

The units of the times t are arbitrary; years, months, or days will do, but i is the interest rate per unit of t . Because of the definition of x above, the precision with which i can be calculated is worse if i is per day rather than per month or per year. If line 40 is replaced by 1 [-], the program calculates the effective period interest rate rather than the continuously compounded rate.

As a test case, suppose $A_1 = -\$1500$, $t_1 = 0.73$ years, $A_2 = \$1000$, $t_2 = 2.13$ years, $A_3 = -\$2000$, $t_3 = 3.04$ years, and $A_4 = \$3000$. From these numbers, the continuously compounded interest rate is $i = 0.106856939$ or about 10.7% per year, and the equivalent rate for compounding yearly is $i = 0.11277505$ or about 11.3% per year.

The equations with interest compounded continuously also apply to other growth and decay problems such as wildlife populations in ecology and radioactive decay in physics.

As an exercise, consider the following problem. Suppose you invest \$1800 in a new business. A year later the business is doing very well and you take out \$4700. But after another year, the business is in real trouble (probably because you took all the working capital the year before) and you must put \$3900 back in to keep it afloat. After one more year, you sell your interest for \$1000. What has been your IRR? Either program above gives $i = 11.11\%$ per year, but a skeptic points out that i is really zero; you seem to have made no return at all! Who's right?

REFERENCES

Ball, John A. *Algorithms for RPN Calculators*. John Wiley Co., New York, 1978.

Martin, Roy E. "Printing Financial Calculator Sets New Standards for Accuracy and Capability." *Hewlett-Packard Journal*, October 1977, p. 22. [R/S]

THE GAME OF KING

THE GAME OF "KING" for HP-97 by D V Smith (663) New Zealand.

In this game you are the dictator (benevolent I hope) of a small island of 2000km² in area. Half of the island is very rugged and mountainous, and is not suitable for either industry or farming. But the tourists love the area and some of your income is derived from tourism.

INPUTS Each year, it is your task to set a budget for the next 12 months. You decide how much land you are going to sell to 'industry'; how much you will allocate to feed your people (it costs \$100 to feed each person for a year); you decide how much of your land you are going to plant; and how much you are going to spend on pollution control. By pressing A you govern for the year.

OUTPUTS Eleven outputs are given so that you can gauge your success for the year. By looking over the printout of the program, you will get an idea of how the various stages of the program are calculated.

INSTRUCTIONS

- (1) Input the program.
- (2) Set up the initial conditions: Decimal seed STO E
 - (a) Amount in treasury - 7 EEX 4 ST08
 - (b) Area of country - 2 EEX 3 ST02
 - (c) Initial population - 500 ST05
 - (d) Cost of seed per km² - 10 ST09
 - (e) Land value per km² P-S EEX 2 ST08 P-S
- (3) Inputs:
 - (a) Amount of land (km²) to sell STO A
 - (b) \$ distributed to people STO B
 - (c) km² to plant. (1 person can look after 2km²) STO C
 - (d) \$ spent on pollution control STO D
- (4) Govern for a year press A
- (5) Outputs:
 - (S0) New land value per km²
 - (P9) Cost of seed for 1km²
 - (P8) Population increase (births and immigration)
 - (P7) Population decrease (deaths, emigration and also pollution deaths (which you pay for))
 - (P6) Funeral costs (pollution deaths only)
 - (P5) Total population at year's end
 - (P4) Number of km² harvested
 - (P3) \$ income from the harvest
 - (P2) The amount of land you control
 - (P1) Income from tourism
 - (P0) \$ amount in the treasury at year's end.
- (6) Go to step 3

NOTE: If there is no money in the treasury to pay for the funerals of the victims of pollution, land is sold to pay for them. Otherwise, the machine will stay within the limits set by you. At the start, decide how many years you will govern for (I suggest 4 years) and you should resign if: (a) you kill off more than 60% of your population in one year (b) you kill off more than 30% of your population and still have funds in the treasury (c) you sell all your land. This is a very difficult game, and it is suggested that you use your machine to estimate all costs before keying in the values of the four parameters.

The program is based on one written for the PDP-11.

Best of luck! You will need it. David V Smith (663) NZ.

KING		EMIGRATION	072	XZY	LAND	153	0
			073	-	SELLING	154	x
			074	INT	VALUE	155	9
			075	X0?	FOR	156	5
			076	0	NEXT	157	+
			077	ST07	YEAR	158	INT
			078	ST-5		159	P2S
			079	RCL0		160	ST08
			080	RCLD		161	P2S
			081	XZY?		162	GSBe
			082	GT08	SEED	163	5
			083	ST-0	COST FOR	164	x
			084	GT01	NEXT	165	1
			085	*LBL0	YEAR	166	0
			086	XZY		167	+
			087	ST0D		168	INT
			088	1		169	ST09
			089	ST08		170	1
			090	*LBL1		171	0
			091	GSBe		172	ST01
			092	GSBe	REBOUND	173	*LBL2
			093	x	OF	174	RCL1
			094	RCLD	ECONOMIC	175	PRTX
			095	2	STATUS	176	DS21
			096	5		177	GT02
			097	+		178	RCL0
			098	+		179	PRTX
			099	INT		180	SPC
			100	ST+7		181	SPC
			101	ST-5		182	SPC
			102	X0?		183	SPC
			103	GSBe		184	R/S
			104	GSBe		185	*LBL0
			105	1	RANDOM	186	RCL0
			106	.	NUMBER	187	TAN+
			107	5	GENERATOR	188	FRC
			108	+		189	ST0E
			109	2		190	RTN
			110	+		191	*LBLd
			111	GSBe		192	ENTY
			112	x	AMOUNT TO	193	RCLD
			113	RCL5	BE SPENT	194	2
			114	2	ON FUNERALS	195	5
			115	x	FOR VICTIMS	196	+
			116	RCLC	OF POLLUTION	197	x
			117	XZY?		198	9
			118	XZY	THROUGH	199	x
			119	ST04	INDUSTRY	200	INT
			120	P4		201	ST06
			121	P2S		202	RCL0
			122	RCL0	IF NECESSARY	203	XZY
			123	P2S	SELL LAND	204	XZY?
			124	2	TO PAY FOR	205	GT08
			125	+	THE	206	ST-0
			126	x	FUNERALS	207	RTN
			127	INT		208	*LBL0
			128	ST03		209	P2S
			129	ST+0		210	RCL0
			130	RCL5		211	P2S
			131	RCL8		212	+
			132	-		213	INT
			133	2		214	ST-2
			134	2		215	RTN
			135	x		216	*LBL0
			136	GSBe	LAND	217	2
			137	5	AVAILABLE	218	EEX
			138	0	SUBROUTINE	219	3
			139	0		220	RCL2
			140	x		221	-
			141	+		222	RTN
			142	GSBe		223	R/S
			143	1			
			144	5			
			145	x			
			146	-			
			147	ABS			
			148	INT			
			149	ST01			
			150	ST+0			
			151	GSBe			
			152	1			