The Rabbit and Fox model for the HP-41C family

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Contents

1 The Rabbit and Fox model HP-41C code

key strokes	step	display code(s)	remark
[ON]			Put the calculator [ON]
[PRGM]			Enter program mode
☐ GTO . .		00 REG nnn	Set program counter @ end of code
☐ LBL [ALPHA]FR[ALPHA]	01	LBL"FR	Start position Rabbit and Fox model
☐ FIX 5	02	FIX 5	Set the display format to 0.00000
RCL 02	03	RCL 02	Read amount of rabbits @ time is t
ENTER↑	04	ENTER↗	
ENTER↑	05	ENTER↗	
RCL 03	06	RCL 03	Read amount of foxes @ time is t
RCL 00	07	RCL 00	Encounter factor
×	08	*	
×	09	*	Number of meetings
STO 04	10	STO 04	Store
$X \lessgtr Y$	11	X<>Y	
2	12	2	
×	13	*	Calculate change rabbits
-	14	-	
RCL 01	15	RCL 01	
×	16	*	
STO + 02	17	ST+ 02	Save new number of rabbits
RCL 04	18	RCL 04	
RCL 03	19	RCL 03	

key strokes	step	display code(s)	remark
-	20	-	Calculate change foxes
RCL 01	21	RCL 01	
×	22	*	
STO + 03	23	ST+ 03	Save new number of foxes
RCL 03	24	RCL 03	
EEX 5	25	1 E5	
÷	26	/	Divide number of foxes by 100000
RCL 02	27	RCL 02	
XEQ [ALPHA]INT[ALPHA]	28	INT	Add rounded number of rabbits
+	29	+	Form: rrr.00fff
□ RTN	30	RTN	Return
□ GTO . .		00 REG nnn	END RPN coding
[PRGM]			Leave program mode
□ ASN [ALPHA]FR[ALPHA] R↓			Assign ”FR” to R↓
[USER]			Set USER mode

2 How to use the Fox and Rabbit program

This model is bases on a publication in a HP Journal (november 1975). It was an example for a HP-25 programmable calculator.

In a fox and rabbit population model the growth functions can be described as a pair of nonlinear differential equations like:

$$\frac{dR}{dt} = 2R - \alpha RF$$

$$\frac{dF}{dt} = -F + \alpha RF$$

Where R is the number of rabbits and F the number of foxes. The α factor describes the effect of a rabbit meeting a fox. And t is for time.

With Euler: $X_{n+1} = X_n + hF(X_n)$

$$R_{n+1} = R_n + h(2R_n - \alpha R_n F_n)$$

$$F_{n+1} = F_n + h(-F_n - \alpha R_n F_n)$$

The RPN coded Fox and Rabbit program with Label "FR" has been assigned to key R↓ . The HP-41C calculator has been set in USER-mode. Enter and store the initial values.

Example:

$\alpha = 0.01$ $\quad h = 0.02$

$R_0 = 300$ $\quad F_0 = 150$

Keystrokes:

```
.01     STO 00
.02     STO 01
300     STO 02
150     STO 03
```

The program will calculate step by step. Initial values are at time is 0. The fist run will result in values at time is 1.

Now run, press key R↓

Result:

```
303.00156
```

The number before the decimal point is the number of rabbits. The number after the decimal point is the number of foxes. So, at time is 1 the number of rabbits are 303 and foxes are 156.

Now run again (step 2), press key R↓

Result:

```
305.00162
```

At time is 2 the number of rabbits are 305 and foxes are 162.
Etc. etc. etc.