

BUY OR SELL RECOMMENDATION FOR A FINANCIAL INVESTMENT,
METHOD AND DATA PROCESSING SYSTEM FOR SUCH A
RECOMMENDATION

Background of the Invention

5 Field of the Invention

The present invention relates to the provision of a buy or sell recommendation for a financial instrument.

Summary of the Prior Art

Composite financial buy or sell recommendations
10 summarise the buy or sell recommendations of several analysts (usually brokerages or other expert financial analysts). Typically such analysts rank individual financial instruments on a scale of 1 to 5 (1 = strong buy, 2 = buy, 3 = hold, 4 = sell, and 5 = strong sell),
15 and the conventional composite buy or sell recommendation for a particular instrument is simply the numerical average of the analysts' rankings. Financial instruments which may be ranked and recommended in this way include stocks and mutual funds.

20 Summary of the Invention

A problem with conventional composite buy or sell recommendations is that they do not take account of each analyst's performance. In other words analysts with relatively poor track records are given equal standing
25 with analysts with relatively good track records. However, financial markets can be very variable, and biassing systems which weight analysts solely on the basis of their historical track records can be undermined

if correlations change between e.g. financial instrument performance and measurable financial instrument parameters.

At its most general, the present invention proposes
5 that a composite buy or sell recommendation is obtained from the buy or sell recommendations of several analysts, the recommendation of each analyst being weighted on the basis of the degree of correspondence (matching) between that analyst's recommendations and the predictions of a
10 neural network.

Accordingly in one aspect the present invention may provide a method of providing a composite buy or sell recommendation for a specified financial instrument including the steps of:

15 (a) using a neural network to derive predictions of instrument performance over a future time period for each of a plurality of financial instruments,

(b) comparing said predictions with corresponding buy or sell recommendations for said plurality of
20 financial instruments made by a plurality of financial analysts for said future time period, and obtaining, for each of said financial analysts, a factor indicating the degree of correspondence between said predictions and said corresponding buy or sell recommendations; and

25 (c) calculating said composite buy or sell recommendation as a weighted average of specific buy or sell recommendations made by said analysts for said specified financial instrument, the weighting given to

each specific recommendation for said weighted average being based on the corresponding one of said factors.

An advantage of this method over conventional methods of calculating composite buy or sell recommendations is that more or less value is attached to the recommendation of each of the analysts depending on the prediction of the neural network. Unlike analytical forecasting methods or statistical methods such as regression analysis, neural networks do not assume the presence of immutable relationships between instrument performance and measurable market parameters. Rather they can evolve and adapt as market conditions change. This makes them highly suitable for "adding value" to analysts' recommendations by the method of the present invention.

Preferably, said factor is based on the proportion of said corresponding buy or sell recommendations which agree with said predictions.

The specified financial instrument of step (c) may be, but is not necessarily, one of the instruments used to produce the weightings. However, preferably the step (c) instrument at least relates to the same subject matter as the other instruments (e.g. in terms of market and instrument type). The weightings should then be relevant to the step (c) instrument.

A typical time period in step (a) is three months, but may be e.g. one, six, nine or twelve months.

The method may be repeated at regular intervals. Before each repeat the neural network is preferably

retrained so that it reflects the latest correlations in the financial market.

Preferably the neural network provides an output prediction on the same ranking scale as the analysts' recommendations. This makes it straightforward to compare the prediction with the analysts' recommendations.

Preferably the input layer of the network receives as input data at least (i) the return on the price of the instrument over a previous time period (i.e. the ratio of the change in price of the instrument over the time period to the price of the instrument at the beginning of the period), (ii) the standard deviation of the price of the instrument over the previous time period (known as the risk), and (iii) the maximum change in price of the instrument over the previous time period (known as the drawdown). However, other inputs may also be used, such as drawdown adjusted return (the return divided by the drawdown), time to profit/loss (the holding period before the recommendation shows a positive return over the loss), simple area under the curve (the accumulated returns over a certain time period), short term area under the curve (the accumulated returns over a specific short term time period), and long term area under the curve (the accumulated returns over a specific longer term time period). The previous time period may be of any duration (e.g. one, three, six, nine or twelve months), but preferably it is the same duration as the future time period and more preferably it is the period which has

immediately ended.

Network training (and retraining) may be performed by inputting the equivalent data available at the beginning of the previous time period (e.g. input data which was gathered for the period before the previous time period) and adjusting the network connections in view of a comparison between the network output and a measure of actual instrument at the end of the previous time period. Such a measure may, for example, be provided by proprietary analysis tools such as MoneyRadar™ and MyRadar™ available from AsianBourses.com.

Other aspects of the present invention are given by the claims and include (i) a method of providing a composite buy or sell recommendation involving using predetermined analysts' weightings, (ii) a composite buy or sell recommendation per se, (iii) a data-processing system operatively configured for providing a composite buy or sell recommendation, (iv) a computer program comprising code for providing a composite buy or sell recommendations, and (v) a computer readable data carrier (such as RAM, ROM, floppy disk(s), hard disk(s), optical disk(s) or other suitable media) onto which is recorded a computer program comprising code for providing a composite buy or sell recommendation.

25 Brief Description of the Drawings

An embodiment of the present invention will now be described in detail, by way of example, with reference to the accompanying drawings in which:

Fig.1 which shows schematically a neural network used to calculate O, the perfect foresight recommendation, and

Fig.2 shows an example of a risk-return analysis chart.

Detailed Description

In the embodiment of the present invention to be described, a neural network is used to service a composite buy or sell recommendation on the basis of weighted averages of analysts' recommendations. In this embodiment it is assumed that there are five such analysts, but the present invention is not limited to this, and is usable to analyse recommendations from any number of analysts provided appropriate data are available.

The first stage of this embodiment is to determine return, risk and drawdown values for 20 stocks over a three month period. These values are fed into a neural network (described in more detail below) to provide corresponding "perfect foresight" recommendations, O, for each stock for the next (future) three month period. O is given as an integer in the range 1 to 5, where 1 = strong buy, 2 = buy, 3 = hold, 4 = sell, and 5 = strong sell.

Buy or sell recommendations (also given as integers in the range 1 to 5) are collated for the same twenty stocks from five analysts, A to E.

A weighting is then generated for each analyst depending on the number of matches and mismatches between the analyst's recommendations and O. If the analyst is

successful 85% or more of the time he receives the highest weighting of 0.4. Success rates of from 70 to 85%, 55 to 70% , and 40 to 55% receive respective weightings of 0.3, 0.2 and 0.1. A zero weighting is given for success rates
5 below 40%.

Table 1 shows the results for each of the analysts.

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Table 1

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Analyst	No. matches	No. Mismatches	Success rate (%)	Weighting
A	17	3	85	0.4
B	9	11	45	0.1
C	12	8	60	0.2
D	6	14	30	0.0
E	15	5	75	0.3

Suppose analysts A to E then make respective recommendations of 1, 1, 4, 3 and 2 for another stock.

20 Based on the weightings of Table 1, the composite buy or sell recommendation for that other stock is calculated as $(0.4*1) + (0.1*1) + (0.2*4) + (0.0*3) + (0.3*2) / (0.4 + 0.1 + 0.2 + 0.0 + 0.3) = 1.9$. That is the recommendations are multiplied by the respective weightings, summed and then
25 normalised by the sum of the weightings.

In contrast, the conventional composite (simple numerical average) recommendation is $(1 + 1 + 4 + 3 + 2) / 5 = 2.2$.

Therefore, there can be significant differences between composite recommendations according to the present invention and as conventionally determined. The present invention provides a more intelligent approach to providing a composite recommendation by favouring analysts who are closer in their calls to the perfect foresight recommendations at the expense of analysts who make more wrong calls. The conventional approach, on the other hand, does not distinguish between "good" and "bad" analysts.

Fig.1 shows schematically the neural network used to calculate, O , for the 20 stocks. The network has three layers of computing elements or nodes, namely the input, hidden and output layers (numbered 1, 2 and 3 respectively). Input layer 1 has three elements, for the normalized return (r), risk (σ) and drawdown (d) values of each stock. Hidden layer 2 has four elements (although more can be used), each connected at one side to the three elements of input layer 1, and at the other side to the single element of output layer 3. This single element gives the value for O .

The connection weights of the input elements to the hidden layer elements are u_{ij} and the connection weights of the hidden elements to the output layer element are w_j (where $i = 1, 2$ or 3 for each of the input elements and $j = 1, 2, 3$ or 4 for each of the hidden elements).

At each of the elements of hidden layer 2 the value of $F_j(u_{1j}r + u_{2j}\sigma + u_{3j}d)$ is calculated, F_j being an

activation function and may be e.g. sigmoidal, hyperbolic tangential, Gaussian, step or linear as appropriate.

The output, O , is then given by $G(w_j \cdot F_j(u_{1j}r + u_{2j}\sigma + u_{3j}d))$, where G is a step function providing an integer value for O in the range 1 to 5. However, G may be any other suitable function, including the same function as F .

The values of the connection weights u_{ij} and w_j are calculated by backpropagation using a set of training data, the training values for O being determined by mapping stock performance over three month periods onto a risk-return analysis chart, of the type provided by MoneyRadar™ and MyRadar™.

An example of such a chart is shown in Fig. 2. The chart is divided into five sectors corresponding to the five desired values of O . The vertical axis of the chart represents the return, r , while the horizontal axis represents the risk, σ . Each point denotes the r - σ coordinates of a particular stock, and so any combination of r and σ can be associated with an O value. In fact in the present case, because the sectors are separated by straight lines intersecting the origin, the O values can be regarded as denoting adjoining r - σ ratio value ranges.

The network is retrained every three months to recalculate the connection weights u_{ij} and w_j . This ensures that the network adapts to take account of the most recent market behaviour.

The retraining data is obtained by associating values of r , σ , and d for each of a number of stocks with

a corresponding value for O determined e.g. using a MoneyRadar™ chart. So for example, assuming two consecutive three month periods with the second period ending at the present, r , σ , and d are measured for each stock based on the stock's behaviour over the first three month period and O is determined based on the stock's performance over the second three month period. This provides a set of training data which is used to retrain the network by backpropagation to take account of recent financial market behaviour.

The perfect foresight recommendation, O , is output from the network when values of r , σ , and d measured over the second three month period are used as input. That is, O is then a prediction of stock performance in the next (future) three month period.

Although in this example the O training values are read off a MoneyRadar™ chart, there is no particular limitation on the method by which historical stock performance data can be used to generate O training values. The choice of method will depend mainly on how the analysts' recommendations are quantified in terms of stock behaviour. Specifically, the method described above is appropriate when the analysts' recommendations are associated with r - σ ratio values.



Claims:

1. A method of providing a composite buy or sell recommendation for a specified financial instrument including the steps of:
 - (a) using a neural network to derive predictions of instrument performance over a future time period for each of a plurality of financial instruments,
 - (b) comparing said predictions with corresponding buy or sell recommendations for said plurality of financial instruments made by a plurality of financial analysts for said future time period, and obtaining, for each of said financial analysts, a factor indicating the degree of correspondence between said predictions and said corresponding buy or sell recommendations; and
 - (c) calculating said composite buy or sell recommendation as a weighted average of specific buy or sell recommendations made by said analysts for said specified financial instrument, the weighting given to each specific recommendation for said weighted average being based on the corresponding one of said factors.
2. A method of providing a composite buy or sell recommendation including calculating said composite buy or sell recommendation as a weighted average of specific buy or sell recommendations made by a plurality of financial analysts for a specified financial instrument, the weightings given to said specific recommendations for said



weighted average having been previously determined by the steps of:

- 5 (a) using a neural network to derive predictions of instrument performance over a future time period for each of a plurality of financial instruments,
- (b) comparing said predictions with corresponding buy or sell recommendations for said plurality of financial instruments made by said financial analysts for said future time period, and obtaining, for each of said
10 financial analysts, a factor indicating the degree of correspondence between said predictions and said corresponding buy or sell recommendations; and
- (c) determining said weightings from the corresponding one of said factors.

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3. A method of providing a composite buy or sell recommendation according to claim 1 or 2, wherein before step (a) said neural network is trained or retrained on financial instrument performance data obtained from a
20 previous time period.

4. A method of providing a composite buy or sell recommendation according to any one of claims 1 to 3, wherein the neural network has an input layer which
25 receives input data on the return, the risk and the drawdown of a financial instrument.

5. A method according to any one of the preceding



claims wherein said factor is based on the proportion of said corresponding buy or sell recommendations which agree with said predictions.

5 6. A composite buy or sell recommendation for a specified financial instrument which has been generated by the steps of:

 (a) using a neural network to derive predictions of instrument performance over a time period for each of a
10 plurality of financial instruments,

 (b) comparing said predictions with corresponding buy or sell recommendations for said plurality of financial instruments made by a plurality of financial analysts for said time period, and obtaining, for each of
15 said financial analysts, a factor indicating the degree of correspondence between said predictions and said corresponding buy or sell recommendations; and

 (c) calculating said composite buy or sell recommendation as a weighted average of specific buy or
20 sell recommendations made by said analysts for said specified financial instrument, the weighting given to each specific recommendation for said weighted average being based on the corresponding one of said factors.

25 7. A composite buy or sell recommendation according to claim 6, wherein before step (a) said neural network is trained or retrained on financial instrument performance data obtained from a previous time period.



8. A composite buy or sell recommendation according to claim 6 or 7, wherein the neural network has an input layer which receives input data on the return, the risk and the drawdown of a financial instrument.

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9. A composite buy or sell recommendation according to any one of claims 6 to 8 wherein said factor is based on the proportion of said corresponding buy or sell recommendations which agree with said predictions.

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10. A data-processing system operatively configured for providing a composite buy or sell recommendation for a specified financial instrument, the system having:

(a) first calculating means for calculating with a
15 neural network to derive predictions of instrument performance over a future time period for each of a plurality of financial instruments,

(b) comparing means for comparing said predictions with corresponding buy or sell recommendations made by a
20 plurality of financial analysts for said plurality of financial instruments for said future time period, and obtaining, for each of said financial analysts, a factor indicating the degree of correspondence between said predictions and said corresponding buy or sell
25 recommendations; and

(c) second calculating means for calculating said composite buy or sell recommendation as a weighted average of specific buy or sell recommendations made by said



analysts for said specified financial instrument, the weighting given to each specific recommendation for said weighted average being based on the corresponding one of said factors.

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11. A data-processing system according to claim 10, wherein said neural network is trained or retrained on financial instrument performance data obtained from a previous time period.

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12. A composite buy or sell recommendation according to claim 10 or 11, wherein the neural network has an input layer which receives input data on the return, the risk and the drawdown of a financial instrument.

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13. A data proceeding system according to any one of claims 10 to 12 wherein said actor is based on the proportion of said corresponding buy or sell recommendations which agree with said predictions.

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14. A computer program comprising code for providing a composite buy or sell recommendation for a specified financial instrument, the code being adapted to perform the following steps when said program is run on a data-processing system:

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(a) using a neural network to derive predictions of instrument performance over a future time period for each of a plurality of financial instruments,



(b) comparing said predictions with corresponding buy or sell recommendations for said plurality of financial instruments made by a plurality of financial analysts for said future time period, and obtaining, for
5 each of said financial analysts, a factor indicating the degree of correspondence between said predictions and said corresponding buy or sell recommendations; and

(c) calculating said composite buy or sell recommendation as a weighted average of specific buy or
10 sell recommendations made by said analysts for said specified financial instrument, the weighting given to each specific recommendation for said weighted average being based on one of said factors.

15 15. A computer program according to claim 14, wherein before step (a) said neural network is trained or retrained on financial instrument performance data obtained from a previous time period.

20 16. A computer program according to claim 14 or 15, wherein the neural network has an input layer which receives input data on the return, the risk and the drawdown of a financial instrument.

25 17. A computer program according to any one of claims 14 to 16, wherein said factor is based on the proportion of said corresponding buy or sell recommendations which agree with said predictions.



18. A computer readable data carrier onto which is recorded a computer program comprising code for providing a composite buy or sell recommendation for a specified financial instrument, the code being adapted to perform the following steps when said program is run on a data-processing system:

- (a) using a neural network to derive predictions of instrument performance over a future time period for each of a plurality of financial instruments,
- 10 (b) comparing said predictions with corresponding buy or sell recommendations for said plurality of financial instruments made by a plurality of financial analysts for said future time period, and obtaining, for each of said financial analysts, a factor indicating the degree of correspondence between said predictions and said
15 corresponding buy or sell recommendations; and
- (c) calculating said composite buy or sell recommendation as a weighted average of specific buy or sell recommendations made by said analysts, for said
20 specified financial instrument, the weighting given to each specific recommendation for said weighted average being based on one of said factors.

19. A computer readable data carrier according to
25 claim 18, wherein before step (a) said neural network is trained or retrained on financial instrument performance data obtained from a previous time period.



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20. A computer readable data carrier according to claim 18 or 19, wherein the neural network has an input layer which receives input data on the return, the risk and the drawdown of a financial instrument.

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21. A computer readable data carrier according to any one of claims 18 to 20, wherein said factor is based on the proportion of said corresponding buy or sell recommendations which agree with said predictions.

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