13. Appendix

Model Formulation

```
Initial Free Cash= INITIAL(
    Free Cash[Hf])
    ~       $
    ~               |

Fraction of Free Cash Invested=
    0.8
    ~       Dmnl
    ~               |

Demand Supply table Security S1(
    [(0,0.5)-(3,4)],(0,0.5),(0.2,0.55),(0.4,0.62),(0.6,0.7),(0.8,0.84),(1,1),(1.2,1.5),(\
        1.4,1.6),(1.6,1.7),(1.8,1.8),(2,2),(3,3))
    ~       Dmnl
    ~               |

Desired Equity Weight L=
    Investor Fraction*(Preference for Liquidity Fraction*Table for Desired Equity
Weight L\
        (Forecast Price Relative to Current Price L
    ))
    ~       Dmnl
    ~               |

Switch for Noise Investors=
    1
    ~       Dmnl
    ~               |

Effect of demand supply balance on price Security S=
    STEP(Demand Supply table Security S2(Perceived Demand Supply Balance
Security S),0)-\
        STEP(Demand Supply table Security S2(Perceived Demand Supply
Balance Security S),20\
        )+STEP(Demand Supply table Security S1(Perceived Demand Supply
Balance Security S),\
        20)-STEP(Demand Supply table Security S1(Perceived Demand Supply
Balance Security S\
        ),30)+STEP(Demand Supply table Security S2(Perceived Demand Supply
Balance Security S\
```

),30)+ 0*Demand Supply table Security S2(Perceived Demand Supply Balance Security S\
)
~ fraction
~ Effect of demand/supply balance on price. It adjusts expected price to \ the real price
|

Investor Fraction=
1
~ Dmnl
~ |

Maintenance Margin=
Federal Regulation Fraction
~ Dmnl
~ |

Margin=
Shares Security L[Hf]*Price L*(1-Federal Regulation Fraction)+Total Basis Security S\
[Hf]+Cash Contrib to Cover Margin
~ $
~ |

Margin Needed=
Margin Required-Margin
~ $
~ |

Desired Equity Weight S=
(1-Desired Equity Weight L)*Investor Fraction
~ Dmnl
~ |

Cash Increase Hf=
Sell Rate Security L[Hf]*Price L+Fraction Reinvested*Sell Rate Security S[Hf]*Price S
~ $/Day
~ |

Cash Decrease Hf=
Buy Rate Security S[Hf]*(Price S-Average Basis for Security S[Hf])+Buy Rate Security L\
[Hf]*Price L
~ $/Day

~ Decrease in cash due to buying of stocks
|

Total Desired Buy Rate Security L=
Desired Buy Rate Security L[Hf]+Desired Buy Rate Security L[D]+Desired Buy Rate Security L\
[Inv]*Investor Fraction
~ shares/Day
~ The sum of total desired buy rates for both fundamental and momentum \ investors
|

Desired Shares By Hf Security L=
(IF THEN ELSE(Decision to Get Into Arbitrage=1,IF THEN ELSE(Margin Needed>0, Cash Decision\
*MAX(Free Cash[Hf]/Price L+Shares Security L
[Hf]-Maximum Allowed Leverage*Margin Needed/Price L,0) + (1-Cash Decision)*MAX(Shares Security L[Hf]-Maximum Allowed Leverage*Margin Needed/Price L,0) , MAX(\
Shares Security L[Hf]+MAX((Free Cash[Hf]-(1-Fraction of Free Cash Invested)*Initial Free Cash\
)/Price L,0),0)),0))
~ shares
~ |

Total Desired Sell Rate Security L=
Desired Sell Rate Security L[Hf]+Desired Sell Rate Security L[D]+Desired Sell Rate Security L\
[Inv]*Investor Fraction
~ shares/Day
~ The sum of total desired sell rates for both fundamental and momentum \ investors
|

Total Desired Sell Rate Security S=
Desired Sell Rate Security S[Hf]+Desired Sell Rate Security S[D]+Desired Sell Rate Security S\
[Inv]*Investor Fraction
~ shares/Day
~ The sum of total desired sell rates for both fundamental and momentum \ investors
|

Consumption Inv=
Total Wealth Inv*Fraction of Wealth Spent on Consumption*Investor Fraction
~ $/Day

~ Amount of dollars spent on consumption each day.
|

Total Income Inv=
87.6*Investor Fraction
~ $/Day
~ Total income earned by both fundamental and momentum investors.
|

Initial Shares Security L[Inv]=
Desired Equity Weight L*Total Income Inv/(Fraction of Wealth Spent on Consumption*
Initial Price L)*0+278*0+400*Investor Fraction ~~|
Initial Shares Security L[Hf]=
0 ~~|
Initial Shares Security L[D]=
400+722*0
~ shares
~ Initial number of shares available in market
|

Initial Shares Security S[Inv]=
Desired Equity Weight S*Total Income Inv/(Fraction of Wealth Spent on Consumption*
Initial Price S)*0+578*0+400*Investor Fraction ~~|
Initial Shares Security S[Hf]=
0 ~~|
Initial Shares Security S[D]=
400+422*0
~ shares
~ Initial number of shares available in market
|

Initial Total Cash Inv=
Investor Fraction*(Total Income Inv/(Fraction of Wealth Spent on Consumption)-Market Value of Equity Invested Inv\
)
~ $
~ Initial total amount of cash. When calculated, the initial amount of cash \ is $40,000, and each person has 400 shares in each.
|

Total Desired Buy Rate Security S=
Desired Buy Rate Security S[Hf]+Desired Buy Rate Security S[D]+Desired Buy Rate Security S\
[Inv]*Investor Fraction

~ shares/Day
~ The sum of total desired buy rates for both fundamental and momentum \
investors
|

Gap Shares By Hf Security S=
Desired Shares By Hf Security S-Shares Security S[Hf]
~ shares
~ |

Gap Shares by Hf Security L=
Desired Shares By Hf Security L-Shares Security L[Hf]
~ shares
~ |

Actual Equity Weight Security L Inv=
ZIDZ(Shares Security L[Inv]*Price L,Market Value of Equity Invested Inv)
~ fraction
~ |

Actual Equity Weight Security S Inv=
ZIDZ(Shares Security S[Inv]*Price S,Market Value of Equity Invested Inv)
~ fraction
~ Fraction of equity held by investor
|

Preference for Liquidity Fraction=
(1-STEP(0.1,10)+STEP(0.1,20)-STEP(0.8,20)+STEP(0.8,30))*0+1
~ Dmnl
~ |

Maximum Allowed Leverage=
1/Federal Regulation Fraction
~ fraction
~ |

Desired Shares By Hf Security S=
-1*MIN((Cash Contrib to Cover Margin*2*0+Maximum Allowed
Leverage*Shares Security L[\
Hf]*Price L-Shares Security L[Hf]*Price L
)/Price S,Desired Shares By Hf Security L)-0*Desired Shares By Hf Security L
~ shares
~ Usually, I put a MIN function.
|

Demand Supply table Security L2(

[(0,0.5)-(3,1.5)],(0,0.5),(0.2,0.55),(0.4,0.62),(0.6,0.7),(0.8,0.84),(1,1),(1.2,1.16\
),(1.4,1.3),(1.6,1.38),(1.8,1.45),(2,1.47),(3,1.5))
~ Dmnl
~ |

Desired Portfolio Rebalancing Security S Inv=
(Desired Equity Weight S-Actual Equity Weight Security S Inv)/Normal Portfolio Rebalancing Time Security S
[Inv]
~ 1/Day
~ Daily portfolio rebalancing fraction desired by investors
|

Change in Perceived Price L=
(Price L-Perceived Price L)/Time to perceive price
~ $/(Day*share)
~ |

Desired Buy Rate Security S[Inv]=
MAX(0,(Cash Inv/Price S)*Normal Daily Turnover Security S[Inv]+(Cash Inv/Price S
)*Desired Portfolio Rebalancing Security S Inv) ~~|
Desired Buy Rate Security S[Hf]=
MAX(0,MIN(Gap Shares By Hf Security S/Normal Portfolio Rebalancing Time Security S[Hf\
],(Free Cash[Hf]/Price S)/Normal Portfolio Rebalancing Time Security S
[Hf])) ~~|
Desired Buy Rate Security S[D]=
Desired Sell Rate Security S[Hf]*(1+STEP(0.8,20)-STEP(0.8,30))
~ shares/Day
~ Desired buy rate by each type of the investors.
|

Total Assets[Hf]=
Cash Hf+Credit Balance of S Position[Hf]+Market Value of L Position[Hf]
~ $
~ |

Historical Price L= INTEG (
Change in Historical Price L,
Initial Price L)
~ $/share
~ |

Desired Sell Rate Security S[Inv]=

```
    MAX(0,Shares Security S[Inv]*Normal Daily Turnover Security S[Inv]-Shares
Security S\
        [Inv]*Desired Portfolio Rebalancing Security S Inv
    ) ~~|
Desired Sell Rate Security S[Hf]=
    MAX(0,-Gap Shares By Hf Security S/Normal Portfolio Rebalancing Time
Security S[Hf])\
        ~~|
Desired Sell Rate Security S[D]=
    Desired Buy Rate Security S[Hf]
    ~       shares/Day
    ~       Desired sell rate by each type of investors
    |

Decrease in Total Value Security S[Hf]=
    Buy Rate Security S[Hf]*Average Basis for Security S[Hf]
    ~       $/Day
    ~               |

Effect of demand supply balance on price Security L=
    (STEP(Demand Supply table Security L2(Perceived Demand Supply Balance
Security L),0)\
        -STEP(Demand Supply table Security L2(Perceived Demand Supply
Balance Security L),20\
        )+STEP(Demand Supply table Security L1(Perceived Demand Supply
Balance Security L),\
        20)-STEP(Demand Supply table Security L1(Perceived Demand Supply
Balance Security L\
        ),30)+STEP(Demand Supply table Security L2(Perceived Demand Supply
Balance Security L\
        ),30))*0+Demand Supply table Security L2(Perceived Demand Supply
Balance Security L\
        )
    ~       fraction
    ~       Effect of demand/supply balance on price.  It adjusts expected price to \
        the real price
    |

Perceived Price L= INTEG (
    Change in Perceived Price L,
        Initial Price L)
    ~       $/share
    ~               |

Demand Supply table Security L1(
    [(0,0.5)-(3,1.5)],(0,0.5),(0.2,0.55),(0.4,0.62),(0.6,0.7),(0.8,0.84),(1,0.84),(1.2,0.84\
```

),(1.4,0.84),(1.6,0.84),(1.8,0.84),(2,0.84),(3,0.84))
~ Dmnl
~ |

Spread=
Price S-Price L
~ $/share
~ |

Desired Buy Rate Security L[Inv]=
MAX(0,(Cash Inv/Price L)*Normal Daily Turnover Security L[Inv]+(Cash Inv/Price L
)*Desired Portfolio Rebalancing Security L Inv) ~~|
Desired Buy Rate Security L[Hf]=
MIN(Desired Buy Rate Security L for Rebalancing, Maximum Share Purchase Rate[Hf]) ~~|
Desired Buy Rate Security L[D]=
Desired Sell Rate Security L[Hf]*(1-STEP(0.8,20)+STEP(0.8,30))
~ shares/Day
~ Desired buy rate by each type of the investors.
|

Arbitrage Profit Per Combined Trade=
Initial Price S-Initial Price L+Expected Price L-Expected Price S
~ $/share
~ |

Desired Portfolio Rebalancing Security L Inv=
(Desired Equity Weight L-Actual Equity Weight Security L Inv)/Normal Portfolio Rebalancing Time Security L
[Inv]
~ 1/Day
~ Daily portfolio rebalancing fraction desired by investors
|

Desired Sell Rate Security L[Inv]=
MAX(0,Shares Security L[Inv]*Normal Daily Turnover Security L[Inv]-Shares Security L\
[Inv]*Desired Portfolio Rebalancing Security L Inv
) ~~|
Desired Sell Rate Security L[Hf]=
MAX(0,-Gap Shares by Hf Security L/Normal Portfolio Rebalancing Time Security L[Hf])\
~~|
Desired Sell Rate Security L[D]=
Desired Buy Rate Security L[Hf]

~ shares/Day
~ Desired sell rate by each type of investors
|

Change in expected price L=
(Price L-Expected Price L)/Time to Adjust expected price Security L
~ $/(share*Day)
~ The change in expected price
|

Price L=
Expected Price L*Effect of demand supply balance on price Security L+0*Fundamental Price Security L\
+0*Test2*0+Test1*0+0*Test22
~ $/share
~ |

Table for Desired Equity Weight L(
[(0.5,0.1)-(1.5,1)],(0.5,0.1),(0.6,0.103),(0.7,0.125),(0.8,0.18),(0.9,0.3),(1,0.5),(\
1.1,0.7),(1.2,0.82),(1.3,0.92),(1.4,0.97),(1.5,1))
~ Dmnl
~ |

Forecast Price Relative to Current Price L=
Forecast Price L/Perceived Price L
~ Dmnl
~ |

Change in Historical Price L=
(Perceived Price L-Historical Price L)/Duration over which to calculate price trend
~ $/(Day*share)
~ |

Price Forecast Horizon=
2
~ Day
~ |

Duration over which to calculate price trend=
5
~ Day
~ |

Forecast Price L=

```
    Perceived Price L*(1+Trend in Price L*(Price Forecast Horizon+Time to perceive
price\
        ))
    ~   $/share
    ~       |

Time to perceive price=
    1
    ~   Day
    ~       |

Trend in Price L=
    (Perceived Price L-Historical Price L)/(Historical Price L*Duration over which to
calculate price trend\
        )
    ~   1/Day
    ~       |

Cash Decrease D=
    Buy Rate Security L[Hf]*Average Basis for Security S[Hf]
    ~   $/Day
    ~   Decrease in cash due to buying of stocks
    |

Total Basis Security S[Hf]= INTEG (
    +Increase in Total Value Security S[Hf]-Decrease in Total Value Security S[Hf],
        -Initial Price S*Initial Shares Security S[Hf])
    ~   $
    ~       |

Expected Price S= INTEG (
    Change in expected price S,
        Initial Price S)
    ~   $/share
    ~   Price expected by investor.  The expected price is adjusted to the real \
        price with some time lag
    |

Cash D= INTEG (
    Cash Increase D-Cash Decrease D,
        -Initial Price S*Initial Shares Security S[Hf])
    ~   $
    ~       |

Past Price S= INTEG (
    Change in Past Price S,
```

```
        Initial Price S)
    ~   $/share
    ~       |

Minimum Risk Premium=
    0.001
    ~   1/Day
    ~   The minimum risk premium investors require.
    |

Risk Premium=
    Volatility Switch*Average Risk Premium*MAX(Minimum Risk
Premium,Volatility of Return\
        )/Average SD of Return
    +(1-Volatility Switch)*Average Risk Premium
    ~   1/Day
    ~   Risk premium desired by fundamental investors.
    |

Demand Supply Balance Security S=
    XIDZ(Total Desired Buy Rate Security S,Total Desired Sell Rate Security S, 1)
    ~   fraction
    ~   The ratio of total desired buy rate to total desired sell rate.  The ratio \
        measures the balance between the supply and demand of the stock
    |

Past Price L= INTEG (
    Change in Past Price L,
        Initial Price L)
    ~   $/share
    ~       |

Change in Past Price L=
    (Price L-Past Price L)/Time to Change Past Price L
    ~   $/(Day*share)
    ~       |

Change in Past Price S=
    (Price S-Past Price S)/Time to Change Past Price S
    ~   $/(Day*share)
    ~       |

Initial Equity[Hf]= INITIAL(
    Equity[Hf])
    ~   $
    ~       |
```

Desired Buy Rate Security L for Rebalancing=
MAX(0,Gap Shares by Hf Security L/Normal Portfolio Rebalancing Time Security L[Hf])
~ shares/Day
~ |

Maximum Share Purchase Rate[Hf]=
(Free Cash[Hf]/Minimum payment time[Hf])/Price L
~ shares/Day
~ |

Profit[Hf]=
Equity[Hf]-Initial Equity[Hf]
~ $
~ |

Credit Balance of S Position[Hf]=
Total Basis Security S[Hf]
~ $
~ |

Market Value of L Position[Hf]=
Price L*Shares Security L[Hf]
~ $
~ |

Market Value of S Position[Hf]=
-Price S*Shares Security S[Hf]
~ $
~ |

Total Liabilities[Hf]=
Market Value of S Position[Hf]
~ $
~ |

Equity[Hf]=
Total Assets[Hf]-Total Liabilities[Hf]
~ $
~ |

Decrease in Total Value Security L[Hf]=
Sell Rate Security L[Hf]*Average Basis for Security L[Hf]
~ $/Day
~ |

```
Margin Required=
    -(1+Maintenance Margin)*Price S*Shares Security S[Hf]
    ~       $
    ~               |

Average Basis for Security L[Hf]=
    ZIDZ( Total Basis Security L[Hf] , Shares Security L[Hf] )
    ~       $/share
    ~               |

Average Basis for Security S[Hf]=
    ZIDZ(Total Basis Security S[Hf],-Shares Security S[Hf])
    ~       $/share
    ~               |

Total Basis Security L[Hf]= INTEG (
    +Increase in Total Value Security L[Hf]-Decrease in Total Value Security L[Hf],
        Initial Price L*Initial Shares Security L[Hf])
    ~       $
    ~               |

Return=
    (Price L-Past Price L)/Past Price L/Duration Over Which Return is Calculated
    ~       1/Day
    ~       Daily return of an asset.
    |

Federal Regulation Fraction=
    0.5
    ~       Dmnl
    ~               |

Increase in Total Value Security L[Hf]=
    Buy Rate Security L[Hf]*Price L
    ~       $/Day
    ~               |

Increase in Total Value Security S[Hf]=
    Sell Rate Security S[Hf]*Price S
    ~       $/Day
    ~               |

Margin Call=
    Cash Decision*(IF THEN ELSE(Margin Needed>0,MIN(Margin Needed/Time to
Cover Margin, \
```

```
        Free Cash[Hf]/Minimum payment time[Hf]),0))
    ~   $/Day
    ~           |

Fraction Reinvested=
    0
    ~   fraction
    ~           |

Test4=
    STEP(40,20)-STEP(40,30)
    ~   $/share
    ~           |

Price S=
    Expected Price S*Effect of demand supply balance on price Security
S+0*Fundamental Price Security S\
        +Test3*0+0*Test4
    ~   $/share
    ~           |

Test22=
    STEP(-80,20)+STEP(80,30)
    ~   $/share
    ~           |

Margin Refund=
    Cash Decision*(IF THEN ELSE(Margin Needed<=0,MIN(-
    Margin Needed/Time to Cover Margin, Cash Contrib to Cover Margin
    /Minimum payment time[Hf] ),0))
    ~   $/Day
    ~           |

Test3=
    STEP(20,20)-STEP(20,30)+STEP(40,30)-STEP(40,60)
    ~   $/share
    ~           |

Test2=
    STEP(-20,30)+STEP(+20,60)
    ~   $/share
    ~           |

Cash L= INTEG (
    Cash Increase L+Margin Call-Margin Refund,
        9.6e+007)
```

~ $
~ |

Cash Contrib to Cover Margin= INTEG (
Margin Call-Margin Refund,
0)
~ $
~ |

Free Cash[Hf]= INTEG (
Cash Increase Hf 1+Income from Other Investments 1+Margin Refund-Cash Decrease Hf 1-\
Margin Call,
Initial Total Cash Hf)
~ $
~ |

Cash Decrease Hf 1=
Cash Decrease Hf
~ $/Day
~ |

Income from Other Investments 1=
Income from Other Investments
~ $/Day
~ |

Cash Increase Hf 1=
Cash Increase Hf
~ $/Day
~ |

Change in Smoothed Shares S=
(Desired Shares By Hf Security S-Smoothed Desired Shares By Hf Security S)/Time to Update Shares S
~ shares/Day
~ |

Smoothed Desired Shares By Hf Security S= INTEG (
Change in Smoothed Shares S,
0)
~ shares
~ |

Time to Update Shares S=
1

~ Day
~ |

Cash Decision=
1
~ fraction
~ Cash Decision=1 if a Hedge Fund decides to cover margin by using cash. If \
Cash Decision=0, then a Hedge Fund decides to cover margin by buying back \
and selling securities.
|

Time to Change Past Price S=
1
~ Day
~ |

Cash Hf= INTEG (
Income from Other Investments+Cash Increase Hf-Cash Decrease Hf,
Initial Total Cash Hf)
~ $
~ |

Income from Other Investments=
0*STEP(1000,20)-0*STEP(1000,30)
~ $/Day
~ |

Cash Increase Inv=
Sell Rate Security S[Inv]*Price S+Sell Rate Security L[Inv]* Price L
~ $/Day
~ Increase in cash due to selling of stocks
|

Demand Supply Balance Security L=
XIDZ(Total Desired Buy Rate Security L, Total Desired Sell Rate Security L, 1)*(1+Noise in Demand Supply Balance Security L\
)
~ fraction
~ The ratio of total desired buy rate to total desired sell rate. The ratio \
measures the balance between the supply and demand of the stock
|

Decision to Get Into Arbitrage=
IF THEN ELSE(Price L<Price S, 1 , 0)

~ fraction
~ |

Change in Smoothed Shares=
(Desired Shares By Hf Security L-Smoothed Desired Shares By Hf Security L)/Time to Update Shares
~ shares/Day
~ |

Time to Update Shares=
1
~ Day
~ |

Smoothed Desired Shares By Hf Security L= INTEG (
Change in Smoothed Shares,
0)
~ shares
~ |

Cash Increase L=
Sell Rate Security S[Hf]*Price S+Sell Rate Security L[Hf]*Price L
~ $/Day
~ |

Minimum payment time[Hf]=
1
~ Day
~ |

Test1=
STEP(-20,30)+STEP(+20,60)
~ $/share
~ |

Trading Volume Security L=
MIN(Total Desired Buy Rate Security L,Total Desired Sell Rate Security L)
~ shares/Day
~ The actual volume of shares traded yearly
|

Cash Increase D=
Sell Rate Security S[Hf]*Price S
~ $/Day
~ Increase in cash due to selling of stocks
|

Time to Cover Margin=
1
~ Day
~ |

Noise in Demand Supply Balance Security L=
Pink Noise*Switch for Noise*STEP(1, Noise Start Time)
~ fraction
~ |

Switch for Noise=
0
~ fraction
~ |

Fundamental Price Security L=
100
~ $/share
~ |

Initial Total Cash Hf=
96000*0+40000+60000*0+1000*0
~ $
~ Initial total amount of cash
|

Initial Price L=
80*0+100
~ $/share
~ Initial price
|

Buy Rate Security L[Types of investors]=
IF THEN ELSE(Total Desired Buy Rate Security L=0,0,Trading Volume Security L*Desired Buy Rate Security L\
[Types of investors]/Total Desired Buy Rate Security L)
~ shares/Day
~ The rate of acquiring shares
|

Cash Decrease Inv=
Buy Rate Security S[Inv]*Price S+Buy Rate Security L[Inv]*Price L
~ $/Day
~ Decrease in cash due to buying of stocks
|

Change in demand supply balance Security L=
    (Demand Supply Balance Security L-Perceived Demand Supply Balance Security L)/Time to perceive demand supply balance Security L
    ~   1/Day
    ~   Change in demand/supply balance
    |

Change in expected price S=
    (Price S-Expected Price S)/Time to Adjust expected price Security S
    ~ $/(share*Day)
    ~   The change in expected price
    |

Normal Daily Turnover Security L[Types of investors]=
    0.003
    ~   1/Day
    ~   The fraction of equity sold/bought during normal conditions
    |

Income Inv=
    Total Income Inv
    ~ $/Day
    ~   Amount of dollars earned each day by an investor
    |

Normal Portfolio Rebalancing Time Security L[Inv]=
    10 ~~|
Normal Portfolio Rebalancing Time Security L[Hf]=
    3
    ~   Day
    ~ |

Perceived Demand Supply Balance Security L= INTEG (
    Change in demand supply balance Security L,
        1)
    ~   fraction
    ~   Perceived demand/supply balance by investors
    |

Fundamental Price Security S=
    100
    ~ $/share
    ~ |

Expected Price L= INTEG (

Change in expected price L,
Initial Price L)
~ $/share
~ Price expected by investor. The expected price is adjusted to the real \
price with some time lag
|

Noise Start Time=
5
~ Day
~ |

Sell Rate Security L[Types of investors]=
IF THEN ELSE(Total Desired Sell Rate Security L=0,0,Trading Volume Security L*Desired Sell Rate Security L\
[Types of investors]/Total Desired Sell Rate Security L)
~ shares/Day
~ The rate of selling shares
|

Demand Supply table Security L(
[(0,0.5)-(3,1.5)],(0,0.5),(0.2,0.55),(0.4,0.62),(0.6,0.7),(0.8,0.84),(1,1),(1.2,1.16\
),(1.4,1.3),(1.6,1.38),(1.8,1.45),(2,1.47),(3,1.5))
~ fraction
~ Table which depicts an effect of demand/supply balance on price\!\!\!
|

Shares Security L[Types of investors]= INTEG (
Buy Rate Security L[Types of investors]-Sell Rate Security L[Types of investors],
Initial Shares Security L[Types of investors])
~ shares
~ The number of shares held by a specific type of investors.
|

Market Value of Equity Invested Inv=
Shares Security S[Inv]*Price S+Shares Security L[Inv]*Price L
~ $
~ Market value of equity investment for each investor
|

Time to perceive demand supply balance Security L=
1
~ Day
~ Time to perceive demand/supply balance
|

Time to Adjust expected price Security L=
14
~ Day
~ Time to adjust expected price
|

Total Shares Security L=
SUM(Shares Security L[Types of investors!])
~ shares
~ Total shares in the market. The model assumes that no shares are issued. \
Therefore, this amount should be conserved and equal to the Initial Number \
of Shares.
|

Initial Earnings0=
0.015
~ $/(Day*share)
~ 1/63
|

Time to Perceive Earnings EA=
1
~ Day
~ Perception time for earnings. It takes into account how long it takes to \
publish and see the earnings.
|

Earnings Forecast Horizon EA=
63
~ Day
~ Time horizon for the calculation of earnings in the future.
|

Duration Over Which to Calculate Earnings Trend EA=
126
~ Day
~ Time over which trend for earnings is calculated
|

Table for Desired Equity Weight UA(
[(0.5,0.1)-(1.5,1)],(0.5,0.1),(0.6,0.103),(0.7,0.125),(0.8,0.18),(0.9,0.3),(1,0.5),(\
1.1,0.7),(1.2,0.82),(1.3,0.92),(1.4,0.97),(1.5,1))
~ Dmnl
~ |

Table for the effect of earnings growth on discount rate EA(
[(-0.4,0)-(0.4,0.4)],(-0.1,0.0001),(-
0.001,0.0001),(0.0001,0.0001),(0.0002,0.0002),(\
0.0005,0.0005),(0.001,0.001),(0.002,0.002),(0.3,0.3))
~ fraction
~ Table for the effect of k-g on indicated fundamental value of an \
asset.\!\!\!
|

Table for Desired Equity Weight EA(
[(0,0)-(4,1)],(0,1),(0.2,0.97),(0.4,0.9),(0.6,0.83),(0.8,0.7),(1,0.5),(1.2,0.3),(1.4\

,0.16),(1.6,0.11),(1.8,0.07),(2,0.04),(2.2,0.03),(2.4,0.02),(2.6,0.01),(2.8,0.005),\
(3,0),(4,0))
~ fraction
~ Table which calculates the desired equity fraction for fundamental \
investor\!\!\!
|

Time to perceive value EA=
1
~ Day
~ Time to perceive value
|

Switch for Step=
0
~ Dmnl
~ |

Earning Noise Start Time=
1
~ Day
~ |

Noise in Earnings=
Pink Noise*STEP(1, Earning Noise Start Time)
~ Dmnl
~ |

Switch for White Noise=
1
~ Dmnl
~ |

White Noise2=
    Mean+(Standard Deviation^2*(2-(TIME STEP/Correlation Time))/(TIME STEP/Correlation Time\
        ))^0.5*RANDOM NORMAL(-100, 100 , 0 , 1 , Noise Seed)
    ~   Dmnl
    ~ |

Change in Pink Noise=
    (White Noise-Pink Noise)/Correlation Time
    ~   1/Day
    ~ |

White Noise=
    MIN(MAX(Switch for White Noise*White Noise1+(1-Switch for White Noise)*White Noise2,\
        0),2)
    ~   Dmnl
    ~ |

White Noise1=
    Mean+Standard Deviation*((24*Correlation Time/TIME STEP)^0.5)*RANDOM UNIFORM(-0.5,0.5\
        ,Noise Seed)
    ~   Dmnl
    ~ |

Standard Deviation=
    0.15
    ~   Dmnl
    ~ |

Switch for Pink Noise=
    STEP(1,20)
    ~   Dmnl
    ~ |

Mean=
    1
    ~   Dmnl
    ~ |

Noise Seed=
    3
    ~   Dmnl
    ~   Originally, had 2.
    |

Pink Noise= INTEG (
Change in Pink Noise,
Mean)
~ Dmnl
~ |

Correlation Time=
1
~ Day
~ 1/4 of the year
|

Volatility Switch=
1
~ Dmnl
~ |

Average SD of Return=
0.0008
~ 1/Day
~ 20.39%/year.
|

Normal Portfolio Rebalancing Time Security S[Inv]=
5 ~~|
Normal Portfolio Rebalancing Time Security S [Hf]=
3
~ Day
~ |

Initial Earnings=
0.015
~ $/(Day*share)
~ 1/63
|

Fraction of Wealth Spent on Consumption=
0.00073
~ 1/Day
~ Fraction of wealth spent on consumption by investors daily. Fractional \
wealth spent on consumption is 18.4% /year.
|

Duration Over Which Change in Consumption is Calculated=
5

~ Day
~ |

Time to Change Past Consumption=
10
~ Day
~ |

Time to Update Moving Average of Change in Consumption=
10
~ Day
~ Time over which the moving average of change in consumption is calculated.
|

Average Risk Premium=
0.00035
~ 1/Day
~ Market risk premium = beta of an asset multiplied by the difference of the \
expected market return and the risk-free rate. 0.0874/252
|

Volatility of Return=
sqrt((Return-Moving Average of Return)*(Return-Moving Average of Return))
~ 1/Day
~ Volatility of a stock
|

Time to Update Moving Average of Return=
200
~ Day
~ Time over which the moving average of return is calculated.
|

Change in Moving Average of Return=
(Return-Moving Average of Return)/Time to Update Moving Average of Return
~ 1/(Day*Day)
~ Rate of the increase in moving average of return
|

Earnings Forecast Horizon=
63
~ Day
~ Time horizon for the calculation of earnings in the future.
|

Moving Average of Return= INTEG (
    Change in Moving Average of Return,
        0)
    ~   1/Day
    ~   This belief is a weighted average of the current value of return and past \
        belief.
    |

Shares Security S[Types of investors]= INTEG (
    Buy Rate Security S[Types of investors]-Sell Rate Security S[Types of investors],
        Initial Shares Security S[Types of investors])
    ~   shares
    ~   The number of shares held by a specific type of investors.
    |

Duration Over Which Return is Calculated=
    1
    ~   Day
    ~   Time duration over which return is calculated. In this model, daily retun \
        is assumed.
    |

Time to Change Past Price L=
    1
    ~   Day
    ~   Time to change past price. It is assumed that price is changed every day.
    |

Perceived Demand Supply Balance Security S= INTEG (
    Change in demand supply balance Security S,
        1)
    ~   fraction
    ~   Perceived demand/supply balance by investors
    |

Riskless Rate=
    0.00015
    ~   1/Day
    ~   Current forward real interest rate or another proxy.0.0376/252
    |

Cost of Equity=
    Riskless Rate+Risk Premium
    ~   1/Day
    ~   Required rate of return or cost of equity.

```
    |

Total Shares Security S=
    SUM(Shares Security S[Types of investors!])
    ~       shares
    ~       Total shares in the market.  The model assumes that no shares are issued.
\
            Therefore, this amount should be conserved and equal to the Initial
Number \
            of Shares.
    |

Table for the effect of earnings growth on discount rate(
    [(-0.4,0)-(0.4,0.4)],(-0.1,0.0001),(-
0.001,0.0001),(0.0001,0.0001),(0.0002,0.0002),(\
            0.0005,0.0005),(0.001,0.001),(0.002,0.002),(0.3,0.3))
    ~       fraction
    ~       Table for the effect of k-g on indicated fundamental value of an \
            asset.\!\!\!
    |

Normal Daily Turnover Security S[Types of investors]=
    0.003
    ~       1/Day
    ~       The fraction of equity sold/bought during normal conditions
    |

Cash Inv= INTEG (
    Cash Increase Inv+Income Inv-Cash Decrease Inv-Consumption Inv,
            Initial Total Cash Inv)
    ~       $
    ~       Amount of cash held by investor
    |

Sell Rate Security S[Types of investors]=
    IF THEN ELSE(Total Desired Sell Rate Security S=0,0,Trading Volume Security
S*Desired Sell Rate Security S\
            [Types of investors]/Total Desired Sell Rate Security S)
    ~       shares/Day
    ~       The rate of selling shares
    |

Buy Rate Security S[Types of investors]=
    IF THEN ELSE(Total Desired Buy Rate Security S=0,0,Trading Volume Security
S*Desired Buy Rate Security S\
            [Types of investors]/Total Desired Buy Rate Security S)
```

~ shares/Day
~ The rate of acquiring shares
|

Time to Adjust expected price Security S=
14
~ Day
~ Time to adjust expected price
|

Change in demand supply balance Security S=
(Demand Supply Balance Security S-Perceived Demand Supply Balance Security S)/Time to perceive demand supply balance Security S
~ 1/Day
~ Change in demand/supply balance
|

Demand Supply table Security S2(
[(0,0.5)-(3,1.5)],(0,0.5),(0.2,0.55),(0.4,0.62),(0.6,0.7),(0.8,0.84),(1,1),(1.2,1.16\
),(1.4,1.3),(1.6,1.38),(1.8,1.45),(2,1.47),(3,1.5))
~ fraction
~ Table which depicts an effect of demand/supply balance on price\!\!\!
|

Time to perceive demand supply balance Security S=
1
~ Day
~ Time to perceive demand/supply balance
|

Table for Desired Equity Weight F(
[(0,0)-(4,1)],(0,1),(0.2,0.97),(0.4,0.9),(0.6,0.83),(0.8,0.7),(1,0.5),(1.2,0.3),(1.4\

,0.16),(1.6,0.11),(1.8,0.07),(2,0.04),(2.2,0.03),(2.4,0.02),(2.6,0.01),(2.8,0.005),\
(3,0),(4,0))
~ fraction
~ Table which calculates the desired equity fraction for fundamental \
investor\!\!\!
|

Total Wealth Inv=
Cash Inv+Market Value of Equity Invested Inv
~ $
~ Sum of cash and equity holdings for each investor
|

```
Time to Perceive Earnings=
    60
    ~       Day
    ~       Perception time for earnings.  It takes into account how long it takes to \
            publish and see the earnings.
    |

Time to perceive value=
    2
    ~       Day
    ~       Time to perceive value
    |

Duration Over Which to Calculate Earnings Trend=
    126
    ~       Day
    ~       Time over which trend for earnings is calculated
    |

Initial Price S=
    120*0+100
    ~       $/share
    ~       Initial price
    |

Trading Volume Security S=
    MIN(Total Desired Buy Rate Security S,Total Desired Sell Rate Security S)
    ~       shares/Day
    ~       The actual volume of shares traded yearly
    |

Types of investors:
    Inv, Hf, D
    ~
    ~               |

********************************************************
    .Control
********************************************************~
            Simulation Control Paramaters
    |

FINAL TIME  = 100
    ~       Day
    ~       The final time for the simulation.
    |
```

INITIAL TIME = 0
~ Day
~ The initial time for the simulation.
|

SAVEPER =
TIME STEP
~ Day
~ The frequency with which output is stored.
|

TIME STEP = 0.03125
~ Day
~ The time step for the simulation.
|