 / 8, 1 / 8, 1 / 4, 1 / 4, 1 / 8, 1 / 8}]
```

```

{{{-262161.,  $\frac{1}{8}$ }, {-261771.,  $\frac{1}{4}$ }, {-261381.,  $\frac{1}{2}$ },
  {-260601.,  $\frac{5}{8}$ }, {-260211.,  $\frac{3}{4}$ }, {-259821., 1}}

```

```
ListPlot[fss, PlotStyle → RGBColor[1, 0, 0], PlotJoined → True]
```



- Graphics -

```
MCRisk[fss, 0.25]
```

```
261966.
```

```
(* ----- Monte Carlo Computations -----*)
```

```
fmc = MonteCarloD[hedgedinst, 1000];
```

```
simulation time :0.05 Second
```

```
200 simulations /1000 val=-2.78298×107
```

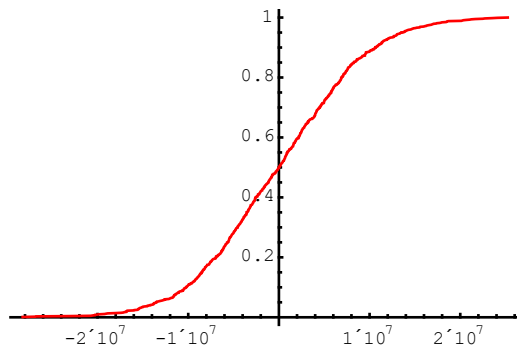
```
400 simulations /1000 val=-2.55468×107
```

```
600 simulations /1000 val=-3.01861×107
```

```
800 simulations /1000 val=-2.52553×107
```

```
1000 simulations /1000 val=-2.83646×107
```

```
ListPlot[fmc, PlotStyle → RGBColor[1, 0, 0], PlotJoined → True]
```



```
- Graphics -
```

```
MCRisk[fmc, 0.05]
```

```
1.35286 × 107
```

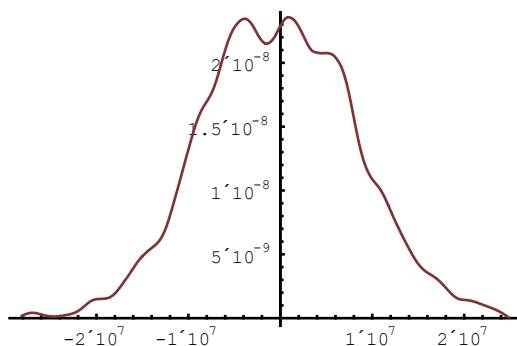
```
MCCM[fmc, 4]
```

```
{4.41516 × 10-9, 6.84503 × 1013, 1.66544 × 1019, 2.19987 × 1026}
```

```
ds = MCSample[fmc, 200];
```

```
ds3 = MCSampleDerive[ds, 1000];
```

```
ListPlot[ds3, PlotStyle → RGBColor[0.5, 0.2, 0.2], PlotJoined → True]
```



```
- Graphics -
```

```
(* -----Credit
Risk Computation ----- *)
```

```
X2 = Bond[buy, 25 mm, usd, TT["15-May-07"], coupon → 0.065, bondprice → 97.6]
```

```
Seq[Inst[Fix[311644., 0.191781, Currency[usd], 0.00352586]],
Inst[Fix[1.625 × 106, 1.19178, Currency[usd], 0.00352586]],
Inst[Fix[1.625 × 106, 2.19178, Currency[usd], 0.00352586]],
Inst[Fix[1.625 × 106, 3.19178, Currency[usd], 0.00352586]],
Inst[Fix[1.625 × 106, 4.19178, Currency[usd], 0.00352586]],
Inst[Fix[1.625 × 106, 5.19178, Currency[usd], 0.00352586]],
Inst[Fix[1.625 × 106, 6.19178, Currency[usd], 0.00352586]],
Inst[Fix[1.625 × 106, 7.19178, Currency[usd], 0.00352586]],
Inst[Fix[1.625 × 106, 8.19178, Currency[usd], 0.00352586]],
Inst[Fix[2.6625 × 107, 9.19178, Currency[usd], 0.00352586]]]
```

```
EXPO[X2, 1]
```

```
2.2527 × 107
```

```
EXPO[X2, 2]
```

```
2.30166 × 107
```

```
X3 = Swap[receivefloat, 125 mm, usd,
TT["31-Dec-05"], fixed → 0.074, reset → 0.07, frequency → 0.5];
```

```
Value[X3]
```

```
-6.5543 × 106
```

```
FindRoot[Value[Swap[receivefloat, 125 mm, usd, TT["31-Dec-05"],
fixed → fff, reset → 0.07, frequency → 0.5]] == 0, {fff, 0.05}]
{fff → 0.065142}
```

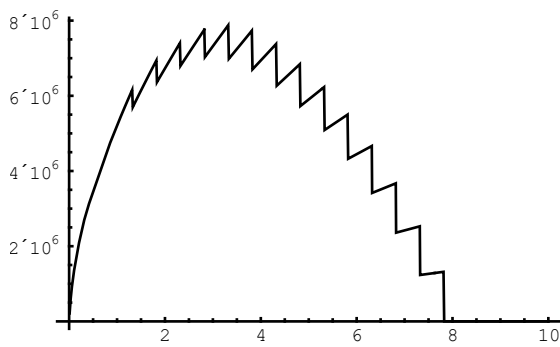
```
X3 = Swap[receivefloat, 125 mm, usd,
TT["31-Dec-05"], fixed → 0.0674014, reset → 0.07, frequency → 0.5];
```

```
Value[X3]
```

```
-1.67179 × 106
```

```
(*----- Computation of the exposition -----*)
```

```
Plot[EXPO[X3, t], {t, 0.01, 10}]
```



- Graphics -

(\* ----- non linear adjustment to options -----\*)

```
bb = Bond[buy, 125 mm, dem, TT["20-May-01"], coupon → 0.06375]
```

```
Seq[Inst[Fix[1.63741 × 106, 0.205479, Currency[dem], 0]],  
  Inst[Fix[7.96875 × 106, 1.20548, Currency[dem], 0]],  
  Inst[Fix[7.96875 × 106, 2.20548, Currency[dem], 0]],  
  Inst[Fix[1.32969 × 108, 3.20548, Currency[dem], 0]]]
```

```
X27 = EuropeanBondOption[buy, 10, call, usd, bb, 0.3, strike → 1.01];
```

```
Value[X27]
```

```
3.54342 × 107
```

```
X27 = EuropeanBondOption[buy, 10, call, usd, bb, 0.3, strike → 1.01, cumulants → 4];
```

```
v00 = Value[X27]
```

```
3.54199 × 107
```

```
debugflag = 1;
```

```
Value[X27]
```

```
True Cumulants={1.0123×1014, 2.21974×1014, 3.00985×1022}
```

```
Forward Value = 8.82165×107      Total Forward Volatility = 0.11405
```

```
LN Cumulants={1.01226×1014, 3.49976×1020, 2.1587×1027}
```

```
Final coeffs={3.24555×109, -3.49976×1020, -2.15867×1027}
```

```
LN Density Derivatives={2.15055×10-8, -3.33323×10-16, -5.39771×10-23}
```

```
adjustement=-14300.4
```

```
3.54199 × 107
```

(\*----- find a volatility spread due to the non linearity -----\*)

```
X27 = EuropeanBondOption[buy, 10, call, usd, bb, 0.3, strike → 1.01, cumulants → 4];
```

```
v00 = Value[X27]
```

```

True Cumulants={1.0123×1014, 2.21974×1014, 3.00985×1022}
Forward Value = 8.82165×107      Total Forward Volatility = 0.11405
LN Cumulants={1.01226×1014, 3.49976×1020, 2.1587×1027}
Final coeffs={3.24555×109, -3.49976×1020, -2.15867×1027}
LN Density Derivatives={2.15055×10-8, -3.33323×10-16, -5.39771×10-23}
adjustement=-14300.4
3.54199 × 107

FindRoot[Value[EuropeanBondOption[buy, 10, call, usd, bb, 0.3,
    strike → 1.01, volatilitiespread → spx]] == v00, {spx, 0.00001, 0.00005}]
{spx → -0.0000413695}

Value[EuropeanBondOption[buy, 10, call, usd,
    bb, 0.3, strike → 1.01, volatilitiespread → -0.00004136]]
3.54199 × 107

debugflag = 0;

Value[X27]
3.54199 × 107

(*----- effect of non linearity on a
highly non linear option -----Exemple 1 *)

inst = FxOption[buy, call, 95 mm, usd,
    TT["30-Mar-98"], currencybase → dem, strike →  $\frac{1}{1.5}$ ]

forward=1.444 k=0.666667
vo=0.0548063

Inst[Option[Call[0.666667], 1.3718 × 108,
    Index[ExchangeRate[0.0657534, Currency[usd], Currency[dem]]],
    Volatility1[Index[ExchangeRate[0.0657534, Currency[usd], Currency[dem]]],
    0.0657534, 0.], 0.0657534, 0, Currency[dem]]]

v1 = Value[inst, TT["15-Mar-98"]]
7.37254 × 107

(*----- effect of non linearity on a
highly non linear option -----Exemple 2 *)

```



```

xi = EuropeanOption[buy, Call, 100 mm, usd, inst, TT["15-Mar-98"], strike → 1.01]
v0=2.71332×10-93  f=-3.66455×1098  k=-3.7012×1098
Inst[Option[Call[-3.7012×1098], -2.72885×10-91,
  Index[FutVal[0.0246575, Currency[usd], Inst[Option[Call[0.666667],
    1.3718×108, Index[ExchangeRate[0.0657534, Currency[usd], Currency[dem]]],
    Volatility1[Index[ExchangeRate[0.0657534, Currency[usd], Currency[dem]]],
      0.0657534, 0.], 0.0657534, 0, Currency[dem]]]],
  Volatility1[Index[FutVal[0.0246575, Currency[usd], Inst[Option[Call[0.666667],
    1.3718×108, Index[ExchangeRate[0.0657534, Currency[usd], Currency[dem]]],
    Volatility1[Index[ExchangeRate[0.0657534, Currency[usd], Currency[dem]]],
      0.0657534, 0.], 0.0657534, 0, Currency[dem]]]],
    0.0246575, 0.], 0.0246575, 2, Currency[usd]]]]

Value[xi]
1.63662317×101802 + 1.34334146×101802 I

xi1 = EuropeanOption[buy, Call, 100 mm,
  usd, inst, TT["15-Mar-98"], strike → 1.01, cumulants → 5]
v0=0.0393215  f=9.17389×1098  k=9.26563×1098
Inst[Option[Call[9.26563×1098], 1.09005×10-91,
  Index[FutVal[0.0246575, Currency[usd], Inst[Option[Call[0.666667],
    1.3718×108, Index[ExchangeRate[0.0657534, Currency[usd], Currency[dem]]],
    Volatility1[Index[ExchangeRate[0.0657534, Currency[usd], Currency[dem]]],
      0.0657534, 0.], 0.0657534, 0, Currency[dem]]]],
  Volatility1[Index[FutVal[0.0246575, Currency[usd], Inst[Option[Call[0.666667],
    1.3718×108, Index[ExchangeRate[0.0657534, Currency[usd], Currency[dem]]],
    Volatility1[Index[ExchangeRate[0.0657534, Currency[usd], Currency[dem]]],
      0.0657534, 0.], 0.0657534, 0, Currency[dem]]]],
    0.0246575, 0.], 0.0246575, 5, Currency[usd]]]]

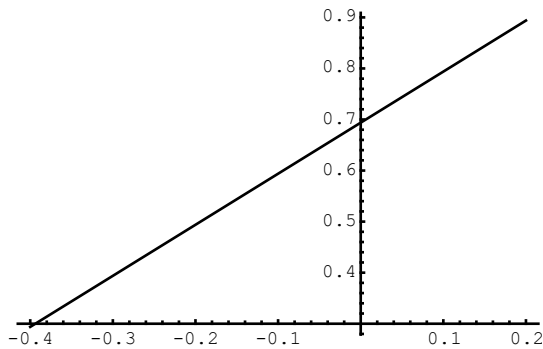
Value[xi1]
-4.85891×1095

Sqrt[CM1[inst, TT["15-Mar-98"]][[1]]×TT["15-Mar-98"]/ProvidedStatisticalTime]/
  Value[inst, TT["15-Mar-98"]]
0.13928

(*----- simple hedging on the FX market -----*)
Value[Index[ExchangeRate[1, Currency[usd], Currency[usd]]]]
0.692411

```

```
Plot[SSValue[Index[ExchangeRate[Currency[dem], Currency[usd]]],
  ExchangeRate[dem] → xx], {xx, -0.4, 0.2}]
```



- Graphics -

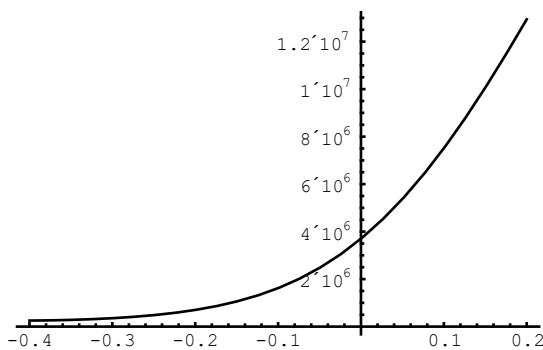
```
insta = FxOption[buy, call, 100 mm, dem, 1., currencybase → usd, strike → 0.7]
```

```
forward=0.693818 k=0.7
```

```
vo=0.215092
```

```
Inst[
  Option[Call[0.7], 6.93818 × 107, Index[ExchangeRate[1., Currency[dem], Currency[usd]]],
    Volatility1[Index[ExchangeRate[1., Currency[dem], Currency[usd]]], 1., 0.],
    1., 0, Currency[usd]]]
```

```
Plot[SSValue[insta, ExchangeRate[dem] → xx], {xx, -0.4, 0.2}]
```



- Graphics -

```
hedg = FxForward[45 mm, dem, TT["30-Sep-98"], soldcurrency → usd, rate → 1.43];
```

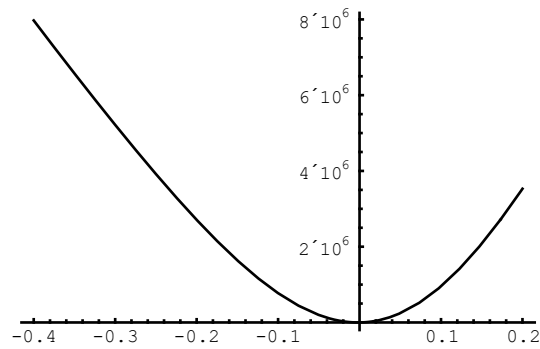
```
ratio = H1[insta, hedg]
```

```
-0.648989
```

```
hedgedinsta = MU[Seq[insta, ratio hedg]]
```

```
Seq[Inst[Option[Call[0.7], 6.93818 × 107,
  Index[ExchangeRate[1., Currency[dem], Currency[usd]]],
  Volatility1[Index[ExchangeRate[1., Currency[dem], Currency[usd]]], 1., 0.], 1.,
  0, Currency[usd]]], Seq[Inst[Fix[-2.92045 × 107, 0.569863, Currency[dem], 0]],
  Inst[Fix[4.17624 × 107, 0.569863, Currency[usd], 0]]]]]
```

```
Plot[SSValue[hedgedinsta, ExchangeRate[dem] → xx] - Value[hedgedinsta], {xx, -0.4, 0.2}]
```



- Graphics -

(\*----- Use of pseudo-sensitivities for hedging barrier options -----\*)

```
instb = FxBarrierOption[buy, call, upandout,
  100 mm, dem, .1, currencybase → usd, strike → 0.7, barrier → 10.9]
```

```
forward=0.693818 k=0.7 b=10.9
```

```
vo=0.0674585
```

```
Inst[Option[BarrierCall[1, 1, 0.7, 10.9], 1.4413 × 108,
  Index[ExchangeRate[0.1, Currency[dem], Currency[usd]]],
  Volatility1[Index[ExchangeRate[0.1, Currency[dem], Currency[usd]]], 0.1, 0.],
  0.1, Currency[usd]]]
```

```
NS1a[instb]
```

```
- 226 743. S1[Index[Rate[0, 0.1, Currency[usd]]]] + 6.60658 × 107
  S1[Index[ExchangeRate[0.1, Currency[dem], Currency[usd]]], 0] + 1.24824 × 107
  S1[Volatility1[Index[ExchangeRate[0.1, Currency[dem], Currency[usd]]], 0.1, 0.], 0]
```

```
insta = FxOption[buy, call, 100 mm, dem, .1, currencybase → usd, strike → 0.7]
```

```
forward=0.693818 k=0.7
```

```
vo=0.0674585
```

```
Inst[Option[Call[0.7], 6.93818 × 107,
  Index[ExchangeRate[0.1, Currency[dem], Currency[usd]]],
  Volatility1[Index[ExchangeRate[0.1, Currency[dem], Currency[usd]]], 0.1, 0.],
  0.1, 0, Currency[usd]]]
```

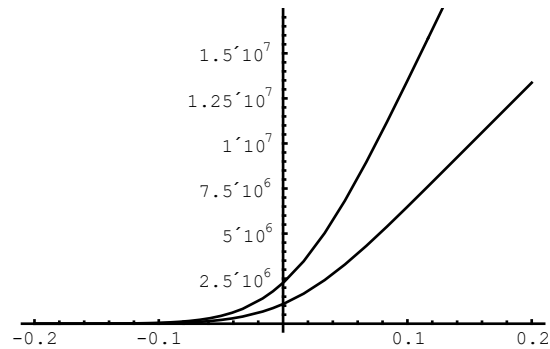
```
Value[insta]
```

```
1.09141 × 106
```

```
NS1a[insta]
```

```
- 109 141. S1[Index[Rate[0, 0.1, Currency[usd]]]] + 3.18028 × 107
  S1[Index[ExchangeRate[0.1, Currency[dem], Currency[usd]]], 0] + 1.90016 × 107
  S1[Volatility1[Index[ExchangeRate[0.1, Currency[dem], Currency[usd]]], 0.1, 0.], 0]
```

```
Plot[{SSValue[instb, ExchangeRate[dem] → xx],
      SSValue[insta, ExchangeRate[dem] → xx]}, {xx, -0.2, 0.2}]
```



- Graphics -

```
hedg = FxForward[45 mm, dem, TT["30-Sep-98"], soldcurrency → usd, rate → 1.43];
```

```
ratiob = H1[instb, hedg]
```

```
-1.46092
```

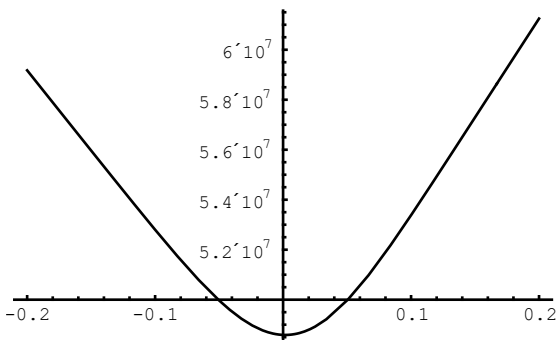
```
ratioa = H1[insta, hedg]
```

```
-0.675118
```

```
hedgedinstb = MU[Seq[instb, ratiob hedg]]
```

```
Seq[Inst[Option[BarrierCall[1, 1, 0.7, 10.9],
  1.4413 × 108, Index[ExchangeRate[0.1, Currency[dem], Currency[usd]]],
  Volatility1[Index[ExchangeRate[0.1, Currency[dem], Currency[usd]]], 0.1, 0.],
  0.1, Currency[usd]]], Seq[Inst[Fix[-6.57416 × 107, 0.569863, Currency[dem], 0]],
  Inst[Fix[9.40105 × 107, 0.569863, Currency[usd], 0]]]]
```

```
Plot[SSValue[hedgedinstb, ExchangeRate[dem] → xx], {xx, -0.2, 0.2}]
```



- Graphics -

```
NS1a[instb]
```

```
-226743. S1[Index[Rate[0, 0.1, Currency[usd]]]] + 6.60658 × 107
```

```
S1[Index[ExchangeRate[0.1, Currency[dem], Currency[usd]]], 0] + 1.24824 × 107
```

```
S1[Volatility1[Index[ExchangeRate[0.1, Currency[dem], Currency[usd]]], 0.1, 0.], 0]
```

```
ratiob = H1[instb, hedg]
```

```
-1.46092
```

(\* If we enlarge the horizon for meta sensitivities \*)

MetaSensitivityFactor = 0.99;

NS1a[instb]

-405740. S1[Index[Rate[0, 0.1, Currency[usd]]]] +  $6.86481 \times 10^7$

S1[Index[ExchangeRate[0.1, Currency[dem], Currency[usd]]], 0] -  $6.59745 \times 10^{77}$

S1[Volatility1[Index[ExchangeRate[0.1, Currency[dem], Currency[usd]]], 0.1, 0.], 0]

ratioB = H1[instb, hedg]

- $1.43053 \times 10^{69}$

hedgedinstb = MU[Seq[instb, ratioB hedg]];

Value[Volatility[Index[ExchangeRate[Currency[usd], Currency[dem]]], 1], 0]

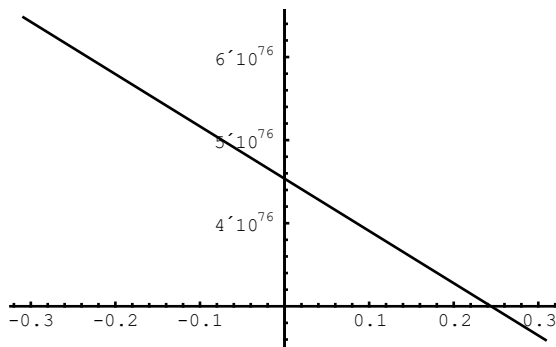
0.214134

StDeviation[index\_, tm\_, tf\_] := Value[Volatility[index, tm], tf] \* Value[index, tf]

sdfx = StDeviation[Index[ExchangeRate[Currency[usd], Currency[dem]]], 1, 0]

0.308631

Plot[SSValue[hedgedinstb, ExchangeRate[dem] → xx], {xx, -sdfx, sdfx}]



- Graphics -

(\* ----- Barrier Option on Bonds -----\*)

bb = Bond[buy, 125 mm, dem, TT["20-May-01"], coupon → 0.06375]

Seq[Inst[Fix[ $1.63741 \times 10^6$ , 0.205479, Currency[dem], 0]],

Inst[Fix[ $7.96875 \times 10^6$ , 1.20548, Currency[dem], 0]],

Inst[Fix[ $7.96875 \times 10^6$ , 2.20548, Currency[dem], 0]],

Inst[Fix[ $1.32969 \times 10^8$ , 3.20548, Currency[dem], 0]]]

Value[EuropeanOption[buy, Call, 100 mm, usd, bb, TT["15-Oct-98"], strike → 1.01]]

v0=0.162701 f= $8.97159 \times 10^7$  k= $9.06131 \times 10^7$

$5.81506 \times 10^6$

Value[BarrierOption[buy, call, upandout, 100 mm,

usd, bb, TT["15-Oct-98"], strike → 1.01, barrier → 1.2]]

```

vo=0.162701
forward= $8.97159 \times 10^7$  k= $9.06131 \times 10^7$  b= $1.07659 \times 10^8$ 
 $1.48487 \times 10^6$ 

xinst = BarrierOption[buy, call, upandout,
  100 mm, usd, bb, TT["15-Oct-98"], strike → 1.01, barrier → 1.2];
vo=0.162701
forward= $8.97159 \times 10^7$  k= $9.06131 \times 10^7$  b= $1.07659 \times 10^8$ 

xhedg = BarrierOption[buy, call, upandout,
  100 mm, usd, bb, TT["15-Oct-98"], strike → 1.01, barrier → 1.2];
vo=0.162701
forward= $8.97159 \times 10^7$  k= $9.06131 \times 10^7$  b= $1.07659 \times 10^8$ 

xratio = H1[xinst, xhedg]
-1.

```