Market Model 8.2 Users Manual by Ralph Abraham
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WHAT IS IT?

User's Manual for NetLogo Market Model 8.2 by Ralph Abraham and Dan Friedman. This model is the second extension of a NetLogo model for financial markets. It implements one more innovation: fickle investors. Further background may be found at www.vismath.org/research/landscapedyn/models/market.

This manual is devoted primarily to the Graphical User Interface of the model. The NetLogo code (under the Procedures tab) is explained an another document, the Program Guide.

HOW IT WORKS

The turtles are money market managers. Each manager is shown as a small triangle in the graphics window. They have different colors just for the visual effect. When several consumers are on the same patch (discretized interval of the strategy space) only the top one can be seen in entirety, but the x and y positions are floating point numbers, so parts of lower turtles may be seen.

The state space is shown as the upper half of the graphics window. The horizontal axis represents a unit interval corresponding to the choice of strategy, u. This is the degree to which the manager is willing to invest in risky assets. Moving to the right increases risk.

The vertical axis represents the value of the manager's portfolio. Zero is indicated by the horizontal magenta strip in the center of the graphics window. The upper limit is set by a slider, the default value is 4. A portfolio value of one is a "normal" portfolio size.

A chosen number of managers begin at initial positions in the state space. Model coords (u, z) correspond to screen coords (xcor, ycor). The initial distribution is important to the outcome of a run. The model starts up with a random distribution in a rectangle of setable width (sliders for width and center) and height (sliders for altitude and height).

At the start, and after each step of the run, the density of managers as a function of the horizontal coordinate in the strategy space is shown as a histogram in the plot window, showing the total number of managers on each patch. Patches are roughly discretized, the graphics window is 35 patches wide and 15 high.

The stepsize may be set with the "frequency" chooser (drop-down menu). For example, if "52" is chosen in the drop-down menu, this signifies a frequency of 52 steps per year, and the variable "stepsize" in the program is set to 1/52 years.

An additional parameter, u-steps, may be set with a chooser. This is the number of substeps in a step. Increasing u-steps decreases the substepsize, called stepsize-u, to stepsize/u-steps, and decreases the numerical error in the Euler integration of

the hill-climbing process. The speed of the simulation is slower of course.

That is, stepsize is a unit of time for periodic reports of financial data, including z updates, while stepsize-u is the increment for the Euler steps of the gradient dynamics of strategy adjustment, or updates of u.

Using the Euler algorithm, each manager is assumed to move horizontally up the slope of the payoff function by the substep increment, jump-u = stepsize-u * slope. This increment is clipped to a maximum size set by a slider, max-u-jump. With every step (or u-step substeps) there is also a vertical motion due to increment or decrement of the size of the manager's portfolio due to payoffs.

The slope of the landscape, or gradient of phi, phisubx, is shown in color on a row in the center of the graphics window. Here is the color code: red for positive slopes (move to the right), green for negative slopes (move to the left) and yellow for a narrow zone around zero.

Fickle investors refers to a loss of capital by a manager due to bad performance. Lost capital goes to a store called "z-pool", which is shown in a monitor, and then may move back to another (better performing) manger's portfolio.

HOW TO USE IT

STEP #1: SET THE INITIAL HERD ("Add Managers" Panel)

(1a) Set the "population" slider to determine the number of managers in the initial herd.

(1b) Set the "center" slider to locate the horizontal center of the initial herd. Horizontal axis corresponds to strategy choice.

(1c) Set the "width" slider to determine the horizontal width of the initial herd, as a percentage of the total horizontal width of the window.

(1d) Set the "altitude" slider to locate the vertical center of the initial herd. Vertical axis corresponds to initial portfolio size.

(1e) Set the "height" slider to determine the vertical width of the initial herd, as a percentage of the total vertical width of the window.

(1f) Press the "setup" button to create the initial distribution of managers. The initial histogram shows the initial herd of managers.

STEP #2: SET THE RUNTIME PARAMETERS ("Runtime Dashboard")

(2a) Adjust the "frequency" chooser for the desired number of steps per year.

(2b) Adjust the "u-steps" chooser for the desired number of substeps per step.

(2c) A slider called "yellow-width" adjusts the width of the yellow band in the color bar, which shows where the slope is in the u-interval

        (-yellow-width, +yellow-width)
SO, if the yellow bar is too wide, just:
        A. stop with a press on the GO button
        B. reduce this "yellow-width" slider
        C. press STEP once to see if new value is OK
        D. press GO again
OR, simply adjust the slider during a run.

(2d) Adjust the "loss-redline" slider to reveal the locall losses, Lhat, of the managers.
(2e) Adjust turtle size for visibility (especially if using a projector)
(2f, g, h) Experiment with different values of gs1, R0, and dR (note: Rs = R0 + dR).
(2i, j) Experiment with the sliders for sigma and tau to control the OU process for surprise.
The button "show-jiggle" (at top) indicates the magnitude of the surprise process.

(2k) The "alpha" slider controls the exponent in PM (controls R1).
(2l) The "beta" slider controls the magnitude of the c2-dynamic, as c2 = beta * mean-Lhat.
(Note: c2 is no longer set by a slider.)
(2m) Experiment with the eta slider to control the strength of the local loss memories, Lhat.

(2n) The "d" slider for portion of z to defect in each step,
        d * stepsize * Lhat.

(2o) The "lambda" slider sets the portion of z-pool to recruit in each step,
        lambda * stepsize * z-pool.

(2p) The "rate" slider sets the rate of recruits leaving the z-pool to join
        successful managers.

STEP #3: ACTION (Top row of buttons)

(3a) Press "setup" to begin a simulation.

(3b) Press the "step" button to activate a single step in the market game. Every manager will take one step:
    * horizontally in proportion to the slope of the landscape at its current position (the value of phisubx at its current u), and
    * vertically in proportion to its value in the payoff function
You will see the managers move, and then the histogram will be redrawn.

Press "step" several times to judge the stepsize choice, and the jitter in the position of the maximum, indicated by the yellow zone in the color bar. After ten clicks the plots will be refreshed.

(3c) Press "go" to trigger a rapid sequence of steps. Press "go" again to halt the action.

(3d) While action is stopped, press "do-math" to update most variables (in case some

sliders have been changed) without actually taking a step of the simulation.

(3e) Press "restore" to reset sliders to default values.

(3f) Press "substep" to monitor the effect of a single substep.

WRITE DATA section

To save time-series data to a file, set "write-data?" switch to "on".
Then press "setup" to start a new run, or press"init-datafile" if
you want to continue the current run. In either case, a file "time-series.txt" is
opened in the current directory, with a header showing
the parameters of the current run. It a file times-series.txt already exists,
it will be appended with a new header.

Header data includes: time and date, frequency, u-steps, totalpop,
center, width, altitude, height, gs1, R0, dR, sigma, tau, beta, eta,
W, and T.

Time series data includes: totalsteps, totaltime, DPM, R1, c2, mean-Lhat,
and "crash-detected". The latter is one if the minimum price divided by maximum price
(in the time window of length "W" steps) is less than "T".
Both "W" and "T" are set by sliders.

THE GRAPHICS WINDOW

The Mean Queen, a large white circle in the Graphics Window, indicates the position,
(mean-u, mean-z).

The Yellow King is a yellow triangle just above the slope color bar. It's horizontal
position shows the value of the cluster point u* (see page 8 of B+C). Eventually, if
the herd converges to a cluster, u* will be at the maximimum of phi, and zero of
phisubx, and thus, the yellow king will be within the yellow bar. Hence, the king is
yellow.

The cluster point, u*, is the solution of a cubic equation derived from slope=0 under
the assumptions:
        A. u[i] = mean-u, all i (that is, a cluster), and
        B. mean-u-dot = 0 (that is, the cluster is at a critical point).
Rather than solving the cubic equation by the exact method of Omar Khayyam, we have
used a crude approximation, obtained numerically by Newton's method.

THE PLOTS

With each ten steps, the plots are redrawn:
        * Density of managers vs u (essentially a histogram)
        * Landscape (phi) vs u
        * PM (price of the risky asset) vs step number (a tickertape display)
At present, the density plot is only approximate.

THE MONITORS (to the right of the plots)

After each step, the monitors are updated, showing:
        * z-min, totalpop
        * mean-u and mean-z (same as the mean-queen) and mean-u-dot
        * DPM, the detrended price of the risky assets.
        * R0, Rs, and R1 (multiplier of u-term in phi)
        * totalsteps, totaltime (based on number of steps)
               and localtime (based on number of substeps)
        * stepsize, and stepsize-u
        * mean-Lhat, mean-Rhat, c2
        * ratio, timeparity, crash-detected, and total-elr

The zmin monitor shows the fixed zmin of the model, which occurs in the center of the graphics window. The zmax slider allows the upper limit of the z-scale to be set between 0 and 10. This is an absolute maximum for the portfolio worth of any manager, and should be a positive integer. After changing this slider, one must click "setup" and begin a fresh run.

DIAGNOSTICS

Below the Landscape plot is a pair of diagnostic tools created by Pablo Viotti. These can be switched on and off, and track the attributes of interesting managers.

THINGS TO TRY

To get a good sense for how the new fickle investors extension affects the model, revert your 82 market model to the previous model (81) by setting 'd' to zero. Leave the other settings at their defaults and press 'Go'. Let the simulation run for a few decades and note the behavior. Now while the simulation is still going, drag the 'd' slider to 1, allowing investors to 'defect' from poorly performing managers and get reallocated to better performing ones. What happens to the movement of the price? Does it overinflate and crash more often? More violently? Explore various settings for lambda and rate as well and note the effect on the dynamics.

To see how managers respond to changes in the underlying growth of the economy, reset the parameters to their defaults and start a new run. Let the simulation settle from the initial conditions and then try giving the 'economy' a boost by increasing the growth rate gs1 to 2%. What happens? Is it possible to see the KMK phases unfolding? Try bringing gs1 down to -2%. How do the managers respond?

Play with the other parameters as well and see what you find!

THINGS TO NOTICE

Watch the view of the individual managers moving through the z-u space and notice how they behave when the market is overpriced and when it is crashing. Watch the mean-Lhat (losses) and Rhat (gains) as well and note how fickle investors drive price changes.

CREDITS AND REFERENCES

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