

The

The 48B Pac[©]

Ultimate

Business

Application

for the

HP 48SX[©]

THE 48BUSINESS PAC[®]

A BUSINESS AND FINANCIAL
APPLICATION PAC FOR
THE HEWLETT-PACKARD 48SX[®]
CALCULATOR.

USERS MANUAL

EDITION 1: APRIL 1992.

Contents

Try it out !.....	5
A word about installing the	7
The Time Value Of Money (TVM) application.....	8
The TVM menu.	11
Amortization.	18
Programming with TVM.	20
Clearing the TVM variables.....	21
The Interest Conversion (ICONV) application.	22
Cash-Flow Calculations (CFLO).....	25
A general description of IRR.	28
The Bonds and Notes (BOND) application.....	31
Bond calculations	33
Notes on the BOND program.....	36
The Option Valuation (OPTIO) application.....	39
A few notes on options.....	39
The Probability Distributions (DISTR) application.....	45
Probability calculations	46
The regression analysis (REGR) application.....	50
Regression analysis	51
A few notes on the regression application.....	56
The Currency conversion (CURRX) application.....	58
Business Calculations (BUS).....	62
Percent Change.....	62
Percent of Total.....	63
Markup on Cost.....	63
Markup on Price.....	63
The Depreciation (DEPRC) application.....	65
Depreciation calculations (SL, DB and SOYD)	66
Depreciation for the ACRS method.....	67
The Instalment Loan (INST) application.....	68
Loan calculations.....	68
The Time (TIME) application	70
The Print (PRINT) application.....	72
Appendix B.....	74

Notice

This application card and the keystroke programs in this manual are provided "As Is" and are subject to change without notice. The authors make no warranty of any kind with regard to this manual or the programs in it. The authors shall not be liable for any errors or consequential or incidental damages connected with the furnishing performance or use of this application card, book or the examples contained herein.

Copyright© Ib Jørgensen and Stein Nævdal-Larsen, 1992. All rights reserved. Reproduction, adaptation or translation of this book including any programs contained herein, is prohibited without the written permission of the authors, except as allowed under copyright laws. The authors grant the right to use any program in this book in a calculator.

The programs contained on the 48 Business Pac© application card are copyrighted and all rights are reserved. Reproduction, adaptation or translation of those programs, is prohibited without the written permission of the authors.

The HP-48SX and Hewlett-Packard are copyrighted trademarks of the Hewlett-Packard Co. of Corvallis, Oregon, USA.

Ib Jørgensen and Stein Nævdal-Larsen,
c/o Datalog A/S,
Hvamsvingen 24,
N-2013 Skjetten,
Norway.

Phone: +47 6 84 55 60, Daytime Central European Time.
Fax: +47 6 84 55 63

The conventions used in this manual:

- Keys on the keyboard are shown in bold italic uppercase letters in square brackets such as [ENTER], [SIN] and [+], except for numbers and the decimal separator.
- Shifted keys are shown [←] for yellow left-shifted keys and [→] for blue right-shifted key choices. [↑] and [↓] denotes the UpArrow and DownArrow on the 48SX keyboard.
- Menu labels seen in the lower part of the display relate to the top row keys of the keyboard and are all shown in uppercase letters in square brackets such as [TVM], [I%YR] and [FV].
- Text in the display is shown in dot matrix such as Memory Clear.

Installing and removing the 48 Business Pac[©].

The Hewlett-Packard 48SX[©] is equipped with two ports for installing plug-in-cards. Please make sure you have read chapter 34 of your HP-48SX[©] Owner's Manual Volume II before installing the 48 Business Pac[©].

The HP-48SX has 2 ports for plug-in-cards named port 1 and port 2. Port 1 is closest to the display and port 2 is closest to the back of the calculator. The 48 Business Pac[©] can be installed in either port.

Caution!

You must turn off the calculator while you are installing or removing the 48 Business Pac[©] plug-in-card. Otherwise, all of the user memory could be erased !

Remember that the contents of the stack is lost when installing or removing a card, due to a system halt.

Try it out !

We assume that you are familiar with the general use of the HP-48SX. If not, we suggest that you familiarize yourself with the use of it. A good start is going through part 1 of the Owner's Manual Volume I.

The 48 Business Pac[©] contains several main applications. The following example illustrates how to start and use an application. If you find yourself in trouble trying out the example, press [ATTN] and start over.

Example: Saving in the bank. You deposit \$4,000 on a new savings account that pays 8.4% annual interest, compounded semi-annually. If you make no other deposits into the account, what time does it take for the account to have reached \$7,000 ?

Go to the home directory; [→] [HOME]. Clear the stack; [→] [CLR]. Set the number of decimals shown to 2 by pressing [←] [MODES] 2 [FIX]. Then you press [α] [α] INSTALL and press [ENTER].

You are now ready to start the TVM application by:

- 1) Invoking the custom menu by pressing [CST].
- 2) Start the 48 Business Pac[©] application by pressing [START].
- 3) Start the TVM application by pressing [FIN] [TVM].

You will then see something like this in your display:

Int	Comp	Annually
END	MODE	
4:		
3:		
2:		
1:		
N	I/YR	PV
PMT	FV	MORE

The first thing to do is to decide which mode to use, so you turn to menu page 2 by pressing [MORE]. Your display will then look similar to the one on the following page:

Int	Comp	Annually
END	MODE	
4:		
3:		
2:		
1:		
[SETUP] [#PER] [TABLE] [MON] [CLEAR] [MORE]		

Press the menu key [→] [SETUP] to select the payment mode if it does not show END. Then you will have to key in the number of payments per year. You want to use 2 payments per year, so you key in 2 and then press [#PER] and [MORE] to turn to menu page 1 again.

Then you key in the facts:

4000 [+/-] [PV]
 8.4 [I%YR]
 0 [PMT]
 7000 [FV]
 [←] [MORE]

Int	Comp	Semi-Annually
END	MODE	
N	:	0
I%YR	:	8.4
PV	:	-4000
PMT	:	0
FV	:	7000
[N]	[I%YR]	[PV] [PMT] [FV] [MORE]

You then solve for the number of periods:

[←] [N]

USER		
{ HOME }		
4:		
3:		
2:		
1:		N: 13.60
[N]	[I%YR]	[PV] [PMT] [FV] [MORE]

It takes more than 13 half years (interest compounded semi-annually) to achieve a balance of at least \$7,000. You find the balance after exact 7 years (14 half years):

14 [N] [←] [FV]

USER		
{ HOME }		
4:		
3:		
2:		N: 13.60
1:		FV: 7115.54
[N]	[I%YR]	[PV] [PMT] [FV] [MORE]

A word about installing the 48B Pac.

To save a lot of time and to speed up application access, a time saver is to be included in the CST variable in the home directory.

This is done by installing the application pac as follows:

Go to the home directory; [→] [HOME]. Clear the stack; [→] [CLR].

Then you press [*α*] [*α*] INSTALL and press [ENTER]. The application pac is now easily accessed by pressing [CST] and [START]. Whenever you want to start the 48B, you select [START] from the [CST] menu.

Another variable; the CURRdir directory is also stored in your [VAR] menu if it's not there already. This is a directory for use with the currency conversion application which is now only accessible from within this directory as a default. To understand how to overrule this, and how to use the currency conversion application, read chapter Currency Conversion.

It is very important to have *SYMBOLIC EVALUATION mode set* to ensure correct function of the 48 Business Pac[©] application card. This is done by pressing [→] [MODES]. The menu label [SYM□] should contain a little square "□" inside the label. If it's not there press the label once, and the little square will show up.

The Time Value Of Money (TVM) application.

The term "Time Value of Money" and the TVM concept describes calculations based on money earning interest over a certain period of time. Basically there are two different types of interest involved in TVM calculations:

1) *Simple interest* is a certain percent of the principal repaid in addition to a certain amount after a specified period. For example, if you borrow \$100.00 from a friend for a year, and he wants to be repaid with a 5% simple annual interest, you owe your friend $\$100 + (\$100 * 5/100) = \$105$.

2) Calculations that take into account that the interest also earns interest when added to the principal at certain specified compounding periods, is called *compound interest*.

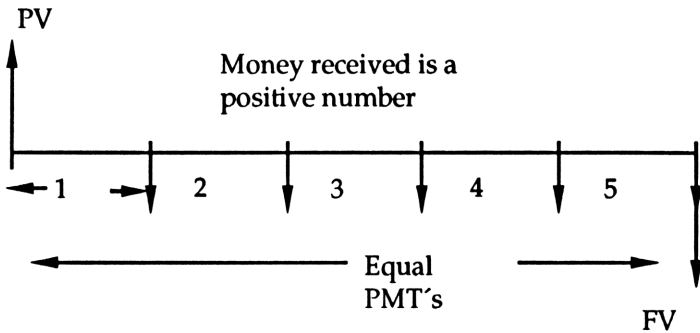
The TVM application contained in the 48 Business Pac[®], provides capabilities for compound interest and amortization calculations that determine the amounts applied toward the principal and interest in a series of payments.

A central point in understanding financial transactions is the use of cash flow diagrams (CFD's). A cash flow diagram is in fact a horizontal time line, divided into equal parts describing the compounding periods. Arrows pointing vertically represent the cash flows, with money received as a positive value with arrows pointing upwards, and money paid out as a negative value with arrows pointing downwards.

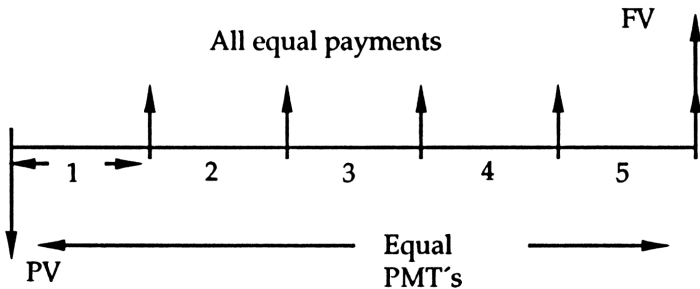
There are two different views of every transaction:

- The borrowers point of view and
- The lenders point of view.

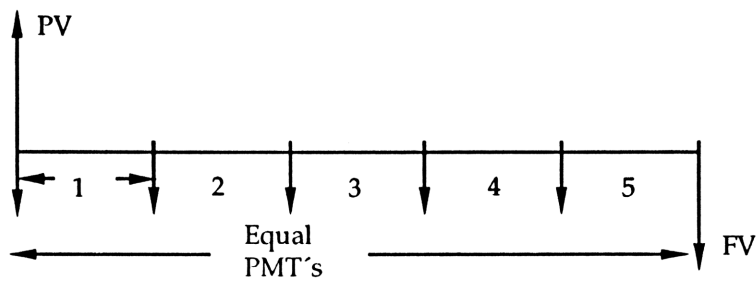
The cash flow diagram following, describe the situation from the borrowers point of view;



And from the lenders point of view;



The Arrows also indicate whether the payments occur in the beginning or the end of the period. If the above diagram would have had payments in the beginning of the periods, it would have looked like this:



Start the TVM application by:

- 1) Start the 48 Business Pac[®] application by pressing [CST] [START].*
- 2) Start the TVM application by pressing [FIN] [TVM].

You will then see something like this in your display:

```
Int Comp Annually
END MODE
4:
3:
2:
1:
N | 12YR | PV | PMT | FV | MORE
```

The first thing to do is to decide which mode to use, so you turn to menu page 2 by pressing [MORE]. Your display will then look similar to this:

```
Int Comp Annually
END MODE
4:
3:
2:
1:
SETUP | #PER | TABLE | AMOR | CLEAR | MORE
```

By pressing [→] [SETUP] you toggle between the payment modes, BEG and END. The one currently selected is displayed in the status area. To change to the other mode, press [→] [SETUP] again. Then you will have to consider the number of payments per year. If you want to use 2 payments per year, you key in 2 and then press [#PER]. You can also toggle between the most used ones by pressing [←] [SETUP].

* If you do not see [START] in the menu after pressing [CST] return to the part A word about installing the 48B Pac on page 4.

The TVM menu.

The TVM menu works quite similar to the built-in SOLVE menu, and it works mainly as follows:

To	Press	What happens
Store a value from stack level 1.	[N]	If necessary creates variable in VAR menu and stores value in variable.
Solve for a value	[←] [N]	If necessary creates variable in VAR menu, solves for value, and stores value in the variable.
Recall a value	[→] [N]	Recalls value of variable to stack.

To turn back to page 1 of the TVM menu press [MORE] again. Observe that the TVM menu contains 10 more labels:

Int	Comp	Annually
END	MODE	
4:		
3:		
2:		
1:		
SETUP	#PER	TABLE
MMOR	CLEAR	MORE

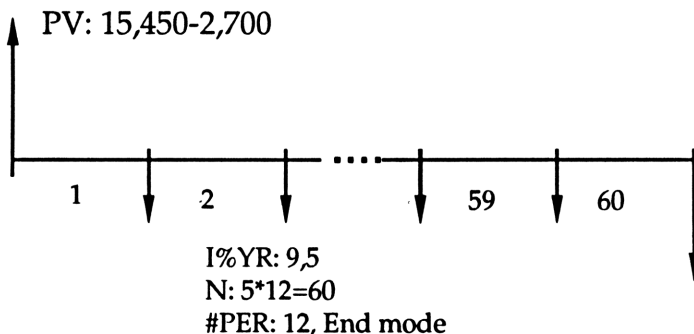
By pressing [→] [SETUP] you toggle between the payment modes, BEG and END. The one currently selected is displayed in the status area. To change to the other mode, press [→] [SETUP] again. Then you will have to consider the number of payments per year. If you want to use 2 payments per year, you key in 2 and then press [#PER]. You can also toggle between the most used ones by pressing [←] [SETUP]. The TVM menu works quite similar to the built-in SOLVE menu, and works mainly as shown in the following page:

Label	What happens when pressed
[N]	Stores or (dependent of the previously pressed shift key) recalls or solves for the total number of payments.
[I%YR]	Stores, recalls or solves for percent annual interest rate. (Nominal).
[PV]	Stores, recalls or solves for the present value. This is the cash flow on the initial time or the value of a series of future cash flows. PV always occurs at the beginning of the first period.
[PMT]	Stores, recalls or solves for the amount of each periodic payment. You cannot skip any payments and all the payments are the same amount. Payments are either in the beginning or in the end of each compounding period.
[FV]	Stores, recalls or solves for the future value. This is the final cash flow or the compounded value of all the previous cash flows. FV always occurs at the end of the last period.
[SETUP]	Show current setup in top of display.
[←][SETUP]	Toggle between predefined number of payments per year.
[→][SETUP]	Toggle between BEG and END modes, i.e. whether the payments occur at the beginning or end of each compounding period. Uses flag 62.
[#PER]	Stores number in command line or stack level 1 as the number of payments per year. If blueshifted it recalls the number.
[TABLE]	Prompts for number of periods to amortize and show in the MatrixWriter and in a matrix table.
[AMOR]	Takes number in command line or stack level 1 to calculate an amortization. This is the interest, principal and remaining balance after the specified period.
[CLEAR]	Clears all the page one variables.
[MORE]	Turn to the next menu page.
[←][MORE]	Views variables currently assigned values.

All of the TVM calculations need 4 values to solve for the fifth. If a value is missing in your problem, it should be set to 0.

Example: A car loan. You want to finance the purchase of a car with a 5-year loan at 9.5% annual interest, compounded monthly. The car is priced at \$ 15,450. Your down payment is \$2,700. What will your monthly payments be ? The first payment comes due 30 days (a month) after purchase.

The CFD will look like this:



You change to the HOME directory after clearing the stack. Clearing the stack is not necessary but is here done for clarity purposes.

[→] [HOME] [→] [CLR]
[←] [MODES] 2 [FIX]

Start the TVM application by:

- 1) Start the 48 Business Pac© application by pressing [CST] [START]
- 2) Start the TVM application by pressing [FIN] [TVM]
- 3) Press [MORE].

Set the payments per year and the payment mode, you set the future value (FV) to 0 since the loan will be fully paid after 5 years.

12 [MORE] [#PER] ([→] [SETUP] if BEG MODE is active) [MORE]
5 [ENTER] 12 [x] [N]
15450 [ENTER] 2700 [-] [PV]
9.5 [I%YR]
0 [FV]
[←] [MORE]

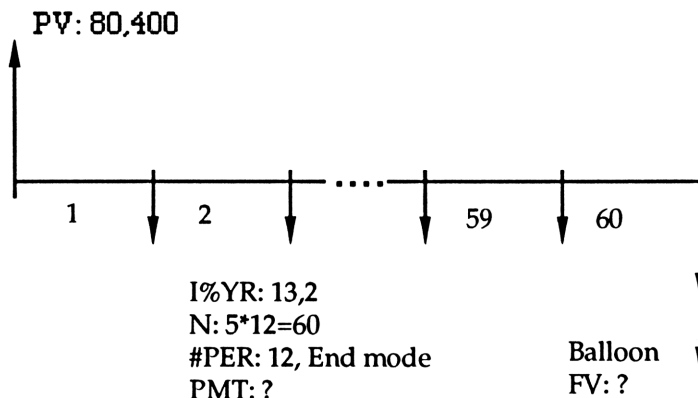
Int	Comp	Monthly
END	MODE	
N	: 60	
I%YR	: 9.5	
PV	: 12750	
PMT	: 0	
FV	: 0	
N	I%YR	PV
PMT	FV	MORE

Solve for the payment;

[←] [PMT] and see:

USER					
{ HOME }					
4:					
3:					
2:					
1:			PMT:	-267.77	
N	I%YR	PV	PMT	FV	MORE

Example: Mortgage loan with balloon payment. You have taken out a \$80,400, 25-year house mortgage at 13.2% annual interest. You are planning to sell the house in 5 years, repaying the loan in a balloon payment. What amount is the balloon payment ? To find out you have to calculate the value after 5 years of payments. We assume 12 payments per year.



First you check and store the payment mode, and number of payments per year.

[←] [MODES] 2 [FIX]
[CST] [START] [FIN] [TVM]
[MORE] [CLEAR] [→] [CLR]
12 [#PER] [→] [SETUP] until
you see

Int	Comp	Monthly
END MODE		
4:		
3:		
2:		
1:		
SETUP	#PER	TABLE
MMOR	CLEAR	MORE

You then store the other variables that are known, before calculating the monthly payment for the 25-year mortgage.

[MORE] 25 [ENTER] 12 [x] [N]
 13.2 [1%YR] 80400 [PV]
 0 [FV]
 [←] [PMT]

USER	
[HOME]	
4:	
3:	
2:	
1:	PMT: -918.91
N	12YR
PV	PMT
FV	MORE

To find the balloon payment you have to key in this result again to calculate with two decimal places rather than fractional cents.

918.91 [+/-] [PMT]

PMT: -918.91
4:
3:
2:
1:
N
12YR
PV
PMT
FV
MORE

You then store the total number of payments made after 5 years and calculate the balloon payment by solving for FV;

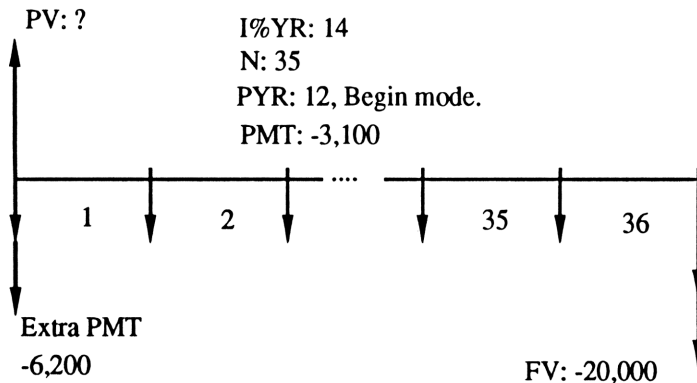
4 [ENTER] 12 [x] [N]
 [←] [FV]

This completes the calculation.

USER	
[HOME]	
4:	
3:	
2:	
1:	FV: -78233.22
N	12YR
PV	PMT
FV	MORE

Example: Leasing. You want to lease some machinery equipment for 3 years. The payment is \$3,100 a month. You have to pay \$3,100 at the beginning of the first period to replace the last payment. You are offered an option to buy the machinery after 3 years for \$20,000. If you were to borrow the same capital today you would have to pay 14% annual interest. You want to find the capitalized value of the lease, the present value (PV). We assume that there are 12 payments per year.

The CFD would look like this:



You have to make 3 initial calculations to be able to find the final result;

First you will compute the present value for the 35 monthly payments which is the initial investment required to make the payments.

Secondly you add the advance payment, and finally you compute the buy option value which you add to the previous amount.

So you store the number of payments per year and then you set the modes to begin.

If your display already looks like the one shown or if you are familiar with the modes setting you can drop the initialization procedure we start with in the examples.

[←] [MODES] 2 [FIX]
[CST] [START] [FIN] [TVM]
[MORE] [CLEAR] [→] [CLR]
12 [#PER] [→] [SETUP] until
you see...

```
Int Comp Monthly
BEG MODE
4:
3:
2:
1:
[SETUP] [#PER] [TABLE] [AMOR] [CLEAR] [MORE]
```

You then find the present value.

[MORE] 35 [N] 14 [I%YR]
3100 [+/-] [PMT] 0 [FV]
[←] [PV]

```
USER
{ HOME }
4:
3:
2:
1: PV: 89695.18
[N] [I%YR] [PV] [PMT] [FV] [MORE]
```

Then you add the advance payment:

3100 [+]

USER	
{ HOME }	
4:	
3:	
2:	
1:	92,795.18
SEND REC'D SERVE KGET FINIS SETUP	

Then you find the present value of the buy option.

36 [N] 0 [PMT]

20000 [+/-] [FV] [←] [PV]

USER	
{ HOME }	
4:	
3:	
2:	92,795.18
1:	PV: 13172.92
N 12YR PV PMT FV MORE	

These sums are then added to get the final result:

[+]

And you have completed the calculation.

USER	
{ HOME }	
4:	
3:	
2:	
1:	105,968.10
N 12YR PV PMT FV MORE	

The [TABLE] function let you compute a table of the selected period's

- NUMBER in column 1
- PAYMENT in column 2
- INTEREST and remaining in column 3
- BALANCE in column 4

All values show accumulated sums.

Amortization.

You can amortize using the AMRT function of the TVM menu to determine the amounts applied toward principal and interest in a payment. You can also do this in a series of payments.

- You first start the 48 Business Pac[®] application by pressing [CST], [START] and then start the TVM application by pressing [FIN] [TVM].
- After selecting begin or end mode you key in the number of payments per year if this number is different from the present one.
- You then store the values for I%YR, PV, PMT and FV.
- Key in the number of payments to amortize and finally you amortize by pressing the [AMOR] key.

The results in your display are tagged as follows:

LEVEL 3: Amount of the payments applied toward principal.

LEVEL 2: Amount of the payments applied toward interest.

LEVEL 1: The balance after the payments so far are made.

An example: You have just got a 5-year, \$15,000 loan at 13.25% annual interest compounded 4 times per year. What is the first year's payment applied towards principal and interest? We assume that the payments start at the end of period 1. You first have to compute the payment:

[←] [MODES] 2 [FIX] [CST] [START] [FIN] [TVM]

[MORE] [CLEAR] [→] [CLR]

4 [#PER] [→] [SETUP]

(until you see END) [MORE]

5 [ENTER] 4 [x] [N] 13.25 [I%YR]

15000 [PV] 0 [FV] [←] [PMT]

USER	
{ HOME }	
4:	
3:	
2:	
1:	PMT: -1037.59
N I%YR PV PMT FV MORE	

You then key in the number of periods to amortize, for instance 2 (for the first half year of the loan).

[MORE]

2 [AMOR]

USER	
{ HOME }	
4:	PMT: -1037.59
3:	Interest: -975.84
2:	Principal: -1099.34
1:	Balance: 13900.66
SETUP #PER TABLE AMOR CLEAR MORE	

To calculate the balance after the next 2 periods (half year) you store the new balance then compute the new amortization.

[MORE] [PV] [MORE] 2 [AMOR]
Levels 1, 2 and 3 now display the
new results for period 3 and 4;

USER	
[HOME]	
4:	Principal: -1099.34
3:	Interest: -901.80
2:	Principal: -1173.38
1:	Balance: 12727.28
[SETUP] [P/P] [TABLE] [AMOR] [CLEAR] [MORE]	

If your results are not tagged when amortizing, you can switch the tagging on and off. You can do this by pressing [→] [LIBRARY] [BUSPA] [←] [PREV]. You will then see two of more menu labels called [TVMT] and [TVMDT]. This is short for TVM Tag Amort results and TVM Don't Tag Amort results. These functions can be included in programs to let you control your output more easily. This leads to the next chapter...

Programming with TVM.

Most of the commands in the TVM library are programmable. These commands are:

Press	Programmable equivalent	What it does
[TVM]	TVM	Displays the TVM menu.
[TVMB]	TVMB	Sets the payment mode to Begin . Sets flag 62.
[TVME]	TVME	Sets the payment mode to End . Clears flag 62.
[TVMR]	TVMR	Solves for the specified TVM variable given in level 1. Can solve for any of N, I%YR, PV, PMT or FV variables as long as the four others are given a correct value in the VAR menu of the current or one of the directories in the PATH. Flag 62 decides the payment mode to be used. (See above). The answer is returned to level 1.
[AMRT]	AMORT	Uses the values of the TVM variables (except N) in the VAR menu of the current or one of the directories in the PATH, to perform amortization. Flag 62 decides the payment mode to be used. (See above). It takes the number of payments from level 1, returning the principal amount in level 3, the interest amount in level 2 and the remaining balance in level 1.
[TVMT]	TVMT	Switches amortization results tagging on.
[TVMDT]	TVMDT	Switches amortization results tagging off.

- First you use TVMB or TVME to set the payment mode.
- You then store all known values of the TVM variables PER, N, I%YR, PV, PMT or FV in the current or one of the directories in the PATH.

- Perform TVMR to solve for the unknown variable, or
- Use AMOR with a number for periods to make an amortization.

Example program:

◀ 'PER' STO	Stores the number of payments per year from level 4.
'I%YR' STO	Stores annual interest rate from level 3.
'PV' STO	Stores the present value from level 2.
PER * 'N' STO	Multiplies the number of years in level 1 with number of payments per year and store it.
0 'FV' STO	Sets future value to 0.
TVM 'PMT' TVMR	Selects END mode, puts 'PMT' on the stack and solves for it.
»	Ends program.
'PAYMENT' [STO]	

The parameters you key in before you press [PAYM] in the [VAR] menu is (in this order):

Number of years [ENTER]
 Present value [ENTER]
 Interest per year [ENTER]
 Payments per year [ENTER].

Clearing the TVM variables.

All the TVM variables are created in the VAR menu of the current directory the first time you use it for calculations. There are two ways of clearing these variables;

- You can press CLEAR on TVM menu page 2, or
- You can delete them from the VAR menu by keying in (N I%YR PV PMT FV PER) and pressing [←] [PURGE] .

The Interest Conversion (ICONV) application.

In most cases interest rates are stated as **nominal interest rates**. This means it is quoted as an annual rate that is compounded monthly, for example 18% per year, compounded 12 times a year (monthly). When investments that have different compounding periods are compared, **effective interest rates** are used to compare them. The effective interest rate is the annual rate that would produce the same interest rate compounded P times per year.

The ICONV (interest conversion) menu is used to convert between effective and nominal interest rates. There are two methods of compounding:

- Periodic compounding, for example semi-annually or monthly.
- Continuous compounding.

To start you first go to the home directory; [→] [HOME]. Clear the stack; [→] [CLR]. Set the number of decimals shown, to for example 2, by pressing [←] [MODES] 2 [FIX].

Start the application by:

- 1) Getting the library menu by pressing [CST]
- 2) Start the 48 Business Pac[®] application by pressing [START]
- 3) Select the business menu by pressing [FIN]
- 4) Start the ICONV application by pressing [ICONV].

Your display will look like this:

The application is now started and the text in the top of the display indicates that the periodic compounding method is active.



```
Periodic Compound
4:
3:
2:
1:
NDM | EFFECT | N | | MORE
```

If you want to change to continuous compounding method you just press [MORE] and your display will change a little:

You can now change back to periodic compounding method by pressing [MORE] again.



To convert between the nominal and effective interest rates the procedure is quite similar.

- Select the compounding method by pressing [MORE] .
- Key in the nominal (or effective) interest rate and press [NOM] (or [EFF%]). For periodic compounding, key in the number of periods per year and press [N].
- Then solve for effective (or nominal) annual interest rate by pressing [←] [EFF%] (or [←] [NOM])

The values of the EFF% and NOM% are shared between continuous and periodic compounding menus.

Example: Converting between compounding interest rates. You plan to open a savings account. The three local banks have different offers:

XX Bank: 8.5% annual interest, compounded quarterly.
 YY Bank: 8.45% annual interest, compounded monthly.
 ZZ Bank: 8.45% annual interest, compounded continuously.

Which is the better?

To start you first go to the home directory; [→] [HOME]. Clear the stack; [→] [CLR]. Set the number of decimals shown, to for example 2, by pressing [←] [MODES] 2 [FIX].

Start the application by:

- 1) Getting the library menu by pressing [CST]
- 2) Start the 48 Business Pac[®] application by pressing [START] [FIN]
 If you want to change to continuous compounding method you just press [MORE] and your display will change a little.
- 3) Start the ICONV application by pressing [ICONV].

8.5 [NOM] (the nominal interest rate in XX Bank). 4 [N] Stores the number of compounding periods per year. [←] [EFF%] calculates the effective interest rate for XX Bank.

USER	
{ HOME }	
4:	
3:	
2:	
1:	EFF : 8.77
NOM	EFF%
N	MORE

You then start with YY Bank:

8.45 [NOM] (the nominal interest rate in YY Bank). 12 [N] Stores the number of compounding periods per year. [←] [EFF%] calculates the effective interest rate for YY Bank.

USER	
{ HOME }	
4:	
3:	
2:	EFF : 8.77
1:	EFF : 8.79
NOM	EFF%
N	MORE

You then change to continuous compounding; [MORE] and since the percent value is the same in the third bank, and the contents of the NOM% variable is unchanged, you only have to solve for the effective interest rate:

[←] [EFF%] calculates the effective interest rate for ZZ Bank.

USER	
{ HOME }	
4:	
3:	EFF : 8.77
2:	EFF : 8.79
1:	EFF : 8.82
NOM	EFF%
	MORE

As you can see ZZ Bank has the better offer.

Cash-Flow Calculations (CFLO)

The cashflow calculations menu (CFLO) is mainly used to solve financial problems where cash flows occur at regular intervals, but are of varying amounts.

When you have stored the amounts you can calculate

- The internal rate of return.
- The net present value.

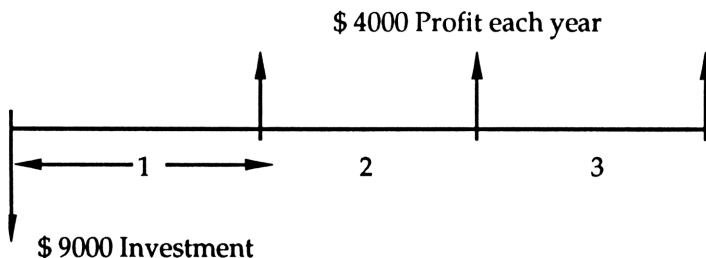
You can also plot the net present value of the cash flows against their interest rate of return, and you can display the cash flows as a bar graph.

The cash flow menu is selected by pressing **[CST]** **[START]** **[FIN]** **[CFLO]**. The menu labels in this menu is as follows;

Press	What it does
[NEW]	Stores new cash flows from the stack in VAR menu variable CFLW.
[EDIT]	Edits the current contents of the CFLW variable (if present) in the MatrixWriter environment.
[CALC]	Calculates Internal Rate of Return (IRR%) or Net Present Value (NPV) dependent of the current contents of the CFLW variable and the interest rate keyed in.
[PLOT]	Plots Net Present Value against the Internal Rate of Return.
[BAR]	Display all the cash flows in CFLW variable as a bar graph.

Example: A short term investment. A three year investment in a new machine in your factory looks like this in a cash flow diagram:
A \$ 9000 price tag gives a \$ 4000 profit each year for three years.

Displayed as a CFD:



When the cash flow menu is selected by pressing **[CST]** **[START]** **[FIN]** **[CFLO]**, you are ready to key in the cash flows:

90 **[+/-]** **[SPC]** 40
[SPC] 40 **[SPC]** 40

USER	
{ HOME }	
3:	
2:	
1:	
-90	40 40 40
NEW EDIT CALC PLOT BAR	

When you now press **[NEW]** the flows are stored in a variable in the VAR-menu called CFLW. As long as this variable exists in the current directory or path you can edit it by pressing the **[EDIT]** key.

Try it out and see this display:

Oops! -90 instead of -9000.

41	1	2	3	4
1	-90...			
2	40,...			
3	40,...			
4	40,...			
5				
1-1: -90,00				
EDIT VEC <WID MID> GO> GO<				

Now lets change the flows to the right magnitude. Press the **[GO↓]** menu key until it contains a little square. This tells the cursor to edit the sums from the top towards the bottom. You then key in

9000 **[+/-]** **[ENTER]** 4000 **[ENTER]** 4000 **[ENTER]** 4000 **[ENTER]** and then **[ENTER]**. You have now corrected all the flows to be: -9000 4000 4000 and 4000, and you are ready to calculate the internal rate of return and the net present value.

Press **[CALC]** and the display will show the following message

USER		PRG
{ HOME }		
Enter Interest Rate %		
(None Gives IRR)		
NEW EDIT CALC PLOT BAR		

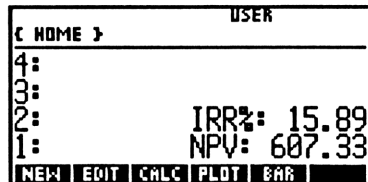
To calculate the IRR (Internal Rate of Return) you just have to press [ENTER].

After a few moments the IRR value is returned

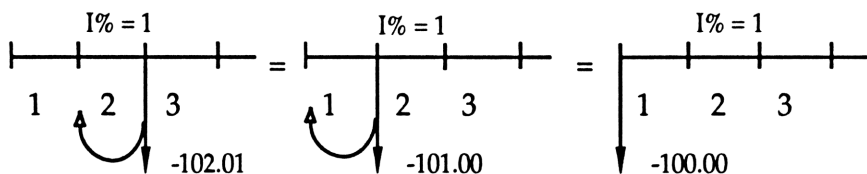


You then want to calculate the net present value of the investment, given that you have to pay the bank a 12% annual interest on a \$9000 loan.

You press [CALC] again and then key in the interest rate 12 and press [ENTER] and the net present value is returned to the stack:



When a cash flow is discounted, it is slid toward the beginning of the time-line and adjusted to compensate for the periodic interest rate. As a matter of fact any cash-flow can be moved to any time period on the cash flow diagram (CFD), as long as it is correctly adjusted to compensate one way or the other for accumulated interest. The figure following shows a \$102.01 payment being discounted one period at a time using an interest rate of 1% per period:



The numbers above were chosen specifically to simplify the explanation of discounting cash flows (1% of 100 equals 1, and 1% of 101 equals 1.01). If you discount a cash flow to the beginning of the time-line, you are essentially calculating its present value. The discounting process is always similar to the one shown here. The problem is generally that the numbers don't work out so nicely.

The NPV (Net Present Value) function finds the present value of each of the cash flows and thereafter sums them. To calculate the net present value you have to key in the periodic interest rate like you did above.

The IRR function calculates the interest rate required to give a net present value that equals zero.

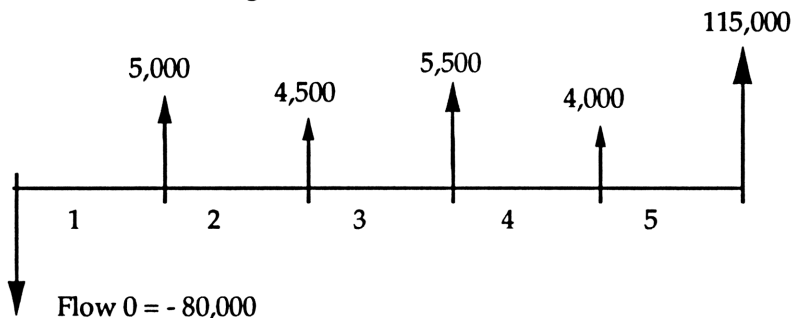
Our example investing in a piece of machinery states that given a yearly \$ 4000 profit for three years, the capital cost of the loan have to be less than \$ 607.33 to give you a overall profit.

A general description of IRR.

The internal rate of return gives the periodic interest rate in the calculation that gives a net present value equalling zero. This means that if your capital cost is less than the IRR%, the investment generally gives a profit. IRR returns a solution only when there are one shift of sign in the cash flows and the sum of all the cash flows is a positive number. If there are more than one shift of sign in the cash flows, there are more than one solution, all being equally mathematically relevant.

Remember that the IRR function calculates the periodic interest. To calculate the annual nominal interest when the cash flows are monthly, you have to multiply the IRR value by 12.

Example: An investor places \$ 80,000 in a company expecting a profit as shown in the following CFD:



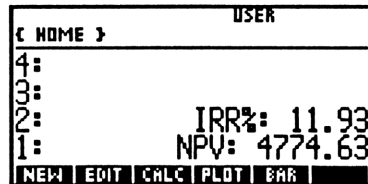
Calculate NPV and IRR of the cash flows using a 10.5% annual interest.

First you key in the cash flows after invoking the application by pressing [CST] [START] [FIN] [CFLO].

Then you key in the values;

80000 [+/-] [SPC] 5000 [SPC] 4500 [SPC] 5500 [SPC] 4000 [SPC] 115000 [SPC] [NEW]. Then you press [CALC] and [ENTER] to calculate IRR and press [ENTER] again to continue the calculation. To calculate NPV you press [CALC] again and key in 10.5, which was the annual interest, before you continue the calculation program by pressing [ENTER].

The results are then displayed as:



A calculator screen showing the results of a calculation. The display is divided into two sections. The top section shows 'IRR%' followed by '11.93'. The bottom section shows 'NPV' followed by '4774.63'. The screen also shows a status bar at the bottom with the text 'NEW | EDIT | CALC | PLOT | BAR'.

What if: To calculate any what ifs you start by pressing [EDIT]. If you have to alter the cash flows then you re-enter the new values and press [ENTER] to store the altered value and press [ENTER] again to end edit mode, or you press [CALC] if you plan to alter the periodic interest rate.

If, in the above case, the fourth cash flow is reduced to \$ 1000, you do the following:

Press [EDIT] to invoke MatrixWriter to edit the flows. Then you press [↓] four times to reach the right flow and you press 1000 so that the display shows:



A MatrixWriter screen showing a list of cash flow values. The screen has a header row with '1' and '2' and a footer row with '1' and '2'. The list contains the following values: 1: -80..., 2: 500..., 3: 450..., 4: 550..., 5: 4000..., 6: 115000. The value 1000 is entered in the 4th row, and a cursor is visible next to it. The screen also shows a status bar at the bottom with the text 'EDIT | VEC | <WID | WID> | GO> | GO<|'.

You then press [ENTER] to store this sum and press [ENTER] again to end editing.

If you by any chance change your mind and want to stop editing, or don't want to store the changes you have keyed in while in the editor environment, just press [ATTN] to quit editing and leave the list as it was when you started off.

You now press [CALC] to calculate the new values, the press [ENTER] without keying in anything to calculate the new IRR and you will see IRR%: 11.33 in the display.

Then press [CALC], and key in the interest rate 10.5 and press [ENTER] to calculate the new NPV; NPV: 2762.43.

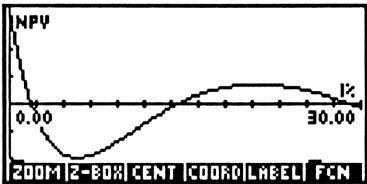
To demonstrate the use of the plotting application, consider the following unusual investment at 13% interest paid for reinvested positive flows and when the payment for negative flows is rated at 8% annual interest;

Flow#	Times occuring	Cash flow (\$)
0	1	-180,000.00
1	5	100,000.00
3	5	-100,000.00
4	9	0
5	1	200,000.00

To key in the flows you do the following:
180000 [+/-] 100000 [ENTER] 5 [α] [α] DUPN [ENTER] 100000 [+/-] 5 [α]
[α] DUPN [ENTER] 0 [α] [α] 9 DUPN [ENTER] 200000 [ENTER] .

You then press [NEW] to store the new list. To see the plot you then press [PLOT] and then you key in 0 [SPC] 30 to see the interest range from zero to 30%. You then press [ENTER] to plot.

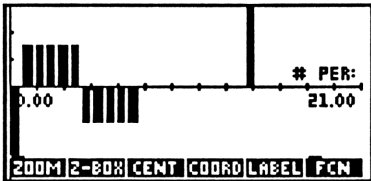
After a few moments your display will look something like this:



As you can see the function curve crosses the horizontal axis three times. This means that there are three roots (solutions) to the investments. The net present value or the internal rate of return can't be used to calculate an answer.

The last menu label of the CFLO menu is the [BAR] plot. If you press it while cash flows of the last example is still present, your display will look something like this:

The cash flows are shown as vertical bars with lengths relative to their value. This function can also be used with statistical data, if they are stored in the CFLW variable with [NEW].



The Bonds and Notes (BOND) application

The 48B card comes with an application to calculate the yield to maturity (price of a bond)*, yield to call on a coupon date and accrued interest. Bonds are expressed as a percentage of face value, e.g. a price of 88 means that a U.S. Treasury bill with a face value of \$ 10 000, is priced to \$ 8 800.

Some of the terms used in the application:

- **Yield:** The interest paid to the holder expressed as a percentage of the face amount
- **Yield to maturity:** The yield of a bond to maturity takes into account the price discount from, or premium over the face amount. It is greater than the current yield when the bond is selling at a discount and less than the current yield when the bond is selling at a premium.
- **Accrued interest:** Interest accrued on a bond since the last interest payment was made. The buyer of the bond usually pays the market price plus accrued interest.
- **Maturity:** The date on which a bond comes due and is to be paid off.
- **Calendar basis:** Actual/Actual (days per month/days per year). Interest is paid on the basis of an "actual" calendar. 30/360 (30 days per month/360 days per year). Interest is paid on the basis of a 360-days calendar. Please refer to the end of this chapter for a guide to most bond types or contact your dealer.

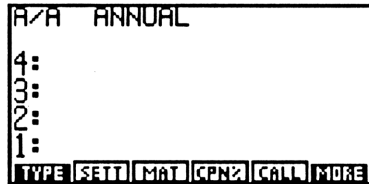
* Not all types of bonds can be calculated exactly with this program. Please refer to the end of this chapter for a guide to some common types solved on the 48B Pac.

To start the BOND application you do the following:

- 1) Start the 48 Business Pac[®] application by pressing [CST] [START].
- 2) Start the BOND application by pressing [FIN] [BOND].

You will see two status messages in the upper left corner of the display, indicating the current settings:

Calendar type and
interest period.



The BOND menu works as follows:

Key	What it does
[TYPE]	Displays Current Bond setting
[←] [TYPE]	Toggles between 30/360 and actual/actual calendar
[→] [TYPE]	Toggles between Annual and Semi-annual Interest compound
[SETT]	Stores ([→] recalls) the settlement date usingt the current date format. (See Owners Manual page 441)
[MAT]	Stores ([→] recalls) the maturity date using the current date format
[CPN%]	Stores ([→] recalls) the annual coupon rate
[→] [MORE]	Displays the currently assigned values for SETT, MAT CPN%, CALL and PRICE
[CALL]	Stores ([→] recalls) the call price per 100 face value. This is set to 100 by default
[YLD%]	Calculates (stores or recalls) the yield to maturity. The result is expressed as an annual percentage.
[PRICE]	Calculates (stores or recalls) the price per 100 face value
[ACCRU]	Calculates the interest accrued from the last coupon date until the settlement date per 100 face value.
[CLEAR]	Clears all variables in the BOND menu

Bond calculations

- 1) Start the BOND application by pressing [FIN] [BOND].
- 2) Define the type of bond you want to make calculations on:
[←] [TYPE] toggles between actual/actual calendar (A/A)
and 30/360 calendar (30/360)

[→] [TYPE] toggles between ANNUAL and
SEMIANNUAL interest periods.
- 3) Enter the settlement (purchase) date (DD.MM.YYYY or
MM/DD/YYYY) by pressing [SETT].
- 4) Enter the maturity date by pressing [MAT].
- 5) Enter the coupon rate expressed as an annual percent by pressing
[CPN%].
- 6) Enter the call value of the bond by pressing [CALL]. This is only
necessary when the call value differs from 100.
- 7) To calculate yield: Enter the price by pressing [PRICE], and press
[←] [YLD%]
- 8) To calculate the price: Enter the yield by pressing [YLD%], and
press [←] [PRICE]
- 9) To calculate accrued interest: Calculate one of the above, and press
[←] [ACCRU]

Example: A U.S. Treasury Note. Jack Pratt is considering the Bond market a good opportunity for investments. At March 20, 1992 he is offered 5% U.S Treasury notes maturing December 11, 2000. How much should Jack pay if he requires a yield of 7 % ?.

The U.S. Treasury Notes earns interest semi-annually on the basis of an actual calendar.

KEYS	DISPLAY	DESCRIPTION
[FIN] [BOND]	A/A SEMIANNUAL	Type Matches, no changes needed.
20.031992 [SETT]	SETT: FRI 20.03.92	Stores the settlement date. (DD.MMYYYY)
11.122000 [MAT]	MAT: MON 11.12.00	Stores the maturity date.

5 [CPN%]	CPN%: 5.00	Stores the annual coupon rate
[MORE]	A/A SEMIANNUAL	Changes menu page
7 [YLD%]	YLD%: 7.00	Stores desired yield.
[←] [PRICE]	1: PRICE: 87.09	Calculates the price per \$ 100 face value.
[→] [ACCRU]	2: PRICE: 87.09 1: ACCRU: 1.37	Interest owed to the seller
+	1: 88.46	Calculates the net price.

Example 2: U.S Treasury Notes cont. Encouraged by his calculations, Jack calls up his dealer. He is informed that the note is currently selling at a price of 90. What is the annual yield ? (This example assumes no changes have been made since example 1.)

KEYS	DISPLAY	DESCRIPTION
90		
[PRICE]	PRICE: 90.00	Stores the market price
[←] [YLD%]	1: YLD%: 6.52	Calculates yield to maturity.

Example 3: Yield of a Zero-Coupon Bond. Jack Pratt, still keen on investing in bonds, calls up his cousin. He is informed of the splendid opportunities offered by MAGNA Inc. On November, 20 1992 he is offered a MAGNA Inc. discount note at price 96.5. The note matures on May, 15 1993. What is the yield to maturity ?

MAGNA Inc. discount notes earns no interest, but are discounted on a 360 days basis.

KEYS	DISPLAY	DESCRIPTION
[←] [TYPE]	30/360 SEMIANNUAL	Sets the right calendar

[→] [TYPE]	30/360 ANNUAL	Sets the discount period
20.111992		
[SETT]	SETT: FRI 20.11.92	Stores purchase date
10.051993	MAT: MON 10.05.93	Stores maturity date
0 [CPN%]	CPN: 0.00	No interest earned
[MORE]	30/360 ANNUAL	Changes menu page
96.5		
[PRICE]	PRICE: 96.50	Stores the current price
[←] [YLD%]	1: YLD%: 7.60	Calculates yield to maturity

Example: A Callable Bond. The Central London Conditioning and Hatchery Centre is offering a 10 % bond maturing on January 25, 2020. The bond is callable on January 25, 2000 (a coupon date) at a value of 105. The market price is currently 108. What yield to call date would this bond offer if it was purchased on august 16, 1993 ?

The bond earns interest on a actual calendar basis with semi-annual coupon payments.

KEYS	DISPLAY	DESCRIPTION
[←] [TYPE]	A/A ANNUAL	Sets the right calendar
[→] [TYPE]	A/A SEMIANNUAL	Sets the discount period
16.081993		
[SETT]	SETT: MON 16.08.93	Stores the Settlement date.
10 [CPN%]	CPN : 10.00	Stores coupon %
25.012000		
[MAT]	MAT: TUE 25.01.00	Stores the call date
105		
[CALL]	CALL: 105	Stores the call value

[MORE] A/A SEMIANNUAL Changes menu page

108

[PRICE] PRICE: 108 Stores the current price

[←] [YLD%] 1: YLD%: 8.93

Notes on the BOND program

The program uses "user-flags" to construct the proper bond type.

User flag 61 : Annual (clear)
 Semi-annual (set)

User flag 60: Actual calendar (clear)
 30 /360 calendar (set)

The program will not accept an "invalid" date. That is, if you try to enter a nonexistent date, (February 29, 1991 or April 31, 1992) the program will return an error message indicating this. Also, the program will report an error if the maturity date proceeds the settlement date.

The "end-of-month" convention is used to determine coupon dates in some exceptional cases. This affects calculations for YLD%, PRICE and ACCRUed interest.

If the maturity date falls on the last day of the month, the coupon date also fall on the last day of the month.

If the maturity date of a semi-annual bond falls on august 29 or 30, the February coupon payment dates fall on the last day of February.

The program will not accept "symbolic" arguments. Any attempt to enter this, will result in an error.

The results obtained from this program should be considered estimates. The program does not take into account other information than what is obtained from the user.

When using the program, the user should bear in mind the influence of factors such as:

- An always changing rate of interest.
- The risk structure of bond yields.
- Tax Issues.

Some bonds solved on the 48B:

Note: The information below should serve as guidelines only. Consult a bond dealer for more detailed information. The list is not all inclusive.

30/360 Bonds, Semi-Annual Coupon Payments

- State, Municipal and Local Government
 - Zero-coupon bonds
 - Tax supported bonds
 - Revenue bonds
 - Revenue supported bonds
 - Assessment supported bonds
 - Special supported bonds
- Federal agency instruments
- Corporate bonds*
- Certificates of deposit with periodic interest
- Inter-American Development Bank bonds
- International Bank for Reconstruction and Development bonds
 - Commodity Credit Corporation (CCC) bonds
 - Export-Import Bank (Ex-Im) certificates
 - Federal Home Loan Bank (FHLB) bonds and notes
 - Federal Intermediate Credit Bank (FICB) debentures if coupon interest is paid periodically
 - Federal Land Bank (FLB) bonds
 - Federal National Mortgage Association (FNMA) bonds
 - General National Mortgage Association (GNMA) bonds and participation certificates.
 - New Communities Act debentures
 - U.S Postal Service bonds
 - Tennessee Valley Authority bonds

* A common convention in calculating corporate bonds in the United States is that if the coupon rate equals the yield percent, then the price of the bond is set to 100 whether the settlement date is a coupon date or not. If the price is 100, the yield is set to the coupon rate. The 48B does not use this convention.

- Merchant Marine Bonds

Actual/Actual, Semi-annual coupon payments

- Treasury Bonds and Notes
- Federal Agency Issues
 - Farmers Home Administration (FHDA) insured notes
 - Federal Housing Administration (FHA) debentures

The Option Valuation (OPTIO) application

The 48B Pac contains an application to calculate the value of a put and a call option. The application uses the Black and Scholes option valuation model.

Some of the terms used in the application:

- **Option:** A right to buy (call) or sell (put) a fixed amount of a given stock at a specified price within a limited period of time. The buyer hopes that the stock's price will go up (if he bought a call) or down (if he bought a put) by an amount sufficient to provide a profit greater than the cost of the contract. If the stock price holds steady or moves in the opposite direction, the price paid for the option is lost entirely.
- **Volatility:** In order to use the application you need to know the standard deviation of the rates of return for the underlying stock. This number is in general not available, but can be estimated by sampling stock prices over a uniform time interval.

An **American option** can be exercised before or at maturity while a **European option** must be exercised at a given future date.

A few notes on options

Assuming no dividends on the underlying stock, the value of a call increases with time to maturity. Hence, an American call will always carry the same price as a European call. The same is not true for an American put, and the Black and Scholes model will in general underestimate the price of an American put.

The Black and Scholes model assumes that no dividends are paid on the underlying stock. Here are two ways to overcome this assumption.

In the case of a European call, simply calculate the net present value of the future dividends, and subtract this from the current stock price. If dividends are sufficiently large, it can pay to exercise an American call before maturity. The following procedure has been suggested to work around this complication;

- 1) Calculate the net present value of the future dividends, assuming the option is held to maturity, and deduct this number from the current stock price.
- 2) Substitute the maturity date with the last ex-dividend date, and calculate the value of the call .
- 3) In the same way, you can calculate the Black Scholes values for all the other ex-dividend dates.

The information entered in the application must be consistent in time, that is, if the standard deviation of the underlying stock is based on monthly observations, the period to strike and the risk free interest must also be expressed in months.

To start the OPTION application you do the following:

- 1) Start the 48 Business Pac[©] application by pressing [CST] [START].
- 2) Start the OPTION application by pressing [FIN] [MORE] [OPTIO].

The menu labels in this display is explained as follows:

Key	What it does
[PRICE]	Stores ([→] recalls) current stock price
[STRI]	Stores ([→] recalls) the striking price
[YLD%]	Stores ([→] recalls) the risk free interest rate as a percentage
[TIME]	Stores ([→] recalls) the time period to maturity
[STDE]	Stores ([→] recalls) the standard deviation of the returns for the underlying stock
[MORE]	Selects next menu page
[←][MORE]	Displays the currently assigned values for PRICE, STRIKE, YLD%, TIME and STDEviation
[←][CALL]	Calculates the value of the call
[←][PUT]	Calculates the value of the put
[CLEAR]	Clears all variables in the option menu

To perform option calculations

- 1) Display the OPTION menu by pressing [FIN] [OPTIO]
- 2) Enter the current stock price and press [PRICE]
- 3) Enter the striking price and press [STRI].
- 4) Enter the risk free interest rate, and press [YLD%].
- 5) Enter the period of the option and press [TIME]
- 6) Enter the standard deviation of the returns and press [STDE].
- 7) Press the [MORE] key.
- 8) To calculate the premium of the call, press [←] [CALL]
- 9) To calculate the premium of the PUT, press [←] [PUT]

Example 1: The value of a call. A RAMP Inc. \$ 60.00 option is presently selling at \$ 12.00. The market price for a RAMP Inc. stock is \$ 68.00, and the yield of U.S. Treasury bonds is 12% per year. The length of the call is 300 days. You call up your good friend Merlin, who tells you that the monthly standard deviation of RAMP Inc. stock is 0.3. Calculate the value of the call.

KEYS	DISPLAY	DESCRIPTION
[FIN] [OPTIO]		Select the Option menu
68 [PRICE]	PRICE: 68.00	Stores the current stock price.
60[STRI]	STRIKE: 60.00	Stores the striking price
12 12 [/] [YLD%]	YLD%: 1.00	Stores the monthly risk free interest rate.
300 365 [/] 12 [x] [TIME]	TIME: 9.86	Stores the length of the call (in months).
0.3 [STDE]	S: .30	Stores the standard deviation
[MORE]		Selects next menu page
[←] [CALL]	CALL: 29.57	Calculates the value of the call.

Example 2: The value of a call without the standard deviation. After having made a bundle on the RAMP Inc. investment, you are encouraged to persuade the option market.. Your friend Merlin , now currently employed by Meryyl Lynch, has decided to charge you (a lot) for his information, and is therefore of no help to you. In the financial section of your local newspaper you find the following information: An Hewlett Packard \$ 50.00 call option is selling for \$ 10.00. The current stock price is \$ 50.00, and you can get 10% interest on U.S. Treasury bills. The option matures in one year. You have tracked down the monthly closing stock prices for 20 months:

Month	Price
1	50
2	52
3	53
4	54
5	55
6	58
7	55
8	52
9	50
10	47
11	48
12	50
13	52
14	55
15	48
16	47
17	50
18	51
19	52
20	50

Step 1) Calculate the standard deviation of returns for the prices.

The easiest way to do this, is to write a program: The program takes a {N 1} array from stack level 1 and calculates the returns.

The return of the stock is given by:

$$(\text{price}_t - \text{price}_{t-1}) / \text{price}_{t-1}$$

where t denotes month 1, 2 ..., 20

« → dat	Define a local variable
« 1 dat SIZE 1 GET 1	
- FOR i	Start a counter from 1 to (# observations - 1)
dat i 1 + GET	
dat i GET -	
LASTARG DROP / NEXT	Remember to enable LASTARG
dat SIZE 1 GET	
1 - {1} + →ARRY	
'ΣDAT' STO » »	Store the resulting array for further use

'RETURNS' STO

Step 2. Enter the monthly closing stock prices:

KEYS	DISPLAY	DESCRIPTION
[→] [CLEAR]		Clear the stack
50 [ENTER]	1: 50	
52 [ENTER]	2: 50 1: 52	
53 [ENTER]	3: 50 2: 52 1: 53	Enter the stock prices:
...		
...		
50 [ENTER]		
[←] [(] 20 [SPC] 1 [ENTER]		
[PRG] [OBJ] [→ARR]	1: [[50...]]	Put the prices in an Array
[']		
[α] [α]		Enter α-mode
HP. PRICE		
[ENTER] [STO]		Store the array
[VAR] [HP.PRICE] [RETUR]		Evaluate the program
[←] [STAT]		Select the STAT menu
[NXT]		Select next menu page

[STDE] 1: 0.05 Calculate the standard deviation

[CST] [START]
[FIN] [MORE] [OPTIO]

[MORE]
[CLEAR] 1: 0.05 Clear all variables

[MORE]
[STDE] STDEV : 0.05 Store the Standard deviation

50 [STRI] STRIKE: 50.00 Store the striking price

50 [PRICE] PRICE : 50.00 Store the current price

12 [TIME] TIME : 12.00 Store the time to maturity:

10 12 [/]
[YLD%] YLD% : 0.83 Store the risk free interest rate

Enter [←] [MORE].

Your display should look like:

[HOME]		USER			
PRICE	:	50			
STRIKE	:	50			
YLD%	:	.833333333333			
TIME	:	12			
STDEV	:	5.33815837021...			
PRICE		STRI	YLD%	TIME	STRE MORE

[MORE]
[←] [CALL] 1: CALL: 6.39 Calculate the value of the call which completes the calculation.

The Probability Distributions (DISTR) application

The DISTRibution menu lets you calculate point- and interval probabilities for some "common" probability distributions.

The table below gives an overview of the distributions available on the 48 B.

Distribution	Example of application
Binomial	The frequency in n independent trials has a binomial distribution. Probability in each trial = p
Geometric	The number of required trials until an event with probability p occurs has a geometric distribution
Poisson	Distribution of number of points in random point process under certain simple assumptions. Approximation to the binomial distribution when n is large and p is small.
Hyper-geometric	This distribution is used in connection with sampling without replacement from a finite population with elements of two different kinds.
Normal	Under general conditions, the sum of a large number of random variables is approximately normally distributed.
Chi-square	Distribution of $u_1^2 + u_2^2 + \dots + u_r^2$ where u_1, u_2, \dots, u_r are independent, and have a normed normal distribution
Student-t	Distribution of $u/(X/r)^{1/2}$ where u and X are independent, u has a normed normal distribution and X has a chi-square distribution with r degrees of freedom
Fischer	Distribution of $(X_1/r_1)/(X_2/r_2)$ where X_1 and X_2 are independent and have a chi-square distribution with r_1 and r_2 degrees of freedom

Probability calculations

To start the application, press **[CST]** **[START]** **[SUM]** and **[DISTR]**.

The program has two menu pages; Page 1 covers the discrete distributions. Page 2 covers the continuous distributions.

If you want a point estimate, that is $P[X=x]$, simply enter the arguments (see below) and press the key for the appropriate distribution.

If you want an interval estimate, that is $P[X < x]$, enter the arguments and press **[←]** and the key for the appropriate distribution.

Distributions:

The binomial distribution.

To calculate	$P[X=x]$	$P[X<x]$
	3: n	3: n
	2: p	2: p
	1: x	1: x

Example: The probability of obtaining heads 15 times if a fair coin is tossed 30 consecutive times:

The stack should look like this before executing **[BINO]**:

USER	
{ HOME }	
4:	
3:	30.00
2:	0.50
1:	15.00
[BINO] [POIS] [HYPER] [GEOM] [MORE]	

Pressing **[BINO]**, you obtain:

USER	
{ HOME }	
4:	
3:	
2:	
1:	P[x = 15.00]: 0.14
[BINO] [POIS] [HYPER] [GEOM] [MORE]	

The Poisson distribution:

To calculate	P[X=x]	P[X<x]
	2: λ 1: x	2: λ 1: x

Example: A shopkeeper wants to know the probability of less than 5 customers arriving in his shop between 3.00 pm and 4.00 pm. The expected number is 10.

The stack should look like this before executing [POIS]

USER	
{ HOME }	
4:	
3:	
2:	10.00
1:	5.00
[BIND] [POIS] [HYPER/GEOM] [MORE]	

Pressing [←] [POIS], you obtain:

USER	
{ HOME }	
4:	
3:	
2:	
1:	P[X ≤ 5.00] = 0.07
[BIND] [POIS] [HYPER/GEOM] [MORE]	

The Hypergeometric distribution:

To calculate	P[X=x]	P[X<x]
	4: n 3: a 2: p 1: x	4: n 3: a 2: p 1: x

Example: The probability of obtaining exactly 5 red balls when drawing 12 balls without replacement from an urn containing 100 balls, 30 of which are red.

The stack should look like:
Remember: P=30/100

USER	
{ HOME }	
4:	100.00
3:	12.00
2:	0.30
1:	5.00
[BIND] [POIS] [HYPER/GEOM] [MORE]	

Pressing [HYPER] you obtain:

USER	
{ HOME }	
4:	
3:	
2:	
1:	$P[X = 5.00] = 0.16$
BINO POIS HYPER GEOM MORE	

The Geometric distribution:

To calculate	$P[X=x]$	$P[X<x]$
	2: p 1: x	2: p 1: x

Example Playing Russian roulette with a six-barrel, you like to know the probability of being shot before or in the 5 round.

The stack should look like:
Remember: $P=1/6$

USER	
{ HOME }	
4:	
3:	
2:	0.17
1:	5.00
BINO POIS HYPER GEOM MORE	

Pressing [←] [GEOM], you obtain the not very encouraging answer:

USER	
{ HOME }	
4:	
3:	
2:	
1:	$P[X \leq 5.00] = 0.60$
BINO POIS HYPER GEOM MORE	

The Normal distribution:

To calculate	$P[X<x]$
	3: μ 2: σ 1: x

The Chi square distribution:

To calculate	$P[X<x]$
	2: r 1: x

The Student -t distribution:

To calculate	P[X<x]
	2: r
	1: x

The Student -f distribution:

To calculate	P[X<x]
	3: r ₁
	2: r ₂
	1: x

The regression analysis application

Regression analysis is concerned with estimating and predicting a dependent variable on the basis of one or more fixed explanatory variables. The HP 48SX has a command for making a straight line fit (with several types of substitutions). However, Σ LINE is limited to regressor and gives no information about the fit.

The program REGR fits a model with an unlimited number of regressors. The program also gives additional information about the fit which enables the user to make inference from the model.

Mathematically speaking, the program fits a model of this form:

$$(1) \quad Y = b_0 + b_1X_1 + b_2X_2 + \dots + b_kX_k + e$$

The terms used in this chapter are defined in most regression textbooks, so here are just a few comments:

- **Regressor:** A fixed non-random variable used to explain a dependent variable.
- **Regression coefficients:** The program estimates partial regression coefficients. A coefficient gives the direct, or "net" effect of a unit change in the regressor on the dependent variable. Speaking calculus, this means the partial derivative of (1) with respect to the regressor.
- **Standard deviation of model:** "s" is the estimated standard deviation about the regression line.
- **RSQ:** This is R^2 , also called the coefficient of determination.
- **Analysis of variance (ANOVA):** An illuminating way of looking at a statistical inference problem is to employ ANOVA. Loosely speaking, ANOVA decomposes the total sum of squares into to components; explained sum of squares (ESS) and residual sum of squares.

• **Durbin-Watson statistic (d-w):** A celebrated test for detecting serial correlation is that developed by statisticians Durbin and Watson. As a rule of thumb, if this statistic is found to be approx. 2 in a fit, one may assume that there is no first order autocorrelation. (either positive or negative).

Regression analysis

The program uses the reserved variable ΣDAT for calculations. You need to enter the data before starting the application.

To start the REGRESSION application you do the following:

- 1) Start the 48 Business Pac[©] application by pressing [CST] [START].
- 2) Start the REGRESSION application by pressing [SUM] [REGR].

To	Press	What happens
Start the application	[REGR]	The program checks to see if SDAT is present, then asks the user to specify a model.
Find the coefficients	[β]	Calculates the coefficients, and returns them to the stack
Find the standard deviation of the coefficients	[S(β)]	Calculates the standard deviation of the coefficients, and returns them to the stack
Perform ANOVA	[ANOV]	Calculates estimates of ESS, RSS, RSQ the number of degrees of freedom associated with these, F-statistic and returns them to the stack.
Calculate Durbin-Watson statistic.	[D - W]	
Make a scatterplot	[PLOT]	Plots a column in SDAT vs another column in SDAT.
Quit the application	[EXIT]	

Example 1: The Capital asset pricing model (CAPM). Consider the CAPM of modern investment theory, which in its risk-premium form may be expressed as:

$$(1) (ER_i - r_f) = \beta_i (ER_m - r_f)$$

where

ER_i = Expected rate of return on security i.
 ER_m = Expected rate of return on the market portfolio.
 r_f = Risk free rate of return.
 β_i = The Beta-coefficient, a measure of systematic risk, that cannot be eliminated through diversification. Also a measure of the extent to which its security's rate of return moves with the market.

If capital markets work efficiently, then CAPM states that security i's expected risk premium ($=ER_i - r_f$) is equal to that security's β coefficient times the expected market risk premium ($ER_m - r_f$)

The following table gives data on the annual rates of return (%) on Afuture Fund, a mutual fund whose primary investment objective is maximum capital gain, and on the market portfolio, as measured by the Fischer Index, for the period 1971-1980.

Year	Return on Afuture fund	Return on Fischer Index
1971	67,5	19,5
1972	19,2	8,5
1973	-35,2	-29,3
1974	-42	-26,5
1975	63,7	61,9
1976	19,3	45,5
1977	3,6	9,5
1978	20	14
1979	40,3	35,3
1980	37,5	31,0

Source: Weissenberg: Investment, Inv. Co. 1981

(1) can be rewritten as:

$$Y_i = \alpha_i + \beta_i X_i + \varepsilon_i$$

where

Y_i = Annual return rate on Afuture Fund

X_i = Annual rate of return on the market portfolio

β_i = slope of coefficients

α_i = the intercept

There is no consensus about the prior value of α_i . Some results have shown it to be positive and some have shown it to be equal to 0.

You can test the CAPM by using regression analysis:

KEYS	DISPLAY	DESCRIPTION
67.5 [ENTER]		
19.5 [ENTER]	2: 67.5 1: 19.5	Enter the data row wise
...		
...		
[←] [F10] [SPC] 2 1: [[67.5 19.5.. [ENTER] [PRG] [OBJ] [→ARR]		Make an array.
[←] [STAT]	1: [[67.5 19.5..	Select the Stat menu
[Σ +]		The program takes the data from ΣDAT
[CST] [START]		
[SUM] [REGR]	Regress C on C..C	Prompting for model
1 [SPC] 2 [ENTER]		Regress column 1 on column 2.

If you press [←] [MODES] 4 [FIX], your display should look like:

```

Make a selection
4:
3:
2:
1:
┌───┴───┐
8 | SC0 | ANOV | D-W | PLOT | EXIT |

```

KEYS	DISPLAY	DESCRIPTION
[β]	2: β0:1.2797 1: β1:1.0691	The coefficients are found.
[S(β)]	3: s : 20,6920 2: Sd(β0): 7,6886 1: Sd(β1): 0.2383	Variance of the model Standard dev of β0 Standard dev of β1

You are now in a position to draw some statistical conclusions from the regression. First of all, by fitting the data you obtained an equation: (the standard deviations of the coefficients are given in parenthesis)

$$Y = 1.28 + 1.069 X$$

(7,69) (0.238)

You can employ a formal test for the intercept term. The t-value is given by $1.28 / 7.69 = 0.167$. From this you can accept the hypothesis that the true intercept term is not different from zero.

Example 2. Per Capita consumption (PPCE) expenditure and per capita disposable income (PPDI) in the United States 1956 - 1980.

The following model has been proposed to explain PPCE in the United States:

$$PPCE = b_0 + b_1 PPDI + b_2 TIME$$

In plain English , the equation says that PPCE is linearly related to PPDI and time. Time should be thought of as a trend variable. Our job is to determine the net effect these regressors have on the dependent variable.

The data for this example is given below.

PPCE Y	PPDI	TIME
1673	1839	1 (=1956)
1688	1844	2
1666	1831	3
1735	1881	4
1749	1883	5
1756	1910	6
1815	1969	7
1867	2016	8
1948	2126	9
2048	2126	10
2128	2336	11
2165	2404	12
2257	2487	13
2316	2535	14
2324	2595	15 (=1970)

Source: Economic Report of the President, Jan. 1972

KEYS	DISPLAY	DESCRIPTION
1673 [ENTER]	1: 1673	Enter the data row wise
1839 [ENTER]	2: 1673	
	1: 1839	

...
...

...

...

15 [ENTER]

[←] [I] 20 [SPC]

1 [ENTER] 1: {20 1 }

[PRG] [OBJ]

[→ARR] [[1673 1839... Put the data into an array

[←] [STAT]

[CLΣ] [Σ+] Make the data the current ΣDAT

[CST] [START]

[SUM] [REGR] Regress C on C..C Program asking for input

1 [SPC] 2 [SPC]

3 [ENTER]

As a check, the data sums up to 29135, 31895 and 120.

(You can see this by pressing [←] [STAT] [NXT] [TOT])

First of all, find the estimates for the coefficients.

Press [β]. The result is returned to the stack:

HOME		HALT	USER
4:			
3:	B0:	300.286256756	
2:	B1:	.741980827258	
1:	B2:	8.04356281947	
0		STAT	ANOV D-W PLOT EXIT

The interpretation of the results is: If both TIME and PPDI are fixed at zero value, the average value of PPCI is estimated at about \$300. As in most regression models, the technical interpretation of the intercept term should be taken with a grain of salt. The interpretation for the two other coefficients follows the same argument; Holding the other variable fixed, the net (or marginal) effect on the dependent variable is given by stack level 2 and 1.

Press [S(β)] to obtain the total variance and the standard errors:

	HALT	USER
C HOME >		
3:	Sd(B0):	78.3176256...
2:	Sd(B1):	4.75337448...
1:	Sd(B2):	
		2.98354565884
	S(S) ANOV D-W PLOT EXIT	

The t-values are obtained by dividing β_i by its standard error, giving:

$$t_{\beta_0} = 3.84$$

$$t_{\beta_1} = 15.61$$

$$t_{\beta_2} = 2.69$$

all of them significant at the 5 %-level of confidence. (See the chapter on probability distributions for how to do this.)

Next let's employ the ANOVA-technique. Press [ANOV] to get:

	HALT	USER
C HOME >		
4:	ESS(2):	828144.23
3:	RSS(12):	1977.10
2:	RSQ:	1.00
1:	F-stat:	2513.21
	STD FIX SCI ENG SYM BEEP	

Stack level 4 contains explained sums of squares with the associated # degrees of freedom.

Stack level 3 contains residual sums of squares with the associated # degrees of freedom.

Stack level 2 contains R^2 .

Stack level 1 contains the Fischer statistic for testing the hypothesis

$$H_0: \beta_0 = \beta_1 = \beta_2 = 0$$

vs

H_1 : all the coefficients are not simultaneously equal to zero

Given the magnitude of the F-statistic H_0 is rejected.

A few notes on the regression application

The regression application employs the ordinary least squares (OLS) method for calculating a regression problem. You should be aware of the "risks" involved when making least square calculations; Regression analysis rests on a few but important assumptions. Violating these, can result in erroneous estimates when applying OLS and therefore making the program useless. The program makes no tests to see if these assumptions holds (with the exception of the program

DW, used to detect autocorrelation). Please refer to a textbook on regression analysis to learn how to work around violation on these assumptions.

When running the program, you will notice that the HALT-annunciator is turned on. The program uses "local variables" (as defined in the User`s Manual). This is done to speed up calculations and to avoid the same calculations from being performed several times. Local variables takes up memory. Therefore, make sure you quit the application "properly" by pressing [EXIT] when finished. Pressing [KILL] or [CONT] will do just as well.

The Currency conversion (CURRX) application.

To calculate with different currencies you can use the currency conversion application. To start it press [CST] [BUS] [CURRX]. If the CST menu label [START] and/or 'CURRdir' message is displayed in the stack, you have deleted your 'CURRdir' directory. To create another you then press 902 [←] [MEMORY] [NXT] [ATTACH] [α] [α] INSTALL and press [ENTER].

When you then press [CURRX] again your display will look like this:

You are now in the CURRdir directory created by the application. This is the default place to do any currency calculations.

USER	
{ HOME CURRDIR }	
4:	
3:	
2:	
1:	
NEWR	NEWC
SETBA	

To change this setup please read the Owners manual of your HP 48SX to understand how to edit the CST menu, and how to purge and create directories. The CURR library is attached only to this directory to avoid any confusions of the customized currencies you enter. If the directory is purged you will have to attach library 902 to another directory to be able to use this application. (The INSTALL command automatically generates the CURRdir, detaches library 902 from the HOME directory and attaches it to this new directory.) All in all it is fast, easy and convenient to use the default setup. As a reminder the CURR library is only visible in the library menu from in the CURRdir directory.

When you enter CURRdir the first time it is invoked, the VAR menu contains only one variable; the CST. This is the defining list for the CuSTom menu which is selected by pressing the [CST] key. Once the custom menu is selected the [NEWR] [NEWC] [SETBA] menu labels described earlier show up.

The three menu keys do the following:

Label	What happens when pressed
[NEWR]	Starts prompting program for storing new currencies and/or new rates.
[NEWC]	Starts program to generate new CST menu after more currencies are added using NEWR program.
[SETBA]	Starts prompting program for selecting a new base currency.

The first thing to do is to decide which base currency to use. In the following you will decide to use United States Dollars (commonly denoted USD in most medias) as the base currency. You then press the [SETBA] menu label to start the SETBASE program. After a few moments you are prompted with a new display, and you are ready to key in USD :

When this is done you press [ENTER] to store the base currency and end the program.

```

                                PRG
{ HOME CURDIR }
Key in new base
then press [ENTER]:

:BASE:USD
NEWR|NEWC|SETBA|_|_|

```

Remember that you cannot start any currency name or base currency with a number. A character has to be first in the name you select. If not, the SETBase or NEWRate programs will halt with an error.

To store a new currency or to change an existing one you press the [NEWR] key. You are then ready to key in the name (short) of the currency, in this case NOK for Norwegian Kroner which rate is .1538.

USD or base units. *You always key in the rate of new currencies expressed in terms of the BASE currency. If you change the base currency remember to change all other currencies' rates accordingly.*

```

                                PRG
{ HOME CURDIR }
Key in new values,
then press [ENTER]:

:CURR:NOK
:RATE: .1538
NEWR|NEWC|SETBA|_|_|

```

The alpha input mode is automatically selected, and you can key in NOK immediately. Then you press [α] to deselect alpha-input mode, and you press [\downarrow] to move the cursor down to the RATE prompt. Then you key in .1538 and press [ENTER] to store the new rate. If you just want to change or update existing currencies you can invoke the

VAR menu by pressing [VAR] while in the prompt mode and then press the menu label of the currency you want to change. Then you press [α] to deselect alpha-input mode, and you press [↓] to move the cursor down to the RATE prompt and key in the new rate before pressing [ENTER] to store it and end the operation.

Example: On your business trip to Europe you spent 205 British Pounds (GBP, rate 1.83), 1760 Norwegian Kroner (NOK, rate .1538) and 7588 French Francs (FFR, rate .1845). How many British Pounds are 7588 French Francs, and how many U.S. Dollars did you use in total on the trip?

Since you already have selected the BASE currency and keyed in the norwegian crowns currency and the according dollar rate, you can start off with defining the British pounds currency and rate. You press [NEWB] and key in GBP, deselect alpha mode by pressing [α]. Then press [↓] to move the cursor down to the RATE prompt and key in the new rate 1.83 before pressing [ENTER] to store it. The whole operation is done again for FFR with the rate .1845.

You are ready to update the custom menu , and to do that you press the [NEWC] menu key to start the NEWCST program. When this is done you press [CST] to see the new custom menu:

As you can see the new labels BASE NOK and GBP are visible, and if you press [NXT] to turn to the next menu page FFR can be seen.

USER	
C HOME CURRDIR }	
4:	
3:	
2:	
1:	
NEWB NEWC SETR BASE NOK GBP	

You are now ready to key in the money spent; you press 205 and then [GBP], 1760 and then [NOK] and finally 7588 and [NXT] [FFR]. The display will look like this:

To convert French Francs to British Pounds you press [NXT] again to see menu page one and the conversion is done by pressing [←] [GBP] as the syntax is with all unit conversions.

USER	
C HOME CURRDIR }	
4:	
3:	205_GBP
2:	1760.00_NOK
1:	7588.00_FFR
FFR	

You will see: 765.02_GBP which is equivalent to 7588 French Francs.

Then you sum the three amounts by pressing [=] [=]. To calculate this amount in U.S. Dollars press [←] [BASE]:

If you are uncertain about what base currency is in use, press [VAR] and [BASE] to see 1_USD.

```
USER
{ HOME CURRDIR }
4:
3:
2:
1: 2053.74_BASE
NEWC NEWC SETER BASE NOK GBP
```

Remember to select the CST menu again to do more conversions. When you want to delete a currency press [←] [[]] then you can press [VAR] and the label(s) to delete before entering the list to the stack with [ENTER]. Then the labels are easily purged with [←] [PURGE]. If you want to update the custom menu after you have removed some currencies, you first purge the 'CST' variable in the VAR menu. Then you press [α] [α] NEWCST and [ENTER] to build a new custom menu based on the currency variables in the VAR menu.

NOTE: The NEWCst program assumes that *all variables* in the VAR menu in the CURRdir directory are currencies. For your own convenient use please keep only currency variables in the VAR menu and go to the HOME directory or another directory when not doing currency calculations.

Business Calculations (BUS)

The 48B includes four programs for calculating business percentage problems. These are:

- **Percent change:** The difference between two numbers expressed as a percentage of one of the numbers.
- **Percent of total:** The portion that one number is of another, expressed as a percent.
- **Markup as a percent of cost:** The difference between price and cost expressed as a percentage of cost.
- **Markup as a percent of price:** The difference between price and cost expressed as a percentage of price.

To start the programs, press **[CST]** **[START]** **[BUS]** and the appropriate key (**[%CHG]** , **[%TOTL]**, **[MU%C]** or **[MU%P]**)

Percent Change

The **[%CHG]** menu consists of three variables, **[OLD]**, **[NEW]** and **[%CHG]**. By entering values for two of the variables, you can calculate the third.

Example: The Hewlett Packard 32SII calculator is currently selling for \$ 70. To boost sales, it is put on a special offer of \$ 56.95. What is the percent change ?.

KEYS	DISPLAY	DESCRIPTION
[CST] [START] [BUS] [%CHG]		Selects the %CHG menu
70 [OLD]	OLD: 70.00	Stores 70 in OLD
56.95 [NEW]	NEW: 56.95	Stores 56.95 in NEW
[←] [%CHG]	1: %CHG -18.64	Calculates %CHG

Percent of Total

The [%TOTL] menu consists of three variables, [TOTAL], [PART] and [%T]. By entering values for two of the variables, you can calculate the third.

Example: Hotfingers Inc. is an equal opportunity employer. 47,8 % of the staff counting 19120 people, is female. How many female employees are there ?

KEYS	DISPLAY	DESCRIPTION
[CST] [START] [BUS] [%TOTL]		Selects the %TOTL menu
47,8 [%T]	%T: 47.80	Stores 47.8 in %T
19120 [TOTL]	TOTL: 19120.00	Stores 19120 in TOTL
[←] [PART]	1: PART: 9139.36	Calculates PART

Markup on Cost

The [MU%C] menu consists of three variables, [COST], [PRICE] and [MU%C]. By entering values for two of the variables, you can calculate the third.

Example: Peter is selling pens. On average he pays \$1.25 for the pens. He offers them to his customers for \$1.85. What is his markup on cost ?

KEYS	DISPLAY	DESCRIPTION
[CST] [START] [BUS] [MU%C]		Selects the MU%C menu
1.25 [COST]	COST 1.25	Stores 1.25 in COST
1.85 [PRICE]	PRICE 1.85	Stores 1.85 in PRICE
[←] [MU%C]	1: MU%C: 48.00	Calculates MU%C

Markup on Price

The [MU%P] menu consists of three variables, [COST], [PRICE] and [MU%P]. By entering values for two of the variables, you can calculate the third.

Example: Refer to the previous example. What is the markup on price? (This example assumes that no changes have been made since the last example)

KEYS	DISPLAY	DESCRIPTION
[CST] [START]		
[BUS] [MU%P]		Selects the MU%P menu
[←] [MU%P]	1: MU%C: 48.00	Calculates MU%C

The Depreciation (DEPRC) application

The depreciation application calculates values for depreciation and remaining depreciable balance for a given year. The methods available are:

- Declining balance (DB)
- Sum of the years digits (SOYD)
- Straight line (SL)
- Accelerated Cost Recovery System (ACRS)

To display the depreciation menu, press **[CST]** **[START]** **[FIN]** and **[DEPR]**

Key	What it does
[BASIS]	Stores ([→] recalls) the depreciable-cost basis of the asset at acquisition
[SALV]	Stores ([→] recalls) the salvage value at the end of its useful life. The default value is SALV=0
[LIFE]	Stores ([→] recalls) the expected useful life (in whole years) of the asset
[ACR%]	Stores ([→] recalls) the appropriate ACRS percentage from the published ACRS tables.
[ACRS]	Calculates the ACRS deduction based on BASIS and ACRS%
[←] [MORE]	Displays the values for BASIS, SALV, LIFE, ACR%, YR# and FAC%
[YR#]	Stores ([→] recalls) the number of the year for which the depreciation will be calculated
[FAC%]	Stores ([→] recalls) the declining-balance factor as a percentage of the straight line rate.
[DB]	Calculates the declining-balance depreciation for the year and RDV*
[SOYD]	Calculates the SOYD depreciation for the year and RDV*
[SL]	Calculates the straight-line depreciation for the year and the RDV

* *RDV denotes (Remaining Depreciable Value) = Basis - SALV - accumulated depreciation.*

Depreciation calculations (SL, DB and SOYD)

- 1) Select the DEPR menu by pressing [CST] [START] [FIN] and [DEPR]
- 2) Enter the cost basis and press [BASIS]
- 3) Enter the salvage value (if any) and press [SALV]
- 4) Enter the life of the asset and press [LIFE]
- 5) Press [MORE] to change menu page
- 6) Enter the year for which you want to calculate depreciation or
- 6) For the declining-balance method: Enter the DB factor (as a percentage of SL) and press [FACT]
- 7) Press [←] [DB], [←] [SOYD] or [←] [SL] to calculate the appropriate depreciation and RDV
- 8) For another year, enter the new year and press [YR#] and repeat (7)

Example: A precious add-in card for the Hewlett Packard 48 SX, purchased for £ 5 000, is to be depreciated over 10 years. Its salvage value is estimated at £1000. Calculate the depreciation for year 4 using 3 different methods. Use a DB factor of 200%.

KEYS	DISPLAY	DESCRIPTION
[CST] [START] [FIN] [DEPR]		Select DEPR menu
5000 [BASIS]	BASIS: 5000	Purchase price
1000 [SALV]	SALV: 1000	Salvage value
10 [LIFE]	LIFE: 10	Useful life
[MORE]		Change menu page
4 [YR#]	YR#: 4	Fourth year of depreciation
200 [FAC%]	FACT: 200	DB factor

Pressing [←] [MORE],
your display should look like:

```

BASIS :5000
SALV :1000
LIFE :10
ACRS% :0
YR# :4
FACT :200
BASIS|SALV|LIFE|ACR%|ACRS|MORE

```

[←] [DB]	2:RDV 1048.00	
	1:DB 512.00	DB-case
[←] [SOYD]	2:RDV: 1527.27	
	1:SOYD:509.10	SOYD-case
[←] [SL]	2:RDV: 2400.00	
	1:SL: 400.00	SL-case

Depreciation for the ACRS method

- 1) Select the DEPR menu by pressing [CST] [START] [FIN] and [DEPR]
- 2) Enter the cost basis and press [BASIS]
- 3) Consult a table published by the Internal Revenue Service that list the percentage of an assets basis that can be deducted each year of its prescribed life. Enter this vale and press [ACR%]
- 4) Press [←] [ACRS] to calculate the value of the deduction.

The Instalment Loan (INST) application

The [INST] application lets you calculate interest and remaining balance of a loan with fixed down payments.

To display the Instalment menu, press [CST] [START] [FIN] and [INST].

Your display should look like:

```

      USER
{ HOME }
4:
3:
2:
1:
[BASE] [I%] [INST] [PER#] [PMT] [VIEW]
  
```

Key	What it does
[BASE]	Stores ([→] recalls) the original loan amount
[I%]	Stores ([→] recalls) the periodic interest rate
[INST]	Stores ([→] recalls) the fixed instalment. This is usually a fraction of the original loan
[PER#]	Stores ([→] recalls) the period for which calculations are made
[←] [PMT]	Calculates the payment (interest + instalment) and remaining balance
[VIEW]	Displays the values for BASE, I%, INST and PER#

Loan calculations

To calculate a loan with fixed instalments:

- 1) To display the [INST] menu, press [CST] [START] [FIN] and [INST]
- 2) Enter the value of the loan and press [BASE]
- 3) Enter the periodic interest rate and press [I%]
- 4) Enter the instalment and press [INST]
- 5) Enter the period (1,2,, N) and press [PER#]
- 6) To calculate the payment (interest+instalment) and remaining balance for a given period, press [←] [PMT]

Example: A mortgage. You have just borrowed \$100 000 for a house purchase. The loan is to be paid back with semi-annual instalments over a period of 20 years. The interest rate is 8% p.a. Calculate the payments for period 1 and 10.

KEYS	DISPLAY	DESCRIPTION
[CST] [START] [FIN] [INST]		Select INST menu
100000 [BASE]	BASE: 100000	Loan amount
8 [ENTER] 2 [/] [%]	I%: 4.00	Semi-annual interest
100000 [ENTER] 40 [/] [INST]	INST: 2500	Fixed instalment
1 [PER#]	PER#: 1.00	The first period
[←] [PMT]	2: PMT: -6500 1:Balance 97500	
10 [PER#]	PER#: 10.00	The 10 period (year 5)
[←] [PMT]	2: PMT:-5600 1:Balance: 75000	

The Time (TIME) application

The time menu is selected by pressing [CST] [START] [TIME]. There are four menu keys:

Label	What happens when pressed
[CALC]	Selects calc menu for calculating with date arithmetics, day of week and timer functions.
[APPT]	Selects the Alarm menu of the HP 48SX (an equivalent to [←] [TIME] [ALRM]). See chapter 24 of the HP 48SX Owners manual for information on usage.
[ADJUST]	Selects the time adjustment menu of the HP 48SX (an equivalent to [←] [TIME] [ADJUST]). See chapter 24 of the HP 48SX Owners manual for information on usage.
[SET]	Selects the time set menu of the HP 48SX (an equivalent to [←] [TIME] [SET]). See chapter 24 of the HP 48SX Owners manual for information on usage.

The Time Calc menu contains 8 menu keys:

Label	What happens when pressed
[DDAYS]	Calculates real days between dates in level 1 and 2.
[D360]	Calculates days between dates in level 1 and 2 based on a 360-day year.
[D365]	Calculates days between dates in level 1 and 2 based on a 365-day year (not counting leap years).
[DATE+]	Adds number of days in level 1 to date in level 2.
[TODAY]	Recalls today's date.
[TSTRT]	Stores the time at the moment it is pressed/executed.
[TSTOP]	Stores the time at the moment it is pressed and calculates the difference in time since [TSTRT] was pressed/executed last.
[DOW]	Calculates the Day Of Week from date in level 1.

Example 1: What number of days passed between January 1st 1974 and May 2nd 1988?

Key in 1.011974 and press [ENTER], then you key in * 5.021988 and press [DDAYS] to calculate the number of days between the dates in level 1 and level 2.

USER	
{ HOME }	
4:	
3:	
2:	
1:	5,235.00
[DATE1][DATE2][DATE+][DDAYS][TODAY][MORE]	

Example 2: What date is 245 days after September 14th 1991?

Key in 9.141991 and press [ENTER], then you key in 245 and press [DATE+] to calculate the date when level 1 days added to the date in level 2.

USER	
{ HOME }	
4:	
3:	
2:	5,235.00
1:	5.161992: SAT
[DATE1][DATE2][DATE+][DDAYS][TODAY][MORE]	

Example 3: What day of week was September 14th 1991?

Key in 9.141991 and press [MORE] [DOW].

USER	
{ HOME }	
4:	
3:	5,235.00
2:	5.161992: SAT
1:	9.141991: SAT
[TSTART][TSTOP][DOW][][][MORE]	

Example 4: To time any interval in seconds press [TSTART] or include this function in a program. A variable, [tim\$], will be generated holding this time. When for instance after 10 seconds [TSTOP] is executed, the time at this moment will be calculated and subtracted from [tim\$], thus giving the time passed in seconds.

Press [TSTART], wait for about 10 seconds, then press [TSTOP].

USER	
{ HOME }	
4:	5,235.00
3:	5.161992: SAT
2:	9.141991: SAT
1:	10.13_s
[TSTART][TSTOP][DOW][][][MORE]	

* Remember to select date convention from the [←] [TIME] [SET] menu. In this example we have used MM.DDYYYY.

The Print (PRINT) application

The 48 Business Pac[©] also contains a print menu. It is selected by pressing [CST] [START] [MORE] [PRINT]. The menu labels in this menu is as follows;

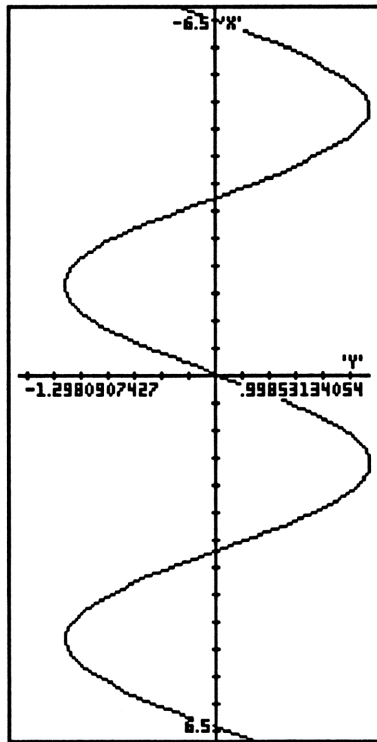
Press	What it does
[PR1]	Sends stack level 1 contents to printer port.
[PRLCD]	Sends LCD contents to printer port.
[PRST]	Sends all stack levels contents to printer port.
[PRVAR]	Sends contents of variables in list to printer port.
[CR←]	Sends a Carriage Return (new line) to printer port.
[PICTURE]	The [VPLOT] application.

The [VPLOT] application:

This function plots a function plot with a 90 degree rotation, so that it can be printed on the infrared printer as a bigger plot than usual. Not all types of functions can be printed correctly, due to the complex procedure to rotate every pixel using a parametric plot to turn the coordinates. Up to 5 simultaneous functions can be plotted. If in doubt whether your plot can be rotated or not, try it out!

Example: A Sine curve. Try plotting a sine curve and rotate it. First you key in [←] [RAD] ['] [SIN] [α] [X] [ENTER] [←] [PLOT] [STEQ] [PLOT] [AUTO].

After some time the plotting stops, and you can press [ATTN] to restore the normal display. Then you start the application by pressing [CST] [START] [MORE] [PRINT]. Press the rightmost menu key with the paper turn picture. After some time the plotting stops and the plot can be inspected after pressing [←] [GRAPH] and by pressing the arrow keys. When done press [ATTN] to restore the normal display. A graphical object is now present on the stack. You can store it as a variable in the VAR menu, but since it takes up a lot of space (4566 bytes of your precious 32768) this is not recommended! It is better to print it at once using the [PR1] key. Try it out to see the following:



This concludes the print menu.

Appendix A

Equations used by the 48B

Business calculations

$$\%chg = \frac{(new - old)}{old} \times 100$$

$$\%totl = \frac{part}{total} \times 100$$

$$mu\%c = \frac{(price - cost)}{cost} \times 100$$

$$mu\%p = \frac{(price - cost)}{price} \times 100$$

Financial equations

In the following

$$i = \frac{I\%YR}{100 \times per}$$

Time Value of Money

$$PV + (1 + i \times s) \times PMT \times \left(\frac{1 - (1 + i)^{-n}}{i} \right) + FV \times (1 + i) = 0$$

Where $s = 1$ if Begin Mode
 $s = 0$ if End Mode

Amortization

$$i = \frac{I\%}{\#PER/YR}$$

n = number of periods

PV_i = Balance after period i

INT_i = Interest in period i

PRN_i = Principal in period $i = PMT - INT_i$

$INT_1 = 0$ if Beg mode else $|PV_0 \cdot i\%/100| \cdot \text{SIGN}(PMT)$

$INT_i = |PV_{i-1} \cdot i\%/100| \cdot \text{SIGN}(PMT)$

$$PV_i = PV_0 + \sum PRN_i$$

Cash flow calculations

Net Present Value

$$NPV = \sum_{k=0}^n \frac{CF_k}{(1 + i)^k}$$

Internal Rate of Return (IRR)

The internal rate of return, is the solution $i^* = \text{IRR}$ to the equation:

$$0 = \sum_{k=0}^n \frac{CF_k}{(1+i)^k}$$

Depreciation

In the following:

$$\text{RDV}_i =$$

$$\text{Remaining depreciable value} = \text{BASIS} - \text{SALV} - \sum_{k < i} \text{DEPR}_k$$

$$\text{yr\#} = 1, 2, \dots, \text{LIFE}$$

Straight line

$$SL_{\text{yr\#}} = \frac{\text{BASIS} - \text{SALV}}{\text{LIFE}}$$

Sum of the Years Digits (SOYD)

$$SOYD_{\text{yr\#}} = \frac{\text{BASIS} - \text{SALV}}{\frac{(\text{INT}(\text{yr\#}) + 1)(\text{INT}(\text{yr\#}) + 2 \times \text{FP}(\text{yr\#}))}{2}} \times (\text{LIFE} - \text{yr\#} + 1)$$

Declining Balance (DB)

$$DB_{yr\#} = RDV_{yr\#-1} \times \frac{FACT\%}{100 \times LIFE}$$

Interest Rate Conversion

Periodic Compounding

$$EFF\% = \left(\left(1 + \frac{NOM\%}{100 \times per} \right)^{per} - 1 \right) \times 100$$

Continuous Copmpounding

$$EFF\% = (e^{\frac{nom\%}{100}} - 1) \times 100$$

Bond calculations

A = Number of accrued days

E = Number of days in Coupon period

M = Number of periods per year

$\# days = ddays(SETT, MAT)$

N = Number of periods = $CEIL\left(\frac{\# days}{M}\right)$

For less than one period to redemption

$$PRICE = \frac{CALL + \frac{CPN\%}{M}}{1 + \frac{YLD\%}{100M} \times \frac{E-A}{E}} - \frac{A}{E} \times \frac{CPN\%}{M}$$

For one or more periods to redemption

$$PRICE = \frac{CALL}{\left(1 + \frac{YLD\%}{100M}\right)^{N-1 + \frac{E-A}{E}}} + \sum_{K=0}^{N-1} \frac{\frac{CPN\%}{M}}{\left(1 + \frac{YLD\%}{100M}\right)^{K + \frac{E-A}{E}}} - \frac{A}{E} \times \frac{CPN\%}{M}$$

Option Valuation

Value of a call option:

P_m = market price of underlying stock

P_s = striking price of the call option

r = riskless rate of t duration

t = time until expiration in fraction of year

σ = Standard deviation of holding period returns

$N(d)$ = Normal cumulative density function

R_c = predicted premium on the call

R_p = predicted premium on the put

$$R_c = P_m \times N(d_1) - \frac{P_s}{\exp(rt)} N(d_2)$$

$$R_p = R_c + 100[P_s \exp(-r \times t) - P_m]$$

where

$$d_1 = \frac{\ln\left(\frac{P_m}{P_s}\right) + \left(r + \frac{1}{2} \sigma^2\right) \times t}{\sigma\sqrt{t}}$$

$$d_1 = \frac{\ln\left(\frac{P_m}{P_s}\right) + \left(r - \frac{1}{2} \sigma^2\right) \times t}{\sigma\sqrt{t}}$$

Instalment loan

BASE = loan amount

I% = periodic interest rate

INST = instalment

PER# = A given period

PMT = instalment + interest for a given period

$$PMT = INST + \frac{I\%}{100} \times (BASE - (PER\# - 1) \times INST)$$

$$BALANCE = BASE - PER\# \times INST$$

Multiple regression analysis

X is the design matrix

Y is a vector containing the dependent observations

$$\beta = (X'X)^{-1}X'Y$$

$$\text{COV}(\beta) = \sigma^2(X'X)^{-1}$$

$$R^2 = \frac{\beta'X'Y - N\bar{Y}^2}{Y'Y - N\bar{Y}^2}$$

$$F - \text{statistic} = \frac{R^2}{1 - R^2} \frac{N - k}{k - 1}$$

$$\text{Durbin} - \text{Watson statistic} = \frac{\sum_{i=2}^n (u_i - u_{i-1})^2}{\sum u_i^2}$$

Date arithmetic

The Gregorian Calendar

$$\text{DDAYS} = f(dt_2) - f(dt_1)$$

where

$$f(dt_i) = 365 (\text{yyyy}) + 31(\text{mm}-1) + \text{dd} + \text{INT}(z/4) - x$$

for $\text{mm} < 2$

$$x = 0$$

$$z = \text{yyyy} - 1$$

for $\text{mm} > 2$

$$x = \text{INT}(0.4 \text{ mm} + 2.3)$$

$$z = (\text{yyyy})$$

The 360-days calendar

$$D360 = f(dt_2) - f(dt_1)$$

$$f(dt_i) = 360(yyyy) + 30(mm) + z$$

For $f(dt_1)$:

$$\text{If } dd_1 = 31 \quad z = 30$$

$$\text{If } dd_1 < 31 \quad z = dd_1$$

For $f(dt_2)$:

$$\text{If } dd_2 = 31 \text{ and } dd_1 = 30 \text{ or } 31 \quad z = 30$$

$$\text{If } dd_2 = 31 \text{ and } dd_1 < 30 \quad z = dd_2$$

$$\text{If } dd_2 < 31 \quad z = dd_2$$

The 365-days calendar

$$DDAYS = f(dt_2) - f(dt_1)$$

where

$$f(dt_i) = 365(yyyy) + DDAYS(mm_2dd_2, mm_1dd_1)$$

where DDAYS ignores february 29.

Appendix B

Variable management on the 48B.

The 48B uses a special technique to manage user defined variables. Instead of creating variables in every application, it uses an array to keep track of the application variables. The variables are stored in an array named 'BΣ'. This variable name should be considered "reserved" when the 48B-card is installed. The array consists of 41 entries, using 347 bytes of user memory when present.

The table below gives the entry number and the name of the variable it holds a value for.

ENTRY #	NAME	ENTRY #	NAME
1	NEW-%CHG	22	CPN%-BONDS
2	OLD-%CHG	23	CALL-BONDS
3	%CHG-%CHG	24	YLD%-BONDS
4	PART-%TOTAL	25	PRICE-BONDS
5	TOTAL-%TOTAL	26	N-TVM
6	%T-%TOTAL	27	I%YR-TVM
7	PRICE-MU%C	28	PV-TVM
8	COST-MU%C	29	PMT-TVM
9	MU%C-MU%C	30	FV-TVM
10	MU%P-MU%P	31	#PER-TVM
11	BASIS-DEPR	32	BASE-INST
12	SALV-DEPR	33	I%-INST
13	LIFE-DEPR	34	INST-INST
14	ACR%-DEPR	35	PER-INST
15	YR#-DEPR	36	not used
16	FAC%-DEPR	37	PRICE-OPTION
17	NOM%-IRR	38	STRIKE-OPTION
18	EFF%-IRR	39	YLD%-OPTION
19	N-IRR	40	TIME-OPTION
20	SETT-BONDS	41	STDEV-OPTION
21	MAT-BONDS		

Registration

To registrate as a user ensures you product update information. A new product; The 48 Business Pac II[®] is already planned and is crammed with new applications and smart solutions. To get the latest information and a rebate on future application cards please fill in and post the Registration Card below.

-----✂-----

48 Business Pac[®]

Place
stamp
here

Name:-----

Occupation:-----

Adress:-----

City:-----

Zip:-----

Country:-----

Datalog A/S,

Hvamsvingen 24,

N-2013 Skjetten,

Norway.

Print Errata:

- Page 1) The page references in the list of contents is to be reduced by 1.
- Page 9) The page reference in the footnote should read 6 instead of 4.
- Page 11) Prompts for period from and period to (Two Numbers)to amortize, and show in MatrixWriter,
- Page 14) The text accompanying the third display should read 5 [ENTER] 12 [x] [N] [←] [FV], and the FV solution in the display should read FV:-77489,14.
- Page 18) Line two should read:" the new balance in PV..."
- Page 20) At the bottom of the page in the Clearing the TVM variables it is stated that pressing [CLEAR] from page 2 of the TVM-menu can be used to clear program generated TVM-variables. As this only applies to the TVM-variables in the 'BΣ' variable, method 2 has to be used.
- Page 22) At the bottom of the page; #3) should follow #2).
- Page 24) The table entry [NEW] Stores new cash flows on the stack in VAR menu variable CFLW. *The stack must contain Cash Flows only!*
- Page 28) The second sentence should read: Then you press [CALC] and [ENTER] to calculate IRR.
- Page 29) The example flows below the table at the top of the page should read[SPC] [α] [α] [NDUP] for all occurrences of [α] [α] [DUPN]. The 11th line from the bottom should read: " The net present value and not the internal rate of return should be used to calculate an answer.
- Page 31) In the table the arrow before [MORE] should be left-shifted (yellow-shifted) instead of right-shifted.
- Page 33) As above stated for the arrow on page 31 the same applies to the arrow before [ACCRU].

- Page 34) In line four [MAT] has to be pressed after keying in 10.051993 to store the maturity date. In line 5 the display will read CPN%: 0.00. The yield calculated in line 9 should read 1: YLD%: 7.68. Line 9 from the bottom should look like: CPN%: 10.00
- Page 41) The array dimension in line four from the bottom should read [Nx1].
- Page 43) [STDE] should read [SDEV].
- Page 45 to 48: All occurrences related to distribution tables should read $P[X \leq x]$ and not just $P[X < x]$.
- Page 50) [PLOT] plots a column in Σ DAT vs another column in Σ DAT. In the formula at the bottom of the page b_i should read β_i .
- Page 52) The text to the left of the display should read "Your display should now look like this:".
- Page 53) The PPDI value for time period 10 should be 2237.
- Page 54) Line 4 should read: [\leftarrow] [] 15 [SPC] 3 [ENTER]
1: {15 3} and line 8; [\leftarrow] [STAT] [STO Σ]. The rest of the displays are shown in STD mode selected from the MODES menu.
- Page 57) Line 2 should read: "To start it press [CST]
[START] [BUS] [CURRX].
- Page 58) The display prompt at the bottom should read NOK instead of NKR.
- Page 59) Line 11; Norwegian crowns should read Norwegian kroner.
- Page 62: All references to [TOTL] in line 11 should read [TOTA]; references to [MU% C] should read [M% C].
- Ch. 9) All references named [DEPR]; read [DEPRC].
- Page 63) All references to MU% C in the example should read MU% P and the answer in the display should read
1: MU% P : 32.43
- Page 71) In the middle of the page: Up to 3 simultaneous functions, (the plot type must be set to function), can be plotted.

- Introduction
- Time Value of Money
- Interest Conversions
- Cash Flow Calculations
- Bond Calculations
- Option Valuation
- Probability Distributions
- Multiple Regression analysis
- Currency Conversion
- Business Calculations
- Depreciation
- Instalment Loan
- Date Arithmetics
- Printing Utilities

Tel: +47 66 84 55 60
Fax: +47 66 84 55 63

The HP 48B Business Pac[©] for the
is introduced by DataLog A/S,