AN ADAPTATION OF EVOLUTIONARY STRATEGIES FOR FORECASTING THE EXCHANGE RATE

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Problem

What is tomorrow's exchange rate?

19 July 2004	40.13 baht/us-dollar
20 July 2004	41.27 baht/us-dollar
21 July 2004	41.04 bath/us-dollar
22 July 2004	???

In general, experts use a statistical model which is complex and the background knowledge is required.

Our work

- Do not require any a priori function or background knowledge.
- Using the technique of adaptive (1+1)-ES.
- Finding a function that can predict the exchange rate.

Technique

1. Random the function.

$$f(x) = \sin(x) + \cos(x)$$

2. Random the coefficient.

$$f(x) = 0.5 + 0.5\sin(x) + 0.5\cos(x)$$

3. Encoding its into chromosomes (strings).

Arithmetic Operators

'+' = 0
'-' = 1
'*' = 2
'/' = 3

Primitive Function

sin(*x*) = 4
cos(*x*) = 5
tan(*x*) = 6
x = 7
exp = *8*

0.5	**0.5**	**0.5**	**4**	**0**	**5**

Technique

4. Evolve function and coefficient using mutation operation.

Generation 1:

$f(x) = 0.5 + 0.5\sin(x) + 0.5\cos(x)$ ✍ RMS = 44.82

$f'(x) = \text{mutate } f(x)$

$f'(x) = 0.47 + 0.89\sin(x) + 0.21\tan(x)$ ✍ RMS = 38.21

Select $f'(x)$ to the next generation.

Generation 2:

$f(x) = 0.47 + 0.89\sin(x) + 0.21\tan(x)$ ✍ RMS = 38.21

$f'(x) = \text{mutate } f(x)$

$f'(x) = 0.96 + 1.23\sin(x) - 0.14\tan(x)$ ✍ RMS = 47.34

Select $f(x)$ to the next generation.

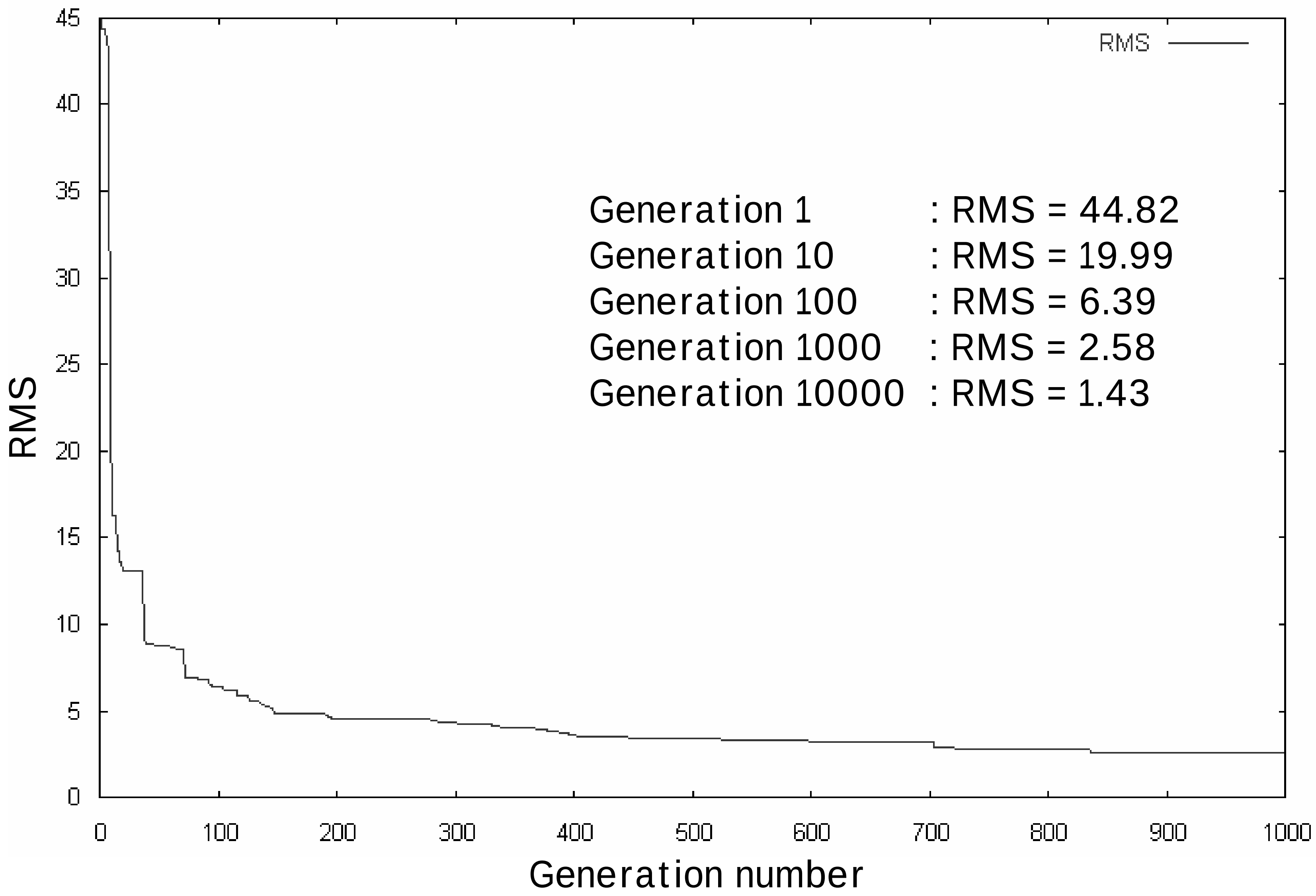
Generation 3:

$f(x) = 0.47 + 0.89\sin(x) + 0.21\tan(x)$ ✍ RMS = 38.21

…

…

Evolution


RMS
Generation number
RMS
Generation 1 : RMS = 44.82
Generation 10 : RMS = 19.99
Generation 100 : RMS = 6.39
Generation 1000 : RMS = 2.58
Generation 10000 : RMS = 1.43
0
5
10
15
20
25
30
35
40
45
0
100
200
300
400
500
600
700
800
900
1000

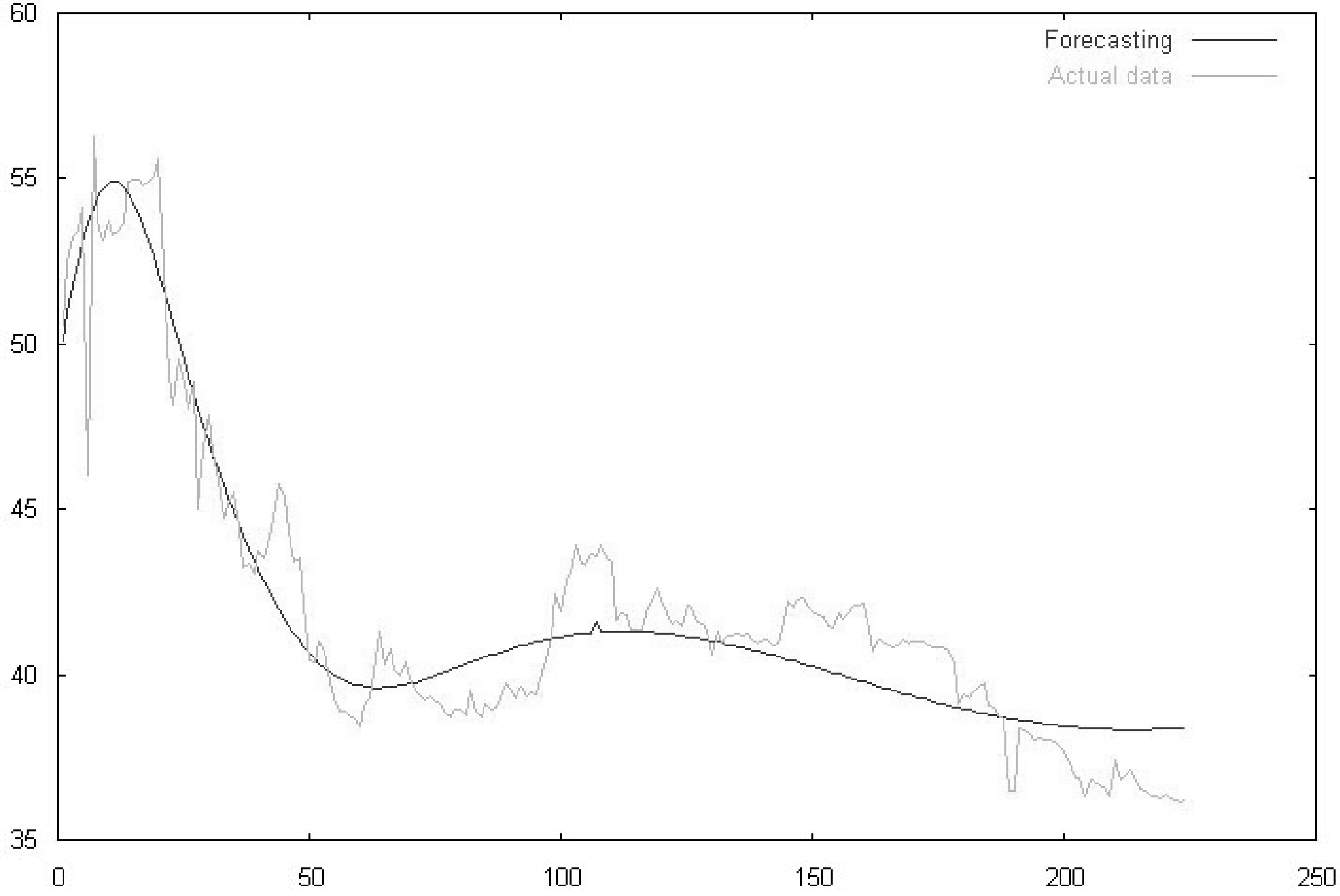
Experiment

- The exchange rate data from Bank of Thailand during the year 1998.
- Root Mean Square error (RMS) is used for evaluation.
- The result is validated using 10-fold cross validation.

Experimental Result – forecasting function

Choosing the function that give a minimum error on testing data.

$23.5913 + 1.2262x^2 / 20.9066x + 11.9073\exp(-(((x-86.889879)/-97.964033)^2))$ -
$-6.5593\exp(-(((x-7.979729)/-14.378492)^2)) + 17.8724\exp(-(((x-11.885456)/30.668756)^2))$
$- 39.1577\tan(2.405826x) * -3.8903\tan^2(0.840118x) * 4.1275x / 20.1120x^5$



Conclusion

- Presenting an adaptation of (1+1)-ES with evolution of functional form.
- Using the data of bath/us-dollar exchange rate for forecasting task.
- Suitable for variety of tasks that the functional form are not known a priori.

Thank you.