Neural Time Series - Parabootstrap

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The parametric bootstrap is a Monte Carlo type method that uses the nature of neural network, the properties and "shape" of the criterial function $S(\mathbf{w})=\mathbf{e}^T\mathbf{e}$ (sum of square residuals as a function of the ANN parameter vector **w**) and, primarily, the instability of the optimal solution. If the parameter w is unknown, the only criterion for a "good" model is minimal $S(\mathbf{w})$. However, for a highly non-linear and often somewhat over-determined neural network, it is common that many very different vectors **w** give very similar minimal prediction error for given data set. So, many different models are "optimal" from the point of view of data fit. They can differ however in predicting for new data (forecasting). It appears that this property can be used to simulate stability, or confidence of prediction and forecast of a time series. This is done by repeated optimization of a ANN-TS (Artificial neural network time series) model with each time randomly generated first estimates of the ANN parameter vector **w**. From the resulting bunch of optimized models, the statistical parameters of the prediction and forecast is then estimated, assuming normal distribution of the predictions and sufficient complexity of the model to ensure instability of the solution. Though the individual models may differ rather significantly, even as little as 20 or 30 models will have relatively consistent behavior and produce very similar statistical estimates.

Data and parameters

This module uses repeatedly the procedure of the previous model ANN-TS, so its dialog windows are very similar with the same meaning of the input parameters. The difference is in the *Terminating conditions* group where the *Max mean error* specifies the maximum mean error for the optimized model to be included in the final statistical evaluation, user-defined maximum number of iterations per one model and a time limit per one model in seconds. The optimization of every model is terminated if one of the two latter values are reached.

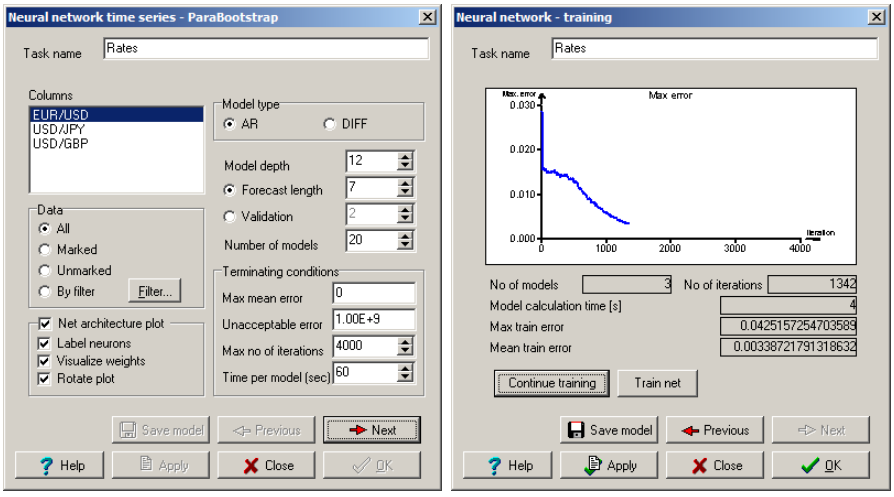
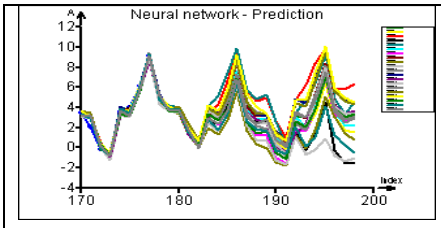
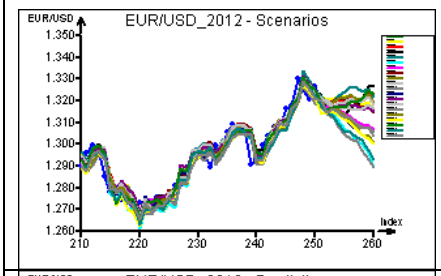
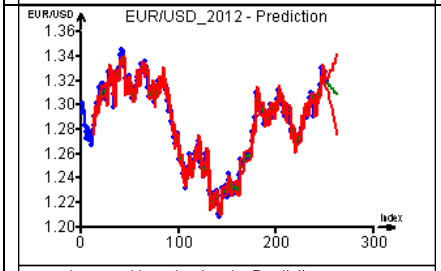
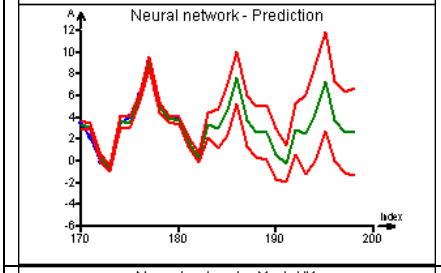
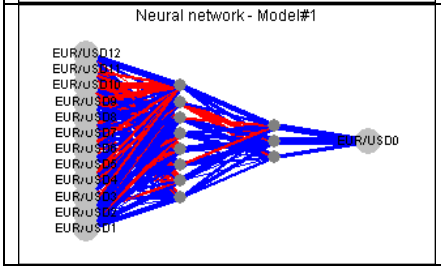


Fig. 1 Dialog window for Monte-Carlo ANN-TS forecast user setting and optimization progress

Graphs

 	Plot of a bunch of computed Monte-Carlo models with clearly distinguishable prediction part (left) and forecast (right) part. Statistical confidence intervals are computed from these curves.
 	Predicted time series with a 95% confidence interval of prediction and forecast based on the computed Monte Carlo models.
	If checked in the dialog window, all used ANN network models are drawn. For more detailed description of this plot, see chapter Neural network. To perform properly, all the constructed networks should be different.