Honeywell Bull

TIME-SHARING APPLICATIONS LIBRARY GUIDE VOLUME IV — BUSINESS & FINANCE

SERIES 600/6000

APPLICATIONS

DA 46, Rev .1

Ref. : 19.53.111 A

Honeywell Bull

TIME-SHARING APPLICATIONS LIBRARY GUIDE VOLUME IV – BUSINESS & FINANCE

SERIES 600/6000

SUBJECT:

Descriptions of Business and Finance Time-Sharing Programs.

SPECIAL INSTRUCTIONS:

This manual, Order Number DA46, Revision 1, supersedes the previous edition, Revision 0, dated December 1972. Change bars in the margins indicate technical changes and additions to this edition.

This is the fourth volume to the Time-Sharing Applications Library Guide. The three related manuals include Series 600/6000 Time-Sharing Applications Library Guide, Volume I - Mathematics (Order No. DA43), Volume II-Statistics (Order No. DA44), and Volume III-Industry (Order No. DA45). A complete printing of the programs in the library is available by listing the library program, CATALOG. A copy of this listing follows the Contents.

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PREFACE

This manual describes and discusses the usage of the business and finance time sharing programs available with Series 600 and 6000 information processing systems. The programs are listed alphabetically in the Contents.

Each program description includes the purpose of the program; language in which it is written; method of approach, if applicable; instructions for use; and sample problems and solutions. In the sample solutions, all information typed by the user is underlined. However, in some programs, instead of the user typing in data, a sample driver program is coded to solve the particular problem. These programs solved by driver programs show *LIST or *RUN at the head of the printout.

The instructions provided assume that the programs are available in the user master catalog, LIBRARY, and accessible with read or execute permission. In the sample solution printouts, the programs have already been accessed using the GET command, and/or copied onto the current file using the OLD or LIB command.

A complete printing of the programs in the library is available by listing the library program, CATALOG. A copy of this listing follows the Contents.

Other Series 600/6000 Time-Sharing Library programs are described in the following documents:

Series 600/6000 Time-Sharing Applications Library Guide

Volume I - Mathematics, Order Number DA43
Volume II - Statistics, Order Number DA44
Volume III - Industry, Order Number DA45

This document describes programs that originated from a variety of sources, such as users and the Honeywell field organization. The programs are made available in the general form and degree of completeness in which they were received. Honeywell Information Systems Inc., therefore, neither guarantees the accuracy of the programs nor assumes support responsibility.

File No. 16R3, 17R3

DA46

The programs listed below have been incorporated in this edition. In addition to MGSIM (MGSIM-IN), which was revised, the following new programs have been added.

ACCRUIT
BALANCE
INTRSTZ
NOM-EFF
RISKIT
SIMFUND
VALSTK

Series 600/6000 Time-Sharing Applications Library programs are also available to users of the DATANETWORK service. Please contact your local Honeywell representative for further details.

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CATALØG ØF SERIES 6000/600 T-S LIBRARY PRØGRAMS

FILE TYPE INDICATØR:

LANGUAGE (FIRST LETTER)		MØDE (FØLLØWING LETTERS)	
A	ALGØL	P	(ØR BLANK) PRØGRAM
B	BASIC	S	SUBRØUTINE(S)
C	CARDIN	F	FUNCTIØN(S)
D	DATABASIC	P-S	PRØGRAM WITH EXTRACTABLE SUBRØUTINE(S)
E	TEXT EDITØR	R	RELØCATABLE ØBJECT (C*)
F	FØRTRAN	H	SYSTEM LØADABLE ØBJECT (H*)
G	GMAP	L	USER'S RANDØM LIBRARY

ALL FILES ARE SØURCE MØDE UNLESS ØTHERWISE INDICATED.

SUBJECTS	DØCUMENTATIØN MANUAL
MATHEMATICS (MA)	ØRDER # DA43
INTEGRATIØN	
DIFFERENTIATIØN, DIFFERENTIAL EQ.	
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PØLYNØMIALS	
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GEØMETRIC AND PLØTTING (GP)	
EDUCATIØN AND TUTØRIAL (ED)	
DEMØNSTRATIØN (DE)	
UTILITY AND MISCELLANEØUS (UM)	
BUSINESS AND FINANCE (BF)	ØRDER # DA46

THE DØCUMENTATIØN FØR THESE PRØGRAMS IS AVAILABLE IN FØUR MANUALS:
SEE ØRDER # DA43 FØR PRØGRAMS IN MATHEMATICS
ØRDER # DA44 FØR PRØGRAMS IN STATISTICS
ØRDER # DA46 FØR PRØGRAMS IN BUSINESS AND FINANCE
ØRDER # DA45 FØR PRØGRAMS IN ALL ØTHER CATEGØRIES.

SUBRØUTINES THAT ARE CALLED BY A PRØGRAM AND MUST BE EXECUTED WITH IT ARE LISTED IN BRACKETS AT THE END ØF THE DESCRIPTIØN.

THESE PRØGRAMS HAVE ALL BEEN REVIEWED AND TESTED BUT NØ RESPØNSIBILITY CAN BE ASSUMED.

**********MA--MATHEMATICS**********

INTEGRATI0N

CLCINT	FF	INTEGRATI0N BY SIMPS0N'S RULE
FINT	FF	EVALUATE F0URIER INTEGRALS BY FIL0N'S F0RMULA
GAHER	FF	GAUSS-HERMITE QUADRATURE
GALA	FF	GAUSS-LAGUERRE QUADRATURE
GAUSSN	FF	EVALUATE DEFINITE D0UBLE 0R TRIPLE INTEGRALS
GAUSS0	FF	GAUSSIAN QUADRATURE
NC0ATES	FP-S	NEWT0N-C0ATES QUADRATURE
NUMINT	B	GAUSSIAN QUADRATURE
R0MBINT	FP-S	R0MBERG INTEGRATI0N
SPLINE	B	INTEGRATE TABULATED FUNCTI0N BY SPLINE FITS

DIFFERENTIATI0N, DIFFERENTIAL EQ.

AMPBX	FS	ADAMS-M0ULT0N F0R 1ST-0RDER DIFF. EQNS [RKPBX]
FDRVUL	FF	DIFFERENTIATE TABULATED FUNCTI0N, UNEQUAL SPACING
HDRVEB	FF	DIFFERENTIATE TABULATED FUNCTI0N, EQUAL SPACING
RKPBX	FS	RUNGE-KUTTA F0R 1ST-0RDER DIFF. EQNS

***INTERP0LATI0N*

		**
SPLINT	B	SPLINE INTERP0LATI0N
TNT1	FF	SINGLE LAGRANGIAN INTERP0LATI0N [TLU1]
TNT2	FF	D0UBLE LAGRANGIAN INTERP0LATI0N [TLU1]
TNT2A	FF	VARIABLE D0UBLE LINEAR INTERP0LATI0N [TLU1]

P0LYN0MIALS

BIC0F	FS	CALCULATE BIN0MIAL C0EFFICIENTS
CLPLY	FF	EVALUATE REAL P0LY AT REAL ARGUMENT
CP0LY	FS	FINDS ZER0ES 0F A C0MPLEX P0LYN0MIAL
CP0LY-DR	FP	FINDS ZER0ES 0F A C0MPLEX P0LYN0MIAL [CP0LY]
DVALG	FS	P0LYN0MIAL DIVISI0N
EUALG	FS	G.C.D. 0F TW0 P0LYN0MIALS [DVALG]
MTALG	FS	MULTIPLY P0LYN0MIALS
PLMLT	FS	REAL P0LY C0EFFICIENTS REC0NSTRUCTED FR0M REAL R00TS
P0LRTS	FP	S0LUTI0N 0F P0LY BY BAIRST0WS METH0D
P0LYC	FS	REAL P0LY C0EFFICIENTS REC0NSTRUCTED FR0M C0MPLEX R00TS
P0LYV	FS	EVALUATE REAL P0LY AT C0MPLEX ARGUMENT
QUADEQ	B	S0LUTI0N T0 QUADRATIC EQUATI0NS
R00TER	B	S0LUTI0N 0F P0LY BY BAIRST0WS METH0D
ZC0P	FP	R00TS 0F P0LYN0MIAL WITH C0MPLEX C0EFF.
ZC0P2	FS	R00TS 0F P0LYN0MIAL WITH C0MPLEX C0EF. [ZC0P2]
Z0RP	FP	R00TS 0F REAL P0LY
Z0RP2	FS	R00TS 0F REAL P0LY

LINEAR EQUATI0NS

GJSIMEQ	FS	S0LVE LINEAR SYSTEMS BY GAUSS-J0RDAN
GSEIDEL	FP-S	S0LVE LINEAR SYSTEMS BY GAUSS-SEIDEL
LINEQ	FS	S0LVE LINEAR SYSTEMS BY GAUSSIAN ELIMINATI0N
LINSR	FP	S0LVE LINEAR SYSTEMS BY GAUSSIAN ELIMINATI0N [LINEQ]
SIMEQN	B	S0LVE LINEAR SYSTEMS BY MATRIX INVERSI0N

MATRICES

DETE	FF	EVALUATE DETERMINANT 0F REAL MATRIX
D0MEIG	FP-S	D0MINANT EIGENVALUES 0F REAL MATRIX
EIG1	FS	EIGENVALUES 0F SYM MATRIX BY JAC0BI METH0D
EIGNHC	FS	EIGENVALUES & VECT0RS 0F C0MPLEX N0N-HERMITIAN MATRICES
EIGNSR	FS	EIGENVALUES & VECT0RS 0F REAL N0N-SYMMETRIC MATRICES
EIGSR	FP	EIGENVALUES AND VECT0RS 0F REAL SYM. MATRIX [EIG1]
LINSD	FS	S0LVE LIN. SYS. W/ SYMMETRIC D0UBLE PREC. C0EF. MATRIX
LINSS	FS	S0LVE LIN. SYS. W/ SYMMETRIC SINGLE PREC. C0EF. MATRIX
MTINV	FS	MATRIX INVERSI0N BY PIV0TS
MTMPY	FS	MATRIX MULTIPLICATI0N
MTRAN	FS	TRANSP0SE A MATRIX
SPEIG1	FS	SPECIAL EIGEN PR0BLEMS [EIG1]
SYMEIG	FP	EIGENVALUES 0F SYM MATRIX BY JAC0BI METH0D

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***NØN-LINEAR EQUATIØNS***
BRØWN      FS     SØLN ØF SIMULTANEØUS SYSTEMS BY BRØWN METHØD
SECANT     FS     SØLN ØF SIMULTANEØUS SYSTEMS BY SECANT METHØD [MTINV]
SØLN       FF     ZERØ ØF AN ARBITRARY FUNCTIØN
ZERØES     B      ZERØ,MAX,MIN ØF FUNCTIØN

***SPECIAL FUNCTIØN EVALUATIØN*
                                **
ARCTAN     FF     ARCTANGENT IN RADIANS ØF Y/X
BESL       FS     BESSEL FUNCTIØN [GAMF]
CØMP1      FF     EVALUATES REAL HYPERBØLIC TRIG FUNCTIØNS
CØMP2      FS     CØMPLEX MULT. AND DIVISIØN
CØMP3      FS     EVALUATES VARIØUS FUNCTIØNS FØR CØMPLEX ARGUMENT [CØMP2]
ERRF       FF     ERRØR FUNCTIØN
ERRINV     FF     INVERSE ERRØR FUNCTIØN
FRESNL     FS     EVALUATES FRESNAL INTEGRALS
GAMF       FF     GAMMA FUNCTIØN
JACELF     FS     EVALUATES JACØBIAN ELLIPTIC FUNCTIØNS SN, CN, DN
ØRTHP      FF     EVALUATE ØRTHØGØNAL PØLYNØMIALS
STIRLING   FP-S   N FACTØRIAL BY STIRLINGS APPRØXIMATIØN
TMFCEV     B      EVALUATE DAMPED ØR UNDAMPED FØURIER SERIES

***LØGIC AND NUMBER THEØRY*
                             **

4SQRS      B      WRITES INTEGERS AS SUM ØF SQUARES ØF FØUR INTEGERS
BASE       FP     CØNVERTS NUMBERS FRØM ØNE BASE TØ ANØTHER
CØNCLUDE   B      DETERMINES LØGICAL CØNCLUSIØNS FRØM PRØPØSITIØNAL LØGIC
GCDN       FS     G.C.D. ØF N INTEGERS

**********************ST--STATISTICS****************************************

***CURVE FITTING AND REGRESSIØN***
CFIT       FP     LEAST SQRS. PØLY. WITH RESTRAINTS
CURFIT     B      FITS SIX DIFFERENT CURVES BY LEAST SQRS
FØRIR      FP     LEAST SQUARES ESTIMATE ØF FINITE FØURIER SERIES MØDEL
FØURIER    B      CØEFF ØF FØURIER SERIES TØ APPRØX A FUNCTIØN
LINEFIT    FS     LEAST SQRS LINE
LINREG     B      LST.SQRS. BY LINEAR, EXPØNENTIAL, ØR PØWER FUNCTIØN
LSPCFP     FP     LEAST SQRS PØLYNØMIAL FIT
LSQMM      FS     GENERALIZED PØLY FIT BY LEAST SQRS ØR MIN-MAX
MREGI      FP     MULTIPLE LINEAR REGRESSIØN
MULFIT     B      MULTIPLE LINEAR FIT WITH TRANSFØRMATIØNS
ØRPØL      FP     LEAST SQRS FIT WITH ØRTHØGØNAL PØLYS
PØLFIT     B      LEAST SQRS PØLYNØMIAL FIT
PØLFT      FP     LEAST SQRS PØLYNØMIAL FIT
SMLRP      FP     MULTIPLE LINEAR REGRESSIØN
STAT20     B      EFFRØYMSØN'S MULTIPLE LINEAR REGRESSIØN ALGØRITHM
STAT21     B      CØMPUTES MULTIPLE LINEAR REGRESSIØNS

***ANALYSIS ØF VARIANCE***
ANØVA      FP     ØNE ØR TWØ WAY ANALYSIS ØF VARIANCE
ANVA1      FP     ØNEWAY ANALYSIS ØF VARIANCE
ANVA3      FP     THREE WAY ANALYSIS ØF VARIANCE
ANVA5      FP     MULTIPLE VARIANCE ANALYSIS
KRUWAL     FP     KRUSKAL-WALLIS 2-WAY VARIANCE [XINGAM]
ØNEWAY     B      ØNEWAY ANALYSIS ØF VARIANCE
STAT13     B      ANALYSIS ØF VARIANCE TABLE, 1-WAY RANDØM DESIGN
STAT14     B      ANALYSIS ØF VARIANCE TABLE FØR RANDØMIZED BLØCK DESIGN
STAT15     B      ANALYSIS ØF VARIANCE TABLE FØR SIMPLE LATIN-SQ DESIGN
STAT16     B      ANALYSIS ØF VARIANCE TABLE, GRAECØ-LATIN SQUARE DESIGN
STAT17     B      ANØVA TABLE ØF BALANCED INCØMPLETE BLØCK DESIGN
STAT18     B      ANALYSIS ØF VARIANCE TABLE, YØUDEN SQUARE DESIGN
STAT33     B      ANALYSIS ØF VARIANCE TABLE, 1-WAY RANDØM DESIGN
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***PRØBABILITY DISTRIBUTIØNS***
ANPF        FF     NØRMAL PRØBABILITY FUNCTIØN (ERRF)
BETA        FF     BETA DISTRIBUTIØN
BINDIS      B      BINØMIAL PRØBABILITIES
EXPLIM      B      EXPØNENTIAL DISTRIBUTIØNS
PØISØN      FF     PØISSØN DISTRIBUTIØN FUNCTIØN
PRØBC       FP     PRØBABLITIES ØF CØMBINATIØNS ØF RANDØM VARIABLES
PRØVAR      B      NØRMAL AND T-DISTRIBUTIØN
TDIST       FF     T-DISTRIBUTIØN (BETA)
XINGAM      FF     INCØMPLETE GAMA FUNCTIØN

***CØNFIDENCE LIMITS***

BAYES       B      DIFFERENCE ØF MEANS IN NØN-EQUAL VARIANCE
BICØNF      B      CØNF. LIMITS FØR PØPULATIØN PRØPØRTIØN (BINØMIAL)
BINØM       FP     BINØMIAL PRØBABILITIES AND CØNFIDENCE BANDS
CØLINR      B      CØNFIDENCE LIMITS ØN LINEAR REGRESSIØNS
CØNBIN      B      CØNF. LIMITS FØR PØPULATIØN PRØPØRTIØN (NØRMAL)
CØNDIF      B      DIFFERENCE ØF MEANS IN EQUAL VARIANCE
CØNLIM      B      CØNF. LIMITS FØR A SAMPLE MEAN
STAT05      B      CØNFIDENCE INTERVAL FØR MEAN BY SIGN TEST
STAT06      B      CØNFIDENCE LIMITS, WILCØXØN SIGNED RANK SUM TEST

***HYPØTHESIS TESTING*
                        **

BITEST      B      TEST ØF BINØMIAL PRØPØRTIØNS
CHISQR      FS     CHI-SQUARE CALCULATIØNS
CØRREL      FP     CØNTINGENCY CØEFFICIENT (XINGAM)
CØRRL2      FP     CØRRELATIØN CØEFFICIENT (TDIST;BETA)
KØKØ        FP     KØLMØGØRØV-SMIRNØV TWØ SAMPLE TEST (XINGAM)
SEVPRØ      B      CHI-SQUARE
STAT01      B      MEAN,STD ØF MEAN, ... , T-RATIØ,2 GRØUPS, PAIRED
STAT02      B      MEANS, VARIANCES, AND T-RATIØ 2 GRØUPS, UNPAIRED DATA
STAT04      B      CHI-SQUARE AND PRØBABILITIES, 2X2 TABLES
STAT08      B      CØMPARES TWØ GRØUPS ØF DATA USING THE MEDIAN TEST
STAT09      B      CØMPARE 2 DATA GRØUPS,MANN-WHITNEY 2-SAMPLE RANK TEST
STAT11      B      SPEARMAN RANK CØRRELATIØN CØEF. FØR 2 SERIES ØF DATA
STAT12      B      CØMPUTES CØRRELATIØN MATRIX FØR N SERIES ØF DATA
TAU         FP     KENDALL-RANK CØRRELATIØN

***DESCRIPTIVE STATISTICS***
MANDSD      B      FIND MEAN, VARIANCE, STD
STAT        FP     FIND SEVERAL STATISTICS FØR SAMPLE DATA (ANPF;ERRF)
STATAN      B      FIND VARIØUS STATISTICAL MEASURES
TESTUD      B      SAMPLE STATISTICS
UNISTA      B      DESCRIPTIØN ØF UNI-VARIANT DATA

***RANDØM NUMBER GENERATIØN***
FLAT        GRF    UNIFØRM RANDØM NUMBER GENERATØR
FLATSØRC    C      CARDIN SØURCE FILE FØR FLAT
RANDX       FF     RANDØM #'S, UNIFØRM DIST. BETWEEN 0 AND 1
RNDNRM      FF     CALCULATES NØRMAL RANDØM NUM. (FLAT)
UNIFM       GRF    UNIFØRM RANDØM NUMBER GENERATØR
UNIFMSØR    C      CARDIN SØURCE FILE FØR UNIFM
URAN        GRF    UNIFØRM RANDØM NUMBER GENERATØR
URANSØRC    C      CARDIN SØURCE FILE FØR URAN
XNØR1       FF     NØRMAL RANDØM NUMBERS, VARIABLE MEAN, STD (RANDX)
XNØRM       FF     NØRMAL RANDØM NUMBERS, MEAN 0, STD 1. (RANDX)

***MISCELLANEØUS STATISTICS***
FACTAN      FP     FACTØR ANALYSIS
STADES             EXPLANATIØN ØF CØLINR,CURFIT,MULFIT,UNISTA
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**********MS--MANAGEMENT SCIENCE AND @PTIMIZATI@N*
                                                **********

***LINEAR PR@GRAMMING***
ASIGNIT   B     THE ASSIGNMENT PR@BLEM
LINPR@    B     LINEAR PR@GRAMMING
LNPR@G    FP    LINEAR PR@GRAMMING
SIMPLEX   B     LINEAR PR@GRAMMING BY THE SIMPLEX METH@D
TRANSP@   B     THE TRANSP@RTATI@N PR@BLEM
UNDE@     FS    FINDS A S@LUTI@N F@R AN UNDERDETERMINED LINEAR SYSTEM

***INTEGER PR@GRAMMING***
INT@1     FP    ZI@NTS' M@DIFICATI@N @F BALAS' ZER@-@NE AL@RITHM
INTLP     FP    G@M@RY'S PURE AND MIXED INTEGER PR@GRAMMING

***N@N-LINEAR @PTIMIZATI@N***
CSM       FS    @PTIMIZE A LINEARLY C@NSTRAINED C@NVEX FUNCTI@N[UNDE@]
DAVID@N   B     DAVID@N'S UNC@NSTRAINED @PTIMIZATI@N
GE@SIM    B     HEURISTIC SCHEDULING @F N J@BS IN A M MACHINE SH@P
GPR@G     FHP   S@LVES GE@METRIC PR@GRAMMING PR@BLEMS
GPR@G-S@  C     CARDIN S@URCE FILE F@R GPR@G [UNDE@;CSM]
JSSIM     B     SCHEDULES N J@BS IN A SH@P WITH M MACHINES
LAY@UT    B     @PTIMIZES A PLANT LAY@UT ACC@RDING T@ V@LLMANN-RUML M@DE
L@GIC3    FP    UNC@NSTRAINED @PTIMIZATI@N
MAX@PT    FP    UNC@NSTRAINED @PTIMIZATI@N

***NETW@RK ANALYSIS***
CPM       FP    CRITICAL PATH METH@D
CPML@@P   FP    DETECTS AND LISTS L@@PS IN A CPM NETW@RK
KILTER    FP    '@UT @F KILTER' AL@RITHM (MINIMUM C@ST CIRCULATI@N)
MAXFL@W   FP    MAXIMUM FL@W THRU NETW@RK
PERT      B     SIMPLE ANALYSIS @F A PERT NETW@RK
SH@RTEST  FP    SH@RTEST PATH - MIN SPANNING TREE

***F@RECASTING***
C@EFS     B     DETERMINE SEAS@NAL C@EFFICIENTS @N TW@ CYCLES
C@MBI     B     DETERMINES EC@N@MIC @RDER QUANITY F@R INVENT@RY ITEMS
@PTIM     F     @PTIMUM SERVICE LEVEL F@R @NE INVENT@RY ITEM
SM@@TH    FS    TRIPLE SM@@THING @F A TIME SERIES
TCAST     FHP   TIME SERIES F@RECASTING

***SIMULATI@N***

GASPDATA  E     DATA FILE F@R SAMPLE PR@GRAM GASPSAMP
GASPIIA   FS    'GASP' SIMULATI@N SYSTEM
GASPSAMP  FP    SAMPLE PR@GRAM F@R GASPIIA [GASPIIA;GASPDATA]

**********EN--ENGINEERING**********

ACNET     FP    FREQUENCY RESP@NSE @F A LINEAR CIRCUIT
BEMDES    B     STEEL BEAM SELECTI@N
GCVSIZ    B     GAS C@NTR@L VALVE C@EFF.
LCVSIC    B     LIQUID C@NTR@L VALVE C@EFF.
LFILTR    B     SYNTHESIZES ACTIVE L@W-PASS FILTERS [LFLDAT]
LFLDAT          DATA F@R LFILTR
LFLTIN          INSTRUCTI@NS F@R LFILTR
LPFILT    B     DESIGN L@W PASS FILTERS
NLNET     FP    GENERAL STEADY-STATE CIRCUIT ANALYSIS
@TT@      B     @TT@ CYCLE @F ENGINE
PAVEIT    B     CALCULATES $ C@ST AND T@NS @F MATERIAL T@ PAVE A R@AD
PVT       FP    FINDS M@LAR V@LUME @F A GAS GIVEN TEMPERATURE AND PRES.
SCVSIZ    B     STEAM C@NTR@L VALVE C@EFF.
SECAP     B     STEEL SECTI@N CAPACITIES
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**********GP-GE0METRIC AND PL0TTING**********

CIRCLE    B     DIVIDES A CIRCLE INT0 N EQUAL PARTS
PL0T      FS    PL0TS UP T0 9 CURVES SIMULTANE0USLY
PL0TT0    B     SIMULTANE0USLY PL0TS 1 T0 6 FUNCTI0NS
PL0T1     FS    PL0TS UP T0 9 CURVES SIMULTANE0USLY
P0LPL0    FP    PL0TS EQNS IN P0LAR C00RDINATES
SPHERE    B     S0LVES ANY SPHERICAL TRIANGLE
TRIANG    B     S0LVES F0R ALL PARTS 0F ANY TRIANGLE
TW0PL0    B     SIMULTANE0USLY PL0TS 2 FUNCTI0NS
XYPL0T    B     PL0TS SINGLE-VALUED FUNCTI0NS

**********
          *******ED--EDUCATI0N AND TUT0RIAL**********

DRIVES    FHP   DRIVER F0R EXPER, A C0MPUTER ASSISTED INST. LANG.
EXPERN    E     EXPER TUT0RIALS IN EXPER (N=1 T0 5) [PREPRS,DRIVES]
PREPRS    FHP   PREPR0CESS0R F0R EXPER, A C0MPUTER ASSISTED INST. LANG.

**
  **********DE--DEM0NSTRATI0N**********

AMAZE     B     C0NSTRUCTS MAZES    -  EACH UNIQUE
BLKJAK    B     THE C0MPUTER DEALS BLACKJACK
M00NER    B     SIMULATES A LUNAR LANDING(M00NER1,M00NER2)
M00NER1         DATA FILE F0R F0R M00NER
M00NER2         INSTRUCTI0NS FILE F0R M00NER
P0PING    B     P0PULATI0N PR0JECTI0NS F0R AN AREA
PRIME     B     PRIME FACT0RIZATI0N 0F A NUMBER
XMAS      B     A H0LIDAY SING-AL0NG, CHRISTMAS CARD AND GREETINGS

**********UM--UTILITY AND MISCELLANE0US**********

ADATER    FP-S  A CALENDER DATING R0UTINE
ACCESS    GS    GMAP SUBR0UTINE T0 USE T/S ACCESS SYSTEM          (APPLIB
APARAM    GS    GMAP SUBR0UTINE T0 DETERMINE T/S 0R BATCH M0DE    (APPLIB
APPLIB    GL    USERS LIBRARY 0F F0RTRAN CALLABLE GMAP R0UTINES(APPLIB-R
ASCBCD    GS    GMAP SUBR0UTINE T0 C0NVERT ASCII T0 BCD           (APPLIB
BCDASC    GS    GMAP SUBR0UTINE T0 C0NVERT BCD T0 ASCII           (APPLIB
CALLSS    GS    GMAP SUBR0UTINE T0 CALL A T/S SUBSYSTEM           (APPLIB
CATAL0G   E     CATAL0G 0F SERIES 6000/600 T/S LIBRARY (THIS FILE)
C0NVRT    B     C0NVERTS MEASUREMENTS FR0M 0NE SCALE T0 AN0THER
DBLS0RT   FS    S0RT TW0 ARRAYS
DCS       FS    F0RTRAN SUBR. T0 TRANSFER CHARACTERS FR0M STRING T0 STRI
DEFIL     GS    GMAP SUBR0UTINE T0 CREATE TEMP0RARY FILES         (APPLIB
DESEQ     FP    STRIPS LINE SEQUENCE NUMBERS FR0M A FILE
GMAP      FP    F0RTRAN--AN INTERFACE T0 GMAP ASSEMBLER  (GMAP-S0R)
KIN       GS    GMAP SUBR.T0 READ LAST LINE FR0M TERM. IN BUFF.   (APPLIB
REF0RM    FP    REF0RMATS A 'NF0RM' F0RTRAN S0URCE FILE T0 'F0RM'
RLINE     FS    READS LINE, 0PTI0NALLY STRIPS LINE # & C0UNTS ENTRIES
SGLS0RT   FS    S0RT AN ARRAY
TLU1      FS    TABLE SEARCH
TPLS0RT   FS    S0RT THREE ARRAYS
UAT0LA    GS    GMAP SUBR. T0 CHANGE CASE 0F ASCII CHAR. STRING   (APPLIB
```

```
**********BF--BUSINESS AND FINANCE**********

ACCRUIT    B      C0MPUTES AND PRINTS ACCRUED INTEREST 0N INSTALLMENT L0AN
ANNUIT     B      ANNUITIES,L0ANS,M0RTGAGES
BALANCE    B      A PR0GRAM T0 REC0NCILE A BANK STATEMENT BALANCE
BLDGC0ST   B      ANALYZE BUILDING C0STS
B0NDATA    B      ANALYSIS 0F A B0ND INVESTMENT P0RTF0LI0
B0NDPR     B      C0MPUTES PRICE AND ACCRUED INTEREST 0F A B0ND
B0NDSW     B      CALCULATES THE EFFECT 0F A B0ND SWITCH
B0NDYD     B      C0MPUTES B0ND YIELDS
CASHFL0W   B      PREDICTS NEXT YEARS CASH FL0W
DEPREC     B      CALCULATES DEPRECIATI0N BY F0UR METH0DS
INSTL0     B      CALCULATES M0NTHLY PAYMENT SCHEDULE 0N INSTALLMENT L0A?
INTRSTZ    B      INTEREST RATES REGARDLESS 0F PAYMENT STREAM --REGULATI0N
INVANL     FP     RETURN 0N INVESTMENT ANALYSIS
LESSEE     B      C0MPARES A LEASE WITH PURCHASE 0F EQUIPMENT
LESSIM     B      SIMULATES LESS0R'S CASH FL0W AND RATE 0F RETURN
LESS0R     B      CALCULATES THE LESS0RS CASH FL0W & RATE 0F RETURN
MAKE-BUY   B      T0 MAKE 0R T0 BUY DECISI0NS
MGSIM      FP     SIMULATES C0MPETITIVE INTERACTI0N 0F C0MPANIES
MGSIM-IN          0N LINE INSTRUCTI0NS F0R MGSIM
M0RTCST    B      M0RTGAGE SCHEDULE F0R VARI0US TERMS
M0RTGAGE   FP     CALCULATES A M0RTGAGE REPAYMENT SCHEDULE
N0M-EFF    B      C0MPUTES MULTIPLE EFFECTIVE ANNUAL RATES 0F INTEREST
RETURN     B      C0MPUTES ANNUAL RETURNS F0R A SECURITY FR0M ANNUAL DATA
RISKIT     B      RISK ANALYSIS BASED 0N HERTZ'S SIMULATI0N M0DEL
SALDATA    B      C0MPUTES PR0FITABILITY 0F DEPARTMENTS 0F A FIRM
SAVING     B      SAVINGS PLAN CALCULATI0NS
SIMFUND    B      SIMULATES L0NG-RUN PERF0RMANCE 0F FUNDS(SIMPL0T)
SIMPL0T    B      PL0TTING PR0GRAM F0R SIMFUND HIST0GRAMS
SMLBUS     B      PAYMENT SCHEDULES F0R A SMALL BUSINESS ADMST. L0AN
TRUINT     B      INTEREST RATE CALCULATI0NS
VALSTK     B      CALCULATES INTRINSIC VALUE 0F ST0CK--M0L0D0VSKY METH0D

***END 0F CATAL0G***
```

This BASIC program computes and prints the accrued interest on installment loans for inclusion in a lender's operating statement at the end of each month. The program computes the portion of unearned interest earned during the current month.

INSTRUCTIONS

To use ACCRUIT, enter the total unearned interest for each month remaining in the current year, plus the next 48 months. Loans are grouped by their month of maturity. Total unearned interest for each loan maturing in the month is determined, and the sum of all unearned interest on loans maturing in a month is used as input for the program. Therefore, this sum must be computed for each month being considered.

A customer credit manager calculates the amounts of unearned interest, by month of maturity, for all installment loans due in the next four years. Monthly totals are as follows:

	1973	1974	1975	1976	1977
Jan.		$ 832.39	$5755.1	$ 5414.98	0
Feb.		936.14	5203.83	11028.33	$ 844.86
March	$800.50	654.66	4856.7	4660.57	0
April	98.35	1146.61	5819.73	7371.53	0
May	150.55	1521.3	2490.84	2572.17	898.64
June	270.66	1226.52	3283.03	3190.66	0
July	27.77	2083.25	4817.39	3712.78	0
Aug.	56.29	2455.6	1927.29	927.05	426.69
Sept.	2.65	1350.4	1867.08	0	0
Oct.	193.42	1597.11	2090.91	0	271.43
Nov.	326.4	2537.63	3912.03	790.34	0
Dec.	609.55	2362.95	7773.25	360.38	0

The unearned interest is computed using the sum of the months digits formula:

> Interest earned during period = $2/(p+1)$ times unearned interest at beginning of the period, where p is the sequential number of the period in which the loans mature. Therefore, interest earned on loans maturing next month would be two-thirds of the interest unearned on those loans at the beginning of the current month.

Data is entered in the following order:

1. The line number, beginning with line 1000
2. The word DATA
3. The monthly unearned interest figures in chronological order, separated by commas

After entering the data, the credit manager types RUN and indicates the current month and year, using numeric notation. Since calculations wanted are for March 1973, the credit manager enters 3, 1973. ACCRUIT then prints a statement showing the portion of interest earned during the current month (March 1973) and the remaining unearned balance for each month.

SAMPLE PROBLEM

The data defined above, entered into the program as listed below, produces a sample run. Data for your problem replaces it.

```
*LIST 1000

 1000 DATA 800.50,98.35,150.55,270.66,27.77,56.29
 1010 DATA 2.65,193.42,362.4,609.55,832.39,936.14
 1020 DATA 654.66,1146.61,1521.3,1226.52,2083.25,2455.6
 1030 DATA 1350.4,1597.11,2537.63,2362.95,5755.1,5203.83
 1040 DATA 4856.7,5819.73,2490.84,3283.03,4817.39,1927.29
 1050 DATA 1867.08,2090.91,3912.03,7773.25,5414.98,11028.33
 1060 DATA 4660.57,7371.53,2572.17,3190.66,3712.78,927.05
 1070 DATA 0,0,790.34,360.38,0,844.86
 1080 DATA 0,0,898.64,0,0,426.69
 1090 DATA 0,271.43,0,0,0,0
99999 END
```

SAMPLE SOLUTION

```
SYSTEM ?BASIC
ØLD ØR NEW-ØLD ACCRUIT
READY
*RUN

WHAT IS THE CURRENT MØNTH AND YEAR(E.G. 12,1972 ?3,1973

            EARNED INTEREST - INSTALLMENT LØANS
            -----------------------------------
MØNTH ØF              EARNED              REMAINING UNEARNED
MATURITY              INTEREST            INTEREST
--------              --------            ------------------

      1973
MARCH                $800.50                $0.00
APRIL                 $65.57               $32.78
MAY                   $75.27               $75.28
JUNE                 $108.26              $162.40
JULY                   $9.26               $18.51
AUGUST                $16.08               $40.21
SEPTEMBER              $0.66                $1.99
ØCTØBER               $42.98              $150.44
NØVEMBER              $72.48              $289.92
DECEMBER             $110.83              $498.72
```

1974		
JANUARY	$138.73	$693.66
FEBRUARY	$144.02	$792.12
MARCH	$93.52	$561.14
APRIL	$152.88	$993.73
MAY	$190.16	$1331.14
JUNE	$144.30	$1082.22
JULY	$231.47	$1851.78
AUGUST	$258.48	$2197.12
SEPTEMBER	$135.04	$1215.36
ØCTØBER	$152.11	$1445.00
NØVEMBER	$230.69	$2306.94
DECEMBER	$205.47	$2157.48
1975		
JANUARY	$479.59	$5275.51
FEBRUARY	$416.31	$4787.52
MARCH	$373.59	$4483.11
APRIL	$431.09	$5388.64
MAY	$177.92	$2312.92
JUNE	$226.42	$3056.61
JULY	$321.16	$4496.23
AUGUST	$124.34	$1802.95
SEPTEMBER	$116.69	$1750.39
ØCTØBER	$126.72	$1964.19
NØVEMBER	$230.12	$3681.91
DECEMBER	$444.19	$7329.06
1976		
JANUARY	$300.83	$5114.15
FEBRUARY	$596.13	$10432.20
MARCH	$245.29	$4415.28
APRIL	$378.03	$6993.50
MAY	$128.61	$2443.56
JUNE	$155.64	$3035.02
JULY	$176.80	$3535.98
AUGUST	$43.12	$883.93
SEPTEMBER	$0.00	$0.00
ØCTØBER	$0.00	$0.00
NØVEMBER	$34.36	$755.98
DECEMBER	$15.34	$345.04
1977		
JANUARY	$0.00	$0.00
FEBRUARY	$34.48	$810.38
MARCH	$0.00	$0.00
APRIL	$0.00	$0.00
MAY	$34.56	$864.08
JUNE	$0.00	$0.00
JULY	$0.00	$0.00
AUGUST	$15.52	$411.17
SEPTEMBER	$0.00	$0.00
ØCTØBER	$9.52	$261.91
NØVEMBER	$0.00	$0.00
DECEMBER	$0.00	$0.00
TØTALS	$9015.13	$104529.15

The first column total indicates the total amount of interest earned during the present month (March 1973); the second column is the total unearned interest balance at the end of the month.

The unearned interest data provided by the program can be utilized as input for next month's run (April 1973), since it indicates total unearned interest as of the first of the month, assuming there are no new loans or early payments of outstanding loans. If either of these events occurs, adjust the unearned interest account for the month of maturity affected.

This BASIC program performs the calculations necessary for determining both payment and withdrawal annuities.

INSTRUCTIONS

To use this program, supply values for the variables as required by the problem. Variables are denoted as follows:

- N is the number of periods
- P is the original principal amount
- A is the total amount at end of n periods
- I is the interest rate per period, in percent
- R is the amount of payment/withdrawal each period

For a payment annuity, you can give any three of N, A, I, R and find the fourth. Given values must be converted to a quarterly basis.

For a withdrawal annuity, you give any three of N, P, I, R and find the fourth. Given values must be converted to a monthly basis.

For loan or mortgage, use the withdrawal annuity option.

After each case, you can choose one of the following six alternatives:

1. Another case, same unknown variable
2. Another case, different unknown
3. Another case, other type of annuity
4. Total interest paid over n periods
5. Table of withdrawals, principal, and interest (use the "CTRL/@" key to stop table printout after the desired number of periods have been printed)
6. Stop the program

For additional instructions, list the program.

SAMPLE PROBLEM

Payment Option

Determine the amount on hand assuming a $35-a-month deposit in the local bank. The bank pays 4-7/8% a year and compounds quarterly. After converting the following variables to a quarterly basis as illustrated, enter them as required:

- N = 3 • 4 = 12 periods
- A = variable of interest
- I = 4.875/4 = 1.21875/period
- R = 35 • 3 = 105/period

The above values of N, I, and R are entered as required.

The total interest, item 4, and table of withdrawls, item 5, alternatives do not apply to the payment option.

The answer ($1842.65) is printed after selection of the proper options at lines 2 and 3 and the entry of (in proper sequence) N, I, and R at line 4. The answer does not account for any simple interest that might have been paid on $35 deposits prior to the first compounding period.

Withdrawal Option

Determine the monthly principal and interest payments on a $20,900 mortgage for 30 years at 5-1/2% per year. After converting the variables to a monthly basis:

- N = 30 • 12 = 360 periods
- P = 20900
- I = 5.5/12 = .458333333/period
- R = variable of interest

They are entered as required.

The answer ($118.668) is printed when the proper options at lines 2 and 3 are entered (in proper sequence) N, P, and I, at line 4. The total interest and a payments table was obtained by answering 4 and 5, respectively, to the "another case" question. The "CTRL@" key was used to stop the table printout at period 17.

SAMPLE SOLUTION

```
*RUN

ANNUIT

WANT INSTRUCTIONS FIRST (1=YES, 2=NO) ?2
WHICH ANNUITY TYPE (1=PAYMENT, 2=WITHDRAWAL) ?1
WHICH VARIABLE IS UNKNOWN (1=N, 2=A, 3=I, 4=R) ?2
WHAT ARE N(INTEGER),I(PCT),R($) ?16,1.21875,105.00
AMOUNT AT END OF N PERIODS = A =   1842.652
ANOTHER CASE (TYPE CODE NUMBER) ?6

READY
*RUN

ANNUIT

WANT INSTRUCTIONS FIRST (1=YES, 2=NO) ?2
WHICH ANNUITY TYPE (1=PAYMENT, 2=WITHDRAWAL) ?2
WHICH VARIABLE IS UNKNOWN (1=N, 2=P, 3=I, 4=R) ?4
WHAT ARE N(INTEGER),P($),I(PCT) ?360,20900,.458333333
WITHDRAWAL EACH PERIOD = R =   118.6679
ANOTHER CASE (TYPE CODE NUMBER) ?4
TOTAL INTEREST PAID =   21820.45
ANOTHER CASE (TYPE CODE NUMBER) ?5
```

PERIOD	PRINCIPAL	INTEREST	PRINC BAL	INT TO DATE
0			20900	
1	22.88	95.79	20877.12	95.79
2	22.98	95.69	20854.14	191.48
3	23.09	95.58	20831.06	287.06
4	23.19	95.48	20807.86	382.54
5	23.3	95.37	20784.56	477.91
6	23.41	95.26	20761.16	573.17
7	23.51	95.16	20737.65	668.33
8	23.62	95.05	20714.03	763.38
9	23.73	94.94	20690.3	858.32
10	23.84	94.83	20666.46	953.15
11	23.95	94.72	20642.51	1047.87
12	24.06	94.61	20618.46	1142.48
13	24.17	94.5	20594.29	1236.98
14	24.28	94.39	20570.01	1331.37
15	24.39	94.28	20545.62	1425.65
16	24.5	94.17	20521.12	1519.82
17	24.61	94.06	20496.51	1613.88

This BASIC program assists in reconciling an error found in a DDA checking account.

METHOD

The program prints the ending balance in the ledger statement, subtracts outstanding checks from this balance, and adds outstanding deposits. From this new balance, the book balance at the end of the period, the total service charge is subtracted to obtain the adjusted book balance.

INSTRUCTIONS

Detailed program instructions can be obtained by listing lines 8-78. However, the Sample Program provides details for a run.

Information from the bank's statement is entered via data statements before a RUN. The program can easily be modified to read these data entries from an existing file used by the bank for maintaining demand deposits. However, information on this modification is not provided here since it is essential to know the format of the bank's demand deposits file.

SAMPLE PROBLEM

The use of BALANCE can best be shown by the following example. Unable to locate an error, Ms. Craig needs help in reconciling her latest checking account statement. She checked her statement and found for the month in question, three checks, numbers 888, 889, and 890, for $1000, $2000 and $3000, respectively, had cleared. Furthermore, two deposits, each for $1000, were made; and, after deducting the service charge and cost of new checks, $5.55, the balance was $2345.67.

In line 1690, after typing the word DATA, she enters the ending balance as shown in the bank's statement, and the total cost of new checks and/or service charges. These two data statements must be separated by a comma. Starting on the following line, she enters the check number and the check amount for each check the bank has cleared for the account during the period, again separating the two entries with a comma. After all checks have been entered, she types 0,0 in the next DATA statement. Then, starting in the next line, she enters the deposit number and deposit amount for her account. After she enters all deposits she again enter 0,0 in the last DATA line. When Ms. Craig types RUN, the program asks her to enter the check number and the amount of each check written during the period, including any checks outstanding based on the customer's records. Using her check-book, she enters the number and amount of all outstanding checks, separating each two

items of data with commas. No comma is used with each amount, such as to separate the hundreds from the thousands. Thus, $1,500 becomes 1500. After the information for all checks written during the period has been entered, Ms. Craig types 0,0.

The program then compares the amounts of all checks already processed by the bank with the amounts just entered and prints a statement alerting the user to any check that may have been posted incorrectly. In this example, check number 889 is being carried on the bank's books with an amount of $2000, as shown in DATA line 1710. However, Ms. Craig's records show an amount of $2500. Therefore, the warning that check number 889 may be posted incorrectly is printed by the program.

Next, the program asks Ms. Craig for the numbers and amounts for all deposits made during the period, including outstanding deposits. She enters the data in the same manner as the check numbers and amounts. If deposits are not numbered, the dates when the deposits were made could be used (i.e., 621 for June 21st). Again Ms. Craig enters 0,0 after the last deposit. The program then compares all deposits shown by the bank with those just entered, and signals any discrepancies.

Finally, the program prints the balance on the bank's ledger statement, the numbers and amounts of outstanding checks and outstanding deposits, and the total service charge to arrive at an adjusted book balance for the account.

SAMPLE RUN

```
SYSTEM ?BASIC
OLD OR NEW-OLD BALANCE
READY
*1690 DATA 2345.67,5.55
*1700 DATA 888,1000
*1710 DATA 889,2000
*1720 DATA 890,3000
*1730 DATA 0,0
*1740 DATA 620,1000
*1750 DATA 621,1000
*1760 DATA 0,0
*RUN
```

```
            RECØNCILEMENT ØF BANK ACCØUNT

PLEASE ENTER THE NUMBER AND AMØUNT ØF EACH CHECK WRITTEN AND
ANY CHECKS ØUTSTANDING AT THE BEGINNING ØF THE PERIØD
(ENTER 0,0 WHEN CØMPLETED)
ENTER NUMBER, AMØUNT
?889,1000
?889,2500
?890,3000
?891,500
?892,1500
?0,0
CHECK NUMBER  889 MAY BE PØSTED INCØRRECTLY


PLEASE ENTER THE NUMBER AND AMØUNT ØF EACH DEPØSIT MADE AND
ANY ØUTSTANDING AT BEGINNING ØF PERIØD
(ENTER 0,0 WHEN CØMPLETED)
ENTER NUMBER, AMØUNT
?620,1000
?621,1000
?622,500
?623,1000
?0,0


ENDING BALANCE ØN STATEMENT              2345.67
SUBSTRACT ØUTSTANDING CHECKS:
     NUMBER      AMØUNT
         891       500.00
         892      1500.00                 2000.00

ADD DEPØSITS ØUTSTANDING:
         622       500.00
         623      1000.00                 1500.00
                                         ---------
BØØK BALANCE AT END ØF PERIØD            1845.67
SERVICE CHARGES                             5.55
                                         ---------
ADJUSTED BØØK BALANCE                    1840.12


REVIEW ØUTSTANDING CHECKS AND DEPØSITS FØR CØRRECT AMØUNTS!
```

This BASIC program analyzes the feasibility of building design proposals. Essentially, the program keeps track of the major building costs and projects them over the life of the building. The program allows the designer or builder to see the effect of changes in construction costs, operating costs, financing costs, and replacement costs on the total cost over the life of the building and on the minimum annual rent required to make the project economically feasible.

INSTRUCTIONS

The input required for this program is as follows:

MAJOR CAPITAL COSTS OF THE PROJECTS

1. Building construction costs
2. Land cost
3. Land development cost
4. Equipment cost

FINANCING DETAILS

1. Mortgage or bond financing
2. Amount of total capital cost to be financed
3. Length of financing period
4. Interest rate

REPLACEMENT

1. Total life of the building
2. 1, if the cost of replacement is to be covered by a sinking fund, otherwise, 2
3. The value and life of each item to be replaced

ANNUAL OPERATION COST

1. Insurance cost
2. Utility cost and air-conditioning cost
3. Property tax and building service cost
4. Maintenance and repair cost (2% annual increase allowed for aging of structure)

SALVAGE VALUE OF THE BUILDING AT THE END OF ITS LIFE

INTEREST LOST

Amount of total project cost to be used in computing interest lost.

To use this program enter data as requested. These instructions can be found by running the program.

SAMPLE PROBLEM

Analyze the feasibility of a project with planned construction costs of $15,000, land costs of $3,000, development costs of $1,000, and equipment costs of $200, where $15,000 of the

total project cost is to be financed by a 7-year mortgage at 5-1/4%. Print a year-by-year financing table when that option is presented. The following are the values and life expectancy of items to be replaced:

$200, 5 years
$150, 3 years
$500, 15 years
$100, 4 years

Annual costs will be as follows: insurance, $100; utilities, $160; air conditioning, $240; property taxes, $600; building service, $50; maintenance and repair, $500. At the end of 10 years, the salvage value of the building is expected to be $15,000. The amount of money to be used in interest loss computations is $4,200.

SAMPLE SOLUTION

```
*RUN BLDGCOST

BLDGCOST

PROGRAM FOR BUILDING COST ANALYSIS
DO YOU WANT INSTRUCTION?  ANSWER 1 FOR YES AND 0 FOR NO
?0


INPUT MAJ0R CAPITAL C0ST $ VALUE AFTER ?

BUILDING C0NSTUCTI0N C0STS. ?15000
LAND C0ST.................. ?3000
LAND DEVEL0PMEMT........... ?1000
EQUIPMENT C0ST............. ?200

T0TAL CAPITAL C0STS=$   19200

IS THE PR0J T0 BE FINANCED BY: 1=M0RT., 2=B0NDS.
?1
WHAT AM0UNT IS T0 BE B0RR0WED, LENGTH 0F PERI0D, AND
INTEREST RATE  INPUT BY TYPING $ AM0UNT, YEARS, PERCENT
?15000,7,5.25
```

```
UNIFØRM ANNUAL PAYMENT REQUIRED =$   2615.833

DØ YØU WANT FINANCING TABLE PRINTED TYPE 1 YES 2 NØ
?1

YEAR              INTEREST          PRINCIPAL          BALANCE
 0                                                      15000
          1          787.5          1828.333          13171.67
          2        691.5125           1924.32          11247.35
          3        590.4857          2025.347          9221.999
          4         484.155          2131.678          7090.321
          5        372.2419          2243.591           4846.73
          6        254.4533           2361.38          2485.351
          7        130.4809          2485.352                 0

R E P L A C E M E N T   S E C T I Ø N

WHAT IS THE TØTAL LIFE ØF THE BUILDING ?10
IS THE CØST ØF REPLACMENT TØ BE CØVERED BY A SINKING FUND?
TYPE 1 YES 2 NØ (INTEREST RATE 4 PERCENT) ?1

 INPUT THE $ VALUE AND THE LIFE ØF EACH ITEM TØ BE REPLACED
IF ALL ITEMS TØ BE REPLACED HAVE BEEN ENTERED TYPE 0,0 AFTER?

FIRST ITEM $ VALUE, LIFE IN YEARS DØNT FØRGET THE CØMMA
?200,5
          NEXT ITEM $ VALUE, LIFE IN YEARS -
?150,3
          NEXT ITEM $ VALUE, LIFE IN YEARS
?500,15
          NEXT ITEM $ VALUE, LIFE IN YEARS
?100,4
          NEXT ITEM $ VALUE, LIFE IN YEARS
?0,0
UNIFØRM ANNUAL SINKING FUND PAYMENT FØR REPLACMENT=$   133.4972
A N N U A L   Ø P E R A T I Ø N   C Ø S T   S E C T I Ø N

WHAT IS THE ANNUAL CØST ØF THE FØLLØWING ITEMS
INPUT BY TYPING $ VALUE AFTER ?

INSURANCE CØST ..............  ?100
UTILITY CØST.................  ?160
AIR CØNDITIØNING CØST........  ?240
PRØPERTY TAXES...............  ?600
BUILDING SERVICE CØST........  ?50
MAINTENANCE AND REPAIR......  ?500
AVERAGE TØTAL ANNUAL ØPERATIØN CØST =$ 1650
```

```
D E P R E C I T A T I Ø N  IS CØMPUTED ØN STRAIGHT LINE
BASIS. WHAT IS THE SALVAGE VALUE ØF THE BUILDING AT YEAR   10
?15000
ANNUAL DEPRECITATIØN=   20
I N T E R E S T  L Ø S T  S E C T I Ø N

WHAT AMØUNT ØF MØNEY INVESTED IN THE PRØJECT SHØULD BE
USED FØR THE INTEREST LØST CØMPUTATIØN
?4200
INTEREST LØST AT     8 % INTEREST RATE =$ 3360
INTEREST LØST AT     6 % INTEREST RATE =$ 2520
INTEREST LØST AT     4 % INTEREST RATE =$ 1680

DØ YØU WANT THE TABLE PRINTED ØUT  TYPE 1 YES 2 NØ
?2

TØTAL LØAN PAYMENTS.........=$   18310.83
TØTAL SINKING FUND PAYMENTS.=$   1334.972
 TØTAL ØPERATIØN CØST.......=$   16550

T Ø T A L  C Ø S T .........=$   36075.92

THE MINIUM ANNUAL RENT =$   3775.592 THIS IS THE
TØTAL CØST   36075.92 PLUS THE INTEREST LØST (AT 4 PERCENT) 1680
DIVIDED BY THE LIFE ØF THE BUILDING   10
```

This BASIC program prepares five reports on the analysis of the composition of a bond investment portfolio.

INSTRUCTIONS

Data is entered in the following order:

1. Description of the bond – bond terminology
2. Type – (government, municipal, federal agency, other)
3. Moody Rating – (N.A. BAA etc.)
4. Par Value – (500,000, 300,000, etc.)
5. Coupon Rate/Percent Form – (3.5, 5, etc.)
6. Coupon Payment Dates – (month, day, month, day (integers))
7. Book Price Per Bond – (95.5, 100, etc.)
8. Purchase Date – year, month, day
9. Maturity Date – year, month, day
10. Current Market Price

A sample entry for one issue follows:

```
1.5 Apr. '69, mun., BAA
10000, 1.5, 4, 1, 10, 1, 91.6, 1960, 6, 2, 1969, 4, 1, 95.7
```

Sample data is presently entered starting in line 9000.

Once a data file is built, enter it in place of the sample data. Then type RUN. The program will ask which reports are desired. In addition, requests are made for ordinary income tax rate, capital gains tax rate, and period (in years) to be analyzed. The five reports available are the portfolio breakdown by:

1. Years of maturity
2. Bond type
3. Moody rating
4. Coupon income
5. Individual issues maturity.

SAMPLE PROBLEM

Generate portfolio breakdowns by years of maturity, bond type, Moody rating, coupon income, and individual issues maturity. Your ordinary income tax rate is 48%; your capital gains rate is 25%. Generate coupon income information for the years 1972 through 1973 and individual issue maturity information for the years through 1975. Other data is the same as sample above.

SAMPLE SOLUTION

```
THIS PRØGRAM PREPARES FIVE REPØRTS WHICH ANALYZE THE CØMPØSITIØN
ØF A BØND INVESTMENT PØRTFØLIØ.

DØ YØU REQUIRE A DESCRIPTIØN ØF HØW TØ BUILD A DATA FILE ?NØ

ENTER YES ØR NØ IF YØU WØULD LIKE THE FØLLØWING REPØRTS:
I. PØRTFØLIØ BREAKDØWN BY YEARS ØF MATURITY ?YES
II. PØRTFØLIØ BREAKDØWN BY BØND TYPE ?YES
III. PØRTFØLIØ BREAKDØWN BY MØØDY'S RATING ?YES
IV. PØRTFØLIØ BREAKDØWN BY CØUPØN INCØME ?YES

FØR WHAT YEARS WØULD YØU LIKE THIS INFØRMATIØN (I.E. FØR YEARS
1968-1978, ENTER 1968,1978) ?1972,1973

V. PØRTFØLIØ BREAKDØWN BY INDIVIDUAL ISSUE MATURITY ?YES

FØR WHAT YEARS WØULD YØU LIKE THIS INFØRMATIØN (I.E. FØR YEARS
1968-1978, ENTER 1968,1978) ?1972,1975

WHAT IS YØR ØRDINARY INCØME TAX RATE(ENTER INTEGER)  ?48

WHAT IS YØUR CAPITAL GAINS TAX RATE(ENTER INTEGER)  ?25

WHAT IS TØDAY'S DATE (ENTER THE YEAR, THE MØNTH, AND THE DAY:
1968,6,26) ?1972,7,8
************************************************************
```

I. PØRTFØLIØ BREAKDØWN BY YEARS ØF MATURITY

YEARS TØ MATURITY	NØ.ØF ISSUES	PAR VALUE	PAR VALUE PERCENT ØF TØTAL	AFTER TAX YIELD AT BØØK	AFTER TAX YIELD AT MARKET
0 - 1	0	0	0	0	0
1 - 2	2	250000	5	2.32	5
2 - 3	2	600000	12	3.22	3.02
3 - 4	3	1100000	22	3.59	4.45
4 - 5	2	600000	12	3.31	3.28
5 - 6	0	0	0	0	0
6 - 7	0	0	0	0	0
7 - 8	0	0	0	0	0
8 - 9	0	0	0	0	0
9 - 10	0	0	0	0	0
11 - 15	4	800000	16	2.49	2.52
16 - 20	3	550000	11	2.29	2.38
21 - 25	1	250000	5	2.43	2.56
26 - 30	3	700000	14	2.57	2.63
31 - 35	1	100000	2	2.47	2.57
TØTALS	21	4950000	100	2.9	3.23

```
************************************************************
```

II. PØRTFØLIØ BREAKDØWN BY BØND TYPE

BØND TYPE	NUMBER ØF ISSUES	PAR VALUE	PAR VALUE AS PERCENT ØF TØTAL
GØV'T	6	1350000	27
MUN.	6	1500000	30
FED. AGENCY	5	900000	18
ØTHER	4	1200000	24
TØTALS	21	4950000	100

BØND TYPE	BØØK VALUE	AFTER-TAX YIELD AT BØØK VALUE	MARKET VALUE	A-T YLD. MARKET
GØV'T	1315255	2.39	1324850	2.57
MUN.	1421100	4.15	1433630	4.94
FED. AGENCY	828000	2.44	855100	2.45
ØTHER	1160000	2.27	1171210	2.42
TØTALS	4724355	2.9	4784790	3.23

****

III. PØRTFØLIØ BREAKDØWN BY MØØDY'S RATING

RATING	NUMBER ØF ISSUES	PAR VALUE	PAR VALUE AS PERCENT ØF TØTAL	AFTER-TAX YIELD AT BØØK	AT MARKET
AAA	2	350000	7	2.4	3.39
AA	1	300000	6	4.03	4.07
A	2	500000	10	2.36	2.39
BAA	5	1300000	26	3.46	4.1
BA	2	450000	9	2.91	2.96
B	1	300000	6	2.25	2.79
N.R.	2	400000	8	3.56	3.56
N.A.	6	1350000	27	2.39	2.57
TØTALS	21	4950000	100	2.9	3.23

IV. P@RTF@LI@ BREAKD@WN BY C@UP@N INC@ME

---------- 1972 ----------

DATE	DESCRIPTI@N	TYPE	BEF@RE-TAX INC@ME	AFTR-TAX +AM@,SVG
1 FEB. 1972	3.75 AUG.'73	G@V'T	2812.5	1462.5
1 FEB. 1972	4 FEB.'85	G@V'T	3000	1560
1 FEB. 1972	5.12 FEB.'75	G@V'T	10240	5507.657
1 FEB. 1972	5.12 FEB.'77	G@V'T	7680	4075.392
1 FEB. 1972	4 AUG.'76	MUN.	6000	6000
1 FEB. 1972	4 FEB.'87	FED. AGENCY	3000	1560
1 FEB. 1972	3.84 AUG.'72	@THER	5760	2995.2
1 FEB. 1972	4.6 FEB.'85	@THER	9200	4830.829
1 FEB. 1972	3 FEB.'01	@THER	4500	2340
1 MAR. 1972	3.25 MAR.'00	FED. AGENCY	1625	845
1 MAR. 1972	5 MAR.'90	@THER	5000	2637.647
			58817.5	33814.22
QUARTERLY ACCRUED C@UP@N INC@ME			49954.99	32600.59
1 APR. 1972	1.5 APR.'74	MUN.	750	750
1 APR. 1972	4.6 APR.'75	MUN.	4600	4600

V. P@RTF@LI@ BREAKD@WN BY INDIVIDUAL ISSUE MATURITY

DATE	DESCRIPTI@N	TYPE	PAR VALUE +C@UP@N	PAR VALUE +CPN.-TAX
1 AUG. 1973	3.75 AUG.'73	G@V'T	152812.5	150086.2
1 APR. 1974	1.5 APR.'74	MUN.	100750	98650
1 FEB. 1975	5.12 FEB.'75	G@V'T	410240	405507.7
1 APR. 1975	4.6 APR.'75	MUN.	204600	204600
1 AUG. 1975	3.84 AUG.'72	@THER	305760	300745.2
1 @CT. 1975	5.12 @CT.'75	FED. AGENCY	307680	304124.5
1 N@V. 1975	4 N@V.'75	MUN.	510000	497500
			1738280	1712477

This BASIC program computes the price and accrued interest for a bond accounting for the annual coupon in dollars, the redemption value, the maturity, and the yield. The purchase of a bond involves the payment of a purchase price plus accrued interest. In exchange for this investment, the purchaser who holds the bond to maturity expects to receive interest payments, usually semiannually, and a principal payment at maturity. The interest payments are the so-called "coupon" payments. The payment at maturity is usually the "par" or face value of the bond, although in some cases there may be a premium stipulated in the bond. If the terms of the bond make it callable before maturity, the purchaser may anticipate receiving interest only up to a call date, and then receiving the par value of the bond plus a specified call premium.

INSTRUCTIONS

The program inquires about the method of entering data as follows:

DO YOU WANT INSTRUCTIONS FOR ENTERING DATA?

There are three options:

1. If you answer YES, the program will print out a description of each line of data to be entered; enter the data one line at a time.
2. If you answer NO, the program will ask for items 1 through 5 to be entered; enter the data, separated by commas, on one line.
3. If you answer DATA, the data already in the program will be printed out.

See the Sample Problem for examples of all three methods discussed above.

All data is expressed per hundred dollars per value of the bond.

SAMPLE PROBLEM

In this example, the user has specified an annual coupon of $6 a year ($3 paid semi-annually), a principal payment of $100 at maturity, maturity in 12 years 5 months, and a yield to maturity of 5-1/2%. The computer summarizes the specified data, so that the user can spot a mistake quickly, and then prints out the calculated price, $104.45, and the accrued interest of $.50. The price calculation is an exact one; no interpolation is used. The accrued interest is calculated from the coupon specified and the maturity. In this example, since the bond matures in 12 years and 5 months, the last coupon payment must have been made one month ago and, therefore, one month of interest must have accrued. One-sixth of $3 is $.50, and this is the figure printed out for accrued interest. The program assumes that where the

time to maturity is an exact multiple of 6 months (that is, where the present date is a coupon payment date), the purchaser is buying just before the coupon is received. In such a case, the accrued interest would be shown as a full half-year coupon payment.

SAMPLE SOLUTION

```
* RUN

DØ YØU WANT INSTRUCTIØNS FØR ENTERING DATA ?YES

ENTER THE FØLLØWING ITEMS ØF DATA

ITEM 1       ANNUAL CØUPØN IN DØLLARS      ?6

ITEM 2       PRØCEEDS ØN REDEMPTIØN        ?100

ITEMS 3 & 4 MATURITY IN YEARS, MØNTHS      ?12,5

ITEM 5       YIELD TØ MATURITY             ?.055

CØUPØN            6   REDEMPTIØN AT  100
MATURITY          12 YEARS        5 MØNTHS
YIELD .055

PRICE              104.4505   ACCR INT          .5000002


READY
*RUN

DØ YØU WANT INSTRUCTIØNS FØR ENTERING DATA ?NØ

ENTER ITEMS 1 THRØUGH 5 ?6,100,12,5,.055

CØUPØN            6   REDEMPTIØN AT  100
MATURITY          12 YEARS        5 MØNTHS
YIELD .055

PRICE              104.4505   ACCR INT          .5000002


READY
*RUN

DØ YØU WANT INSTRUCTIØNS FØR ENTERING DATA ?DATA

CØUPØN            6   REDEMPTIØN AT  100
MATURITY          12 YEARS        5 MØNTHS
YIELD .055

PRICE              104.4505   ACCR INT          .5000002
```

This BASIC program calculates the effect of a bond switch (that is, a bondholder selling a bond and purchasing another, expecting that a change in yield spread will make the switch profitable). The user supplies information about the bonds, tax rates, yield forecasts, and reinvestment rates. Then, the program calculates terminal values for three alternatives: keeping the old bond, making a pure tax switch (selling and repurchasing the same issue), and selling the old bond and purchasing a new one.

A simple example: if the present spread between high-grade utility bonds and government bonds is 116 basis points, and an accurate forecast is a reduction of this spread to 90 basis points at some future date, prices of utility bonds will rise relative to prices of government bonds and there is money to be made (or a loss to be avoided) in a switch from government to utility bonds.

The basic calculation involved in evaluating a bond switch is fairly straightforward in principle. The user of BONDSW must supply the vital statistics for the bond he presently owns (the "old" bond) and the bond to which he is thinking of switching (the "new" bond), some information with respect to his tax rates, his yield forecast, and an estimate of the rate of interest he will obtain on the reinvestment of coupon interest income. He must also indicate the length of time to the terminal date (this being the date for which his interest rate forecasts are made) he has in mind. Any terminal date may be chosen, up to the maturity of the shorter of the two bonds.

The program will calculate the terminal values (the number of dollars, after income tax, that the investor will have after selling out at the terminal date) for three alternatives: keep the old bond, make a pure tax switch, and sell the old bond and purchase a new one. The first of these alternatives is simple enough. The investor keeps the old bond until the terminal date and then sells it at a price that is a function of his yield forecast for that terminal date. The program BONDSW takes into account taxes on coupon interest received, the tax reduction due to amortization of any premium (based on the present book value of the old bond), and any taxes arising from gain or loss at the terminal date. The user of the program must furnish a variety of tax rates so that tax exempt bonds may be considered in switch decisions, and either gain or loss years may be forecasted for a bond-switching decision.

The second alternative is a pure tax switch. That is, the program assumes that the old bond is sold now and the net proceeds after taxes are immediately reinvested in the same bond, which is held to the terminal date and then resold.

The third alternative is a switch from the old bond to the new bond. The program calculates the net after-tax proceeds of selling the old bond, invests this amount in the new bond, and calculates, again after all tax effects, the number of dollars the investor will have after selling this new bond at the terminal date.

Terminal value is chosen as the best measure of the attractiveness of a bond switch because it is a relatively unambiguous figure. It is, of course, sensitive to some extent to the rate that has been specified for the return on reinvested coupon interest. The investor may be in some doubt about what rate he will receive as he reinvests coupon payments, but he can always try several rates and see what difference it makes to the terminal value comparison. Perhaps, a more obvious comparison measure would be yield. BONDSW actually does calculate the yield to the terminal dates for the three alternatives. This figure is an ordinary after-tax bond yield. It is simply the rate that discounts the net after-tax proceeds of sale at the terminal date, and the net after-tax coupon receipts, back to the price of the old bond (which is what the investor now has). The yield to terminal date is, however, an ambiguous figure. The difficulty comes in deciding the amount on which the yield should be calculated: the market price of the old bond or the amount the investor would net after taxes if he were to sell the old bond. It is impossible to say which of these choices is "correct," but the program bases this yield to terminal date on the market price of the old bond.

In theory, at least, the yield-to-sale date is a less attractive comparative measure than the terminal value; but because yield is probably a more familiar concept than terminal value to most bond men, the program has been set up to delivery yield figures as well as terminal value.

INSTRUCTIONS

The program inquiries about the method of entering data as follows:

DO YOU WANT INSTRUCTIONS FOR SUPPLYING DATA?

There are three options:

1. If you answer YES, the program will print out a description of each line of data to be entered; enter the data one line at a time.
2. If you answer NO, the program will ask for the data to be entered in lines one through five; enter the data, separated by commas, on one line.
3. If you answer DATA, the data already in the program will be printed out.

See the Sample Problem for examples of all three methods discussed above.

SAMPLE PROBLEM

In this case the old bond has a book value of $90-3/8, a current quoted price of $91, an annual coupon of 2-3/4, and a maturity of 2 years and 5 months. The proceeds at redemption (including any call premium) are $100, and the tax rate applicable to coupon interest payment on this bond is 48%. The quoted price of the new bond is $84, the coupon is 5-1/8, the maturity is 32 years and 9 months, the amount to be received at redemption is $100, and the tax rate to be applied to coupon interest payment on this bond is also 48%. The terminal date the investor has in mind is 2 years and 0 months in the future, and forecasts a yield of 5% on the old bond and 4-1/2% on the new bond at that date. Capital loss and capital gain tax rates now and at the terminal date are all 25%. Tax rates on capital gains at maturity on the old and the new bonds are also 25%. Finally, the investor has estimated a gain of 3% a year after taxes on the reinvestment of coupon interest up to the terminal date.

(The data above correspond to a testing of a choice between keeping an AT&T 2-3/4% debenture maturing in 1972, and switching to an AT&T 5-1/8% debenture maturing in 2001, where the investor is looking two years ahead.)

* LIST 10-230

```
10REM  BØNDSW          (BASIC PRØGRAM BEGINS AT LINE 110)
14REM     **********         :::::::         **********
15REM
20REM  THIS BASIC PRØGRAM IS TØ CALCULATE AND ANALYZE THE
25REM  EFFECT ØF A BØND SWITCH
26REM
27REM     ****************************************
36REM  TYPE "RUN" TØ USE.   DATA INPUTS ARE DESCRIBED IN
37REM  PRINT STATEMENTS.
50REM
55REM * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
60REM
110REM  DESCRIPTIØN ØF VARIABLES IN DATA
120REM C1,C2: ANNUAL CØUPØN ØN ØLD AND NEW BØNDS
130REM B1: BØØK VALUE ØLD BØND
140REM P1,P2: PRICE ØLD AND NEW BØNDS
150REM M1;M3,M2;M4: MATURITIES ØLD AND NEW BØNDS IN YEARS AND MØNTHS
160REM R1,R2: REDEMPTIØN PRICE ØLD AND NEW BØNDS
170REM T1,T2: TAX RATE ØN THE INTEREST ØF ØLD AND NEW BØNDS
180REM S1,S2: TERMINAL DATE IN YEARS AND MØNTHS HENCE
190REM Y3,Y4: ESTIMATED YIELD ØN ØLD AND NEW BØNDS AT TERMINAL DATE
200REM T3,T5: CAPITAL LØSS RATE NØW AND AT TERMINAL DATE
210REM T4,T6: CAPITAL GAIN RATE NØW AND AT TERMINAL DATE
220REM D3,D4: CAPITAL GAIN RATE AT MATURITY ØF ØLD AND NEW BØND
230REM Y9: AFTER TAX REINVESTMENT RATE FØR CØUPØNS
```

A run of BONDSW is illustrated below. In this run, the data must already be available in the program's data lines:

```
1110 DATA 90.375,91,2.75,2,5,100,.48
1120 DATA 84,5.125,32,9,100,.48
1130 DATA 2,0,.05,.045
1140 DATA .25,.25,.25,.25
1150 DATA .25,.25
1160 DATA .03
```

When the program responds by asking which of five tables is wanted, the investor replies by typing 0. This enables verification of data input.

```
DØ YØU WANT INSTRUCTIØNS FØR SUPPLYING DATA ?DATA
TABLE ØF YIELDS AND TERMINAL VALUES AT TERM. DATE TYPE:
   0-FØR NØ TABLES
   1-FØR SENSITIVITY ØF YIELD AND TERMINAL VALUES TØ TERM.
   2-FØR SENSITIVITY TØ YIELD SPREAD
   3-FØR SENSITIVITY TØ YIELDS
   4-FØR YIELDS AND TERMINAL VALUES AT YØUR TERM. DATE

WHICH TABLE DØ YØU WANT ?0

DØ YØU WANT A SUMMARY ØF BØND DATA  ?YES
```

SUMMARY ØF DATA

YIELDS TØ MATURITY

YIELD ØN ØLD BØND BEFØRE TAX	6.85
YIELD ØN ØLD BØND AFTER TAX	4.44
YIELD ØN REPURCHASED ØLD BØND AFTER TAX	4.51
YIELD ØN NEW BØND BEFØRE TAX	6.28
YIELD ØN NEW BØND AFTER TAX	3.41

ØLD BØND

PRESENT PRICE	91	CØUPØN	2.75
REDEMPTIØN AT	100	BØØK VALUE	90.375
MATURITY	2 YEARS	5 MØNTHS	
TAX RATES	.48 ØN INC	.25 ØN CAP GNS	
.25 ØN CAP LØSSES		.25 ØN CAP GNS AT MATURITY	
YIELD BEF TAX FØRECAST FØR SALE DATE			.05

NEW BØND

PRESENT PRICE	84	CØUPØN	5.125
REDEMPTIØN AT	100		
MATURITY	32 YEARS	9 MØNTHS	
TAX RATES	.48 ØN INC	.25 ØN CAP GNS AT MATURITY	
YIELD BEF TAX FØRECAST FØR SALE DATE			.045

SALE DATE IS IN		2 YEARS	0 MØNTHS
TAX	.25 ØN CAP LØSS		.25 ØN CAP GNS
ØPPØRTUNITY RATE A/T		.03	

SAMPLE SOLUTION

Illustrated below is an example of entering data in the interactive mode.

```
*RUN

DØ YØU WANT INSTRUCTIØNS FØR SUPPLYING DATA ?YES
ENTER THE FØLLØWING ITEMS ØF DATA
ITEM 1        BØØK VALUE ØF ØLD BØND              ?90.375
ITEM 2        PRICE ØF ØLD BØND                   ?91
ITEM 3        CØUPØN ØN ØLD BØND                  ?2.75
ITEMS 4 & 5 MATURITY ØLD BØND IN YRS,MØNTHS       ?2,5
ITEM 6        PRØCEEDS ØN REDEMPTIØN ØLD BØND     ?100
ITEM 7        TAX RATE ØN ØLD BØND INTEREST PMTS  ?.48
ITEM 8        PRICE ØF NEW BØND                   ?84
ITEM 9        CØUPØN ØN NEW BØND                  ?5.125
ITEMS 10,11 MATURITY NEW BØND- YRS,MØNTHS         ?32,9
ITEM 12       PRØCEEDS ØN REDEMPTIØN NEW BØND     ?100
ITEM 13       TAX RATE ØN NEW BØND INTEREST PMTS  ?.48
ITEMS 14,15 YRS,MØNTHS TØ TERMINAL DATE           ?2,0
ITEM 16       PREDICT YIELD ØLD BØND TERM. DATE   ?.05
ITEM 17       PREDICT YIELD NEW BØND TERM. DATE   ?.045
ITEMS 18,19 CAP LØSS,GAIN RATES NØW               ?.25,.25
ITEMS 20,21 CAP LØSS, GAIN RATES TERM.DATE        ?.25,.25
ITEM 22       CAP GAIN RATE AT MATURITY ØLD BØND  ?.25
ITEM 23       CAP GAIN RATE AT MATURITY NEW BØND  ?.25
ITEM 24       AFTER TAX REINVEST RATE CØUPØNS     ?.03
TABLE ØF YIELDS AND TERMINAL VALUES AT TERM. DATE TYPE:
   0-FØR NØ TABLES
   1-FØR SENSITIVITY ØF YIELD AND TERMINAL VALUES TØ TERM.
   2-FØR SENSITIVITY TØ YIELD SPREAD
   3-FØR SENSITIVITY TØ YIELDS
   4-FØR YIELDS AND TERMINAL VALUES AT YØUR TERM. DATE
WHICH TABLE DØ YØU WANT ?1
```

SENSITIVITY ØF YIELD AND TERM. VALUE TØ TERM. DATE AT TERM.

TERM. DATE (IN YEARS)	YIELD TØ TERMINAL DATE			TERMINAL VALUE		
	ØLD BØND	TAX SW.	NEW BØND	ØLD BØND	TAX SW.	NEW BØND
.5	9.36	9.34	50.17	96.11	96.1	115.28
1	6.24	6.23	25.22	96.87	96.86	115.22
1.5	5.21	5.2	17.47	98.4	98.39	116.65
2	4.7	4.7	13.69	99.96	99.94	118.09
2.5	4.4	4.4	11.46	101.54	101.53	119.56
3	4.2	4.2	9.98	103.16	103.14	121.05

The first table illustrates that for the two-year time horizon a tax switch is actually disadvantageous, but a switch into the new bond offers a substantial advantage, the terminal value rising from about $100 to about $118. In addition, the dollar advantage in terminal value is about the same whether the yield forecasts are achieved in half a year or three years. If they are achieved early, as yield comparisons show, the terminal advantage will be earned quickly and the switch will prove that much more profitable.

After printing the sensitivity table, the program asks the investor again which table is wanted. By typing 2, the user indicates the table of sensitivity of yields and terminal values to the yield stpread. For this table, the program needs more information; therefore, it asks the investor to supply the range of spreads over which the analysis should be made. In our example, a range has been specified from a spread of -100 basis points to a spread of +100 basis points, and has indicated the desire to see the results for steps of 30 basis points. (The yield originally forecasted for the old bond will be used for the table, and the yield forecast for the new bond will be varied in steps of 30 basis points.)

The computer has printed the yield comparison and the terminal value comparison for yield spreads between the old and new bond at the terminal date (-100 basis points, -70 basis points, -40 basis points, and so on down to +80 basis points). (It does not show the comparison for a spread of +100 basis points, of course, because steps of 30 beginning at -100 will not reach +100.) The spread that was actually supplied in the original data was -50 points. As the second table illustrates, the more negative the spread at the terminal date, the more profitable the switch will prove. In addition, even if the spread is as high as +80 basis points, the switch will still be profitable. To see at exactly what point the switch would become unprofitable, the program could be rerun supplying different high and low spreads.

WHICH TABLE DØ YØU WANT ?2

DESIGNATE RANGE ØF SPREAD(NEW BØND YIELD-ØLD BØND YIELD AT TERMINAL DATE) INPUT HIGH SPREAD, LØW SPREAD AND INCREMENT IN BASIS PØINTS. FØR EXAMPLE, -100,100,25.
?-100,100,30

SENSITIVITY ØF YIELD AND TERMINAL VALUE TØ SPREAD AT TERM. ØLD BØND YIELD HELD CØNSTANT.

SPREAD (IN BASIS PTS.)	YIELD TØ TERMINAL DATE			TERMINAL VALUE		
	ØLD BØND	TAX SW.	NEW BØND	ØLD BØND	TAX SW.	NEW BØND
-100	4.7	4.7	17.13	99.96	99.94	125.71
-70.00001	4.7	4.7	15.04	99.96	99.94	121.03
-40.00001	4.7	4.7	13.03	99.96	99.94	116.67
-10.00002	4.7	4.7	11.11	99.96	99.94	112.61
19.99998	4.7	4.7	9.26	99.96	99.94	108.83
49.99998	4.7	4.7	7.49	99.96	99.94	105.29
79.99997	4.7	4.7	5.8	99.96	99.94	101.99

Once again, the program asks the investor to specify which is wanted. This time, the investor has typed 3, indicating that a table of sensitivity of yields and terminal values to the yield forecast is made. When the original data was supplied, an estimated yield of 5% at the terminal date on the old bond and 4-1/2% at the terminal date on the new bond was specified. As the printout below indicates, the computer asks the investor to specify a high and a low yield for the old bond at the terminal date, and to indicate the steps the computer should go through in printing the yield and terminal value comparisons. The investor has indicated that he would like to look at comparisons over the range from a 5 to a 6% yield on the old bond at the terminal date, in steps of 20 basis points.

```
WHICH TABLE DØ YØU WANT ?3

DESIGNATE RANGE ØF ØLD BØND YIELDS AT TERMINAL DATE.
INPUT HIGH YIELD, LØW YIELD AND INCREMENT DESIRED, FØR EXAMPLE:
.06,.05,.002.
?.06,.05,.002

SENSITIVITY ØF YIELD AND TERM. VALUE TØ YIELD AT TERM.
SPREAD HELD CØNSTANT.
```

YIELD (ØLD BØND)	YIELD TØ TERMINAL DATE			TERMINAL VALUE		
	ØLD BØND	TAX SW.	NEW BØND	ØLD BØND	TAX SW.	NEW BØND
.05	4.7	4.7	13.69	99.96	99.94	118.09
.052	4.67	4.66	12.38	99.9	99.88	115.29
.054	4.64	4.63	11.11	99.84	99.82	112.61
.056	4.61	4.6	9.87	99.77	99.76	110.06
.058	4.58	4.57	8.66	99.71	99.7	107.62
.06	4.55	4.54	7.49	99.65	99.64	105.29

For this table, the yield spread has been held constant at the -50 basis points originally specified when the data was placed in the program. As the third table illustrates, if the yield spread at the terminal date turns out to be the -50 basis points that the investor has estimated, the comparison is still sensitive to the general yield level. If the old bond is yielding 6% two years in the future, rather than the 5% estimated by the investor, the switch will still prove profitable, but considerably less profitable.

Next, the program asks again which table the investor would like. This time the answer is 4, indicating that the investor would simply like to see the yield and terminal values corresponding to the date originally supplied to the program. As shown below, the computer then prints these yields and terminal values.

```
WHICH TABLE DØ YØU WANT ?4


YIELD TØ SALE DATE A/T IF ØLD BØND KEPT          4.703 PERCENT
YIELD TØ SALE DATE A/T ØN TAX SWITCH               4.695
YIELD TØ SALE DATE A/T ØN SWITCH TØ NEW BD        13.689


TERMINAL VALUE IF ØLD BØND KEPT                    99.96
TERMINAL VALUE ØF TAX SWITCH                       99.94
TERMINAL VALUE ØF SWITCH TØ NEW BØND              118.09
```

Example 2 illustrated below is the method of entering data by line.

```
DØ YØU WANT INSTRUCTIØNS FØR SUPPLYING DATA ?NØ
ENTER DATA ITEMS 1 THRØUGH 13

?90.375,91,2.75,2,5,100,.48,84,5.125,32,9,100,.48

ENTER DATA ITEMS 14 THRØUGH 24

?2,0,.05,.045,.25,.25,.25,.25,.25,.25,.03

TABLE ØF YIELDS AND TERMINAL VALUES AT TERM. DATE TYPE:
   0-FØR NØ TABLES
   1-FØR SENSITIVITY ØF YIELD AND TERMINAL VALUES TØ TERM.
   2-FØR SENSITIVITY TØ YIELD SPREAD
   3-FØR SENSITIVITY TØ YIELDS
   4-FØR YIELDS AND TERMINAL VALUES AT YØUR TERM. DATE

WHICH TABLE DØ YØU WANT ?1
```

This BASIC program computes the before- and after-tax yield to maturity of a bond given the annual coupon, the redemption value, the maturity, and the price. The user specifies tax rates for interest receipts (T1) and capital gains (T2). Premium on purchase is amortized over the maturity and deducted at rate T1. Discount at purchase is taxed at maturity at rate T2.

This is a more complex program than BONDPR, because it calculates not only a yield to maturity, but also a yield to maturity after income tax. In addition to the annual coupon payment, the amounts to be received at redemption, the maturity, and the current price of the bond, the user must furnish two tax rates. The first tax rate, T1, will be applied to receipts of interest payments. This rate will generally be the investor's ordinary income tax rate except where the bond is tax-exempt in which case this rate will be zero. The second tax rate, T2, is the capital gain rate. The computer will apply this tax rate at maturity to the amount by which the redemption proceeds exceed the purchase price of the bond. For an individual purchaser, the capital gain rate will normally be half the ordinary tax rate, with a maximum of 25%. For a corporate purchaser, the rate will normally be 25%.

For tax purposes, any premium at purchase above the amount to be received at redemption is amortized over the maturity of the bond, and the amortization reduces taxes at the rate T1.

INSTRUCTIONS

The program inquires about the method of entering data as follows:
DO YOU WANT INSTRUCTIONS FOR SUPPLYING DATA?

There are three options:

1. If you answer YES, the program will print out a description of each line of data to be entered; enter the data one line at a time.
2. If you answer NO, the program will ask for the data to be entered in lines one through five; enter the data, separated by commas, on one line.
3. If you answer DATA, the data already in the program will be printed out.

See the Sample Problem for examples of all three methods discussed above.

SAMPLE PROBLEM

Find the before- and after-tax yields, assuming a $5 annual coupon, $100 proceeds at redemption, a maturity of six years, 5-1/4 months, a price of $97, and tax rates of 50% on interest receipts and 25% on capital gains.

SAMPLE SOLUTION

The three printouts illustrate the three methods available to the user of BONDYD. In the first the user requests instructions, while in the second data is entered on a line basis. The final example uses data already entered in the program.

Example 1

```
* RUN

DØ YØU WANT INSTRUCTIØNS FØR ENTERING DATA ?YES
ENTER THE FØLLØWING DATA ITEMS
ITEM 1          ANNUAL CØUPØN (IN DØLLARS)      ?5
ITEM 2          PRØCEEDS ØN REDEMPTIØN          ?100
ITEMS 3 & 4     MATURITY IN YEARS, MØNTHS       ?6,5.25
ITEM 5          PRICE                           ?97
ITEMS 6 & 7     TAX RATES ØN INCØME, CAP GNS    ?.5,.25
CØUPØN            5   REDEMPTIØN AT          100   PRICE   97
MATURITY            6 YEARS     5.25 MØNTHS
TAX RATES          .5 ØN INCØME                    .25 ØN CAPITAL GAINS
YIELD BEFØRE TAX                  5.560054 PERCENT
YIELD AFTER TAX                   2.907394 PERCENT
```

Example 2

```
*RUN


DØ YØU WANT INSTRUCTIØNS FØR ENTERING DATA ?NØ

ENTER ITEMS 1 THRØUGH 7 ?5,5.25@@@@100,6,5.25,97,.5..25
ILLEGAL INPUT. RETYPE ?5,100,6,5.25,97,.5,.25

CØUPØN            5   REDEMPTIØN AT          100   PRICE   97
MATURITY            6 YEARS     5.25 MØNTHS
TAX RATES          .5 ØN INCØME                  .25 ØN CAPITAL GAINS

YIELD BEFØRE TAX                  5.560054 PERCENT

YIELD AFTER TAX                   2.907394 PERCENT
```

Example 3

```
*RUN


DØ YØU WANT INSTRUCTIØNS FØR ENTERING DATA ?DATA

CØUPØN            5   REDEMPTIØN AT          100   PRICE   97
MATURITY            6 YEARS     5.25 MØNTHS
TAX RATES          .5 ØN INCØME                  .25 ØN CAPITAL GAINS

YIELD BEFØRE TAX                  5.560054 PERCENT

YIELD AFTER TAX                   2.907394 PERCENT
```

SAMPLE PROBLEM 2

Calculate the yield on a callable bond if the bond is called three years, 11-1/4 months in the future, at the call price ($102.75 in this case), corresponding to that call date. Other variables are the same as those in the first sample problem.

SAMPLE SOLUTION 2

```
READY
*RUN

DØ YØU WANT INSTRUCTIØNS FØR ENTERING DATA ?YES

ENTER THE FØLLØWING DATA ITEMS

ITEM 1          ANNUAL CØUPØN (IN DØLLARS)      ?5

ITEM 2          PRØCEEDS ØN REDEMPTIØN          ?102.75

ITEMS 3 & 4     MATURITY IN YEARS, MØNTHS       ?3,11.25

ITEM 5          PRICE                           ?97

ITEMS 6 & 7     TAX RATES ØN INCØME, CAP GNS    ?.5,.25

CØUPØN            5   REDEMPTIØN AT      102.75   PRICE   97
MATURITY            3 YEARS        11.25 MØNTHS
TAX RATES          .5 ØN INCØME                    .25 ØN CAPITAL GAINS

YIELD BEFØRE TAX                  6.498593 PERCENT

YIELD AFTER TAX                   3.637365 PERCENT
```

This BASIC program takes historical data of monthly revenues and expenses and predicts the next year's cash flow requirements. This problem is slanted to a municipality or state government, but the user may adjust names and expense and revenue accounts to cover any situation.

INSTRUCTIONS

To use program:

1. Delete sample data in lines 100-400 (DELETE 100, 400).
2. Type data in lines 100-1000 in this manner:
   a. First type in the number of revenue accounts; second, type the number of expense accounts; and third, type the number of years of data.
   b. Next, type the name of the first revenue account, followed by its monthly data from the first year.
   c. After this, type the monthly data for the second year through the last year.
   d. After this account data has been entered, the other revenue accounts are typed, followed by the expense accounts.
   e. The last data to be entered is the budget totals for each account for the coming year.
3. Now type RUN.

SAMPLE PROBLEM

Predict the next year's cash flow requirements based on the historical data already entered and illustrated as follows.

SAMPLE SOLUTION

```
READY

*LIST 99-400

99REM SAMPLE DATA
100 DATA 2,3,4
110 DATA TAXES
120 DATA 22.4,29.13,35.10,42.3,48.29,57.48,66.30,72.25,77.1,84.40
130 DATA 91.17,96.23
140 DATA 24.09,30.23,38.12,45.82,55.12,62.96,68.87,74.57,80.9
150 DATA 92.13,101.93,109.67
160 DATA 24.50,33.42,41.86,52.15,59.23,69.98,78.32,89.75,95.69
170 DATA 106.42,114.35,124.7
180 DATA 25.22,35.19,46.17,57.47,68.67,76.34,85.72,96.24,108.95
190 DATA 117.38,126.56,138.40
200 DATA LICENCES
210 DATA 5.3,6.2,7.2,6.9,5.6,4.2,3.1,2.9,3.4,5.3,2.1,1.8
220 DATA 2.9,7.4,8.1,7.2,6.1,5.6,4.2,2.9,3.3,5.5,2.3,1.9
230 DATA 4.8,8.2,9.0,7.8,6.7,5.9,5.1,3.3,3.7,5.4,2.7,1.8
240 DATA 5.0,7.9,9.2,8.3,7.2,6.4,5.3,3.7,4.1,5.2,2.8,1.7
250 DATA PAYROLL
260 DATA 55,55,55,55,55,55,55,55,55,56,57,57
270 DATA 61,62,62,62,62,62,62,62,56,56,56,63
280 DATA 69,69,69,69,69,69,69,70,70,70,70,70
290 DATA 77,77,77,77,77,79,79,79,79,79,79,79
300 DATA WELFARE
310 DATA 7.28,6.29,5.37,5.42,3.56,3.56,3.68,3.98,4.45,6.37,6.98,7.10
320 DATA 7.33,6.32,5.27,5.40,3.60,3.60,3.60,3.87,4.87,6.42,6.95,7.03
330 DATA 6.27,6.33,5.22,5.37,3.41,3.43,3.41,3.59,4.43,6.07,6.16,6.83
340 DATA 5.98,6.07,5.25,5.23,4.21,3.45,3.37,3.37,3.99,5.86,5.75,6.08
350 DATA HIGHWAY
360 DATA 4.2,4.1,3.8,3.8,4.0,4.8,4.41,4.7,4.08,2.9,2.8,3.5
370 DATA 4.1,4.3,3.9,3.7,4.2,4.9,4.95,4.95,4.35,3.3,3.2,3.7
380 DATA 4.3,4.2,3.85,3.9,4.5,5.0,5.1,4.9,4.8,3.4,3.4,4.1
390 DATA 4.4,4.2,3.9,4.1,4.6,5.2,5.3,5.1,4.1,3.7,3.7,4.2
400 DATA 1080,68,1030,60,58
```

READY

*RUN

FØRECASTED INCØME STATEMENT

	JAN	FEB	MAR	APR	MAY	JUN
REV ACCTS						
TAXES	28.45	39.25	50.87	63.20	74.78	84.27
LICENCES	5.03	8.19	9.40	8.42	7.27	6.45
TØTAL REVENUES	33.48	47.44	60.27	71.62	82.05	90.72
EXP ACCCTS						
PAYRØLL	84.80	84.87	84.87	84.87	84.87	86.51
WELFARE	6.18	6.21	5.31	5.33	4.08	3.50
HIGHWAY	4.86	4.68	4.33	4.50	5.07	5.73
TØTAL EXPENSES	95.84	95.76	94.51	94.70	94.02	95.74
NET SURP(DEF)	-62.36	-48.32	-34.24	-23.08	-11.97	-5.02
CUM SURP(DEF)	-62.36	-110.68	-144.92	-168.00	-179.97	-184.99

CASHFLOW-4

	JUL	AUG	SEP	ØCT	NØV	DEC
REV ACCTS						
TAXES	94.49	106.27	118.62	128.91	139.08	151.81
LICENCES	5.35	3.70	4.11	5.45	2.84	1.80
TØTAL REVENUES	99.84	109.97	122.73	134.36	141.92	153.61
EXP ACCCTS						
PAYRØLL	86.51	86.74	86.35	86.37	86.39	86.86
WELFARE	3.43	3.48	4.17	6.00	5.97	6.35
HIGHWAY	5.83	5.62	4.73	4.02	4.01	4.62
TØTAL EXPENSES	95.77	95.84	95.25	96.39	96.37	97.83
NET SURP(DEF)	4.07	14.13	27.48	37.97	45.55	55.78
CÜM SURP(DEF)	-180.92	-166.79	-139.31	-101.34	-55.79	.00

This BASIC program calculates monthly or annual depreciation by straight-line, double-declining balance, sum-of-the-years-digits, and 150% declining balance.

INSTRUCTIONS

Enter data as requested by the program.

SAMPLE PROBLEM

Calculate the depreciation of a machine costing $2,100 and having a salvage value of $100 after ten years. Use a discount rate of 5%.

SAMPLE SOLUTION

```
THIS PRØGRAM CØMPUTES AND PRINTS DEPRECIATIØN BY MØNTHS BY
STRAIGHT LINE, DØUBLE DECLINING BALANCE, SUM-
THE-YEARS-DIGITS, AND 150 PERCENT DECLINING BALANCE.

IF YØU WISH TØ SUPPRESS MØNTH BY MØNTH DETAIL,TYPE
'1' AFTER QUESTION MARK. ØTHERWISE, TYPE '0'. ?1

WHAT IS THE AMØUNT ØF THE INVESTMENT ?2100

WHAT IS THE SALVAGE VALUE ?100

WHAT IS THE DEPRECIABLE LIFE (IN YEARS) ?10

AT THE END ØF WHICH MØNTH (1 THRU 12), AND IN WHAT YEAR
(EG.1968) IS THE INVESTMENT MADE ?12,1969

WHAT IS THE DISCØUNT RATE (IN DECIMAL NØTATIØN) FØR CØMPUTING
THE PRESENT VALUE ØF THE ANNUAL DEPRECIATIØN ?.05

YØU HAVE ØPTIØNS ØN SWITCHØVER FRØM DØUBLE DECLINING BALANCE TØ
STRAIGHT LINE. TØ PREVENT SWITCHØVER TYPE 0; TØ SPECIFY THE
YEAR ØF SWITCHØVER, TYPE THE YEAR; TØ ØBTAIN AUTØMATIC SWITCH-
ØVER WHEN THE ANNUAL STRAIGHT LINE DEPRECIATIØN BECØMES
GREATER THAN DØUBLE DECLINING BALANCE, TYPE 1. WHICH DØ YØU
WANT ?0
```

DATE	STRLINE	DDB	SYD	150\DB
1969	0	0	0	0
CUM DEP	0	0	0	0
UNDEPR BAL	2000	2000	2000	2000
1970	200	420	363.6364	315
CUM DEP	200	420	363.6364	315
UNDEPR BAL	1800	1580	1636.364	1685
1971	200	336	327.2727	267.75
CUM DEP	400	756	690.909	582.75
UNDEPR BAL	1600	1244	1309.091	1417.25
1972	200	268.8	290.9091	227.5875
CUM DEP	599.9999	1024.8	981.8181	810.3374
UNDEPR BAL	1400	975.2001	1018.182	1189.663
1973	200	215.04	254.5455	193.4494
CUM DEP	799.9999	1239.84	1236.363	1003.787
UNDEPR BAL	1200	760.1601	763.6365	996.2132
1974	200	172.032	218.1819	164.432
CUM DEP	999.9999	1411.872	1454.545	1168.219
UNDEPR BAL	1000	588.1281	545.4548	831.7814
1975	200	137.6256	181.8183	139.7672
CUM DEP	1200	1549.497	1636.363	1307.986
UNDEPR BAL	800.0002	450.5026	363.6366	692.0142
1976	200	110.1005	145.4546	118.8021
CUM DEP	1400	1659.598	1781.818	1426.788
UNDEPR BAL	600.0004	340.4022	218.182	573.2121
1977	200	88.08044	109.091	100.9818
CUM DEP	1600	1747.678	1890.909	1527.77
UNDEPR BAL	400.0005	252.3219	109.0911	472.2303
1978	200	70.46437	72.72738	85.83455
CUM DEP	1799.999	1818.142	1963.636	1613.604
UNDEPR BAL	200.0006	181.8576	36.36377	386.3958
1979	200.0006	56.37151	36.36377	72.95937
CUM DEP	1999.999	1874.514	2000	1686.563
UNDEPR BAL	0	125.4862	0	313.4365
PRESENT VALUE OF DEPRECIATION AT THE BEGINNING OF 1969 @ 5 %	1470.807	1494.531	1578.019	1318.704

This BASIC program calculates the monthly payments schedule for an installment loan and prints it in ledger format. The program determines the monthly payment to be made by the borrower and prorates it among three uses: principal repayment, insurance expense reimbursement, and interest payment. Interest and insurance are amortized over the life of the loan according to the sum-of-the-months digits method. The residual of the monthly payment is then used for principal repayment.

INSTRUCTIONS

Sample data is entered in lines 1090 and 1100. To use the program, remove sample data (DELETE 1090, 1100) and enter new data in this format:

*1090, Name, Street, City

*1100 Beginning month, beginning day, beginning year, loan amount, insurance amount, interest rate, effective rate, month to maturity.

SAMPLE PROBLEM

Calculate the monthly payments schedule of a 12-month loan of $2500 beginning on July 1, 1972, at an interest rate of 6%, an effective interest rate of 11%. The insurance costs $31.91.

SAMPLE SOLUTION

```
* RUN

                INSTALLMENT LØAN LEDGER
                -----------------------

JAMES JØNES
100 CACTUS AVE.
PHØENIX, ARIZ.

AMØUNT ØF LØAN              2500.00
INTEREST                     152.01
INSURANCE                     31.91
                            --------
FACE AMØUNT ØF THE NØTE     2683.92


ADD ØN INTEREST RATE  .06
EFFECTIVE RATE  .11
DATE ØF LØAN IS  JULY      1 , 1972
MØNTHS TØ MATURITY   12
MØNTHLY PAYMENT   $      223.66
```

INSTLO-2

DATE DUE	DATE PAID	BALANCE REMAIN	PAYØFF BALANCE	IRREG PAYMENT	NEW ØR SHØRT	UNEARN INSURE	REMAINING INTEREST	EARNED INTERE$
1972								
JULY	NØNE	2683.92	2500.00			31.91	152.01	
AUG		2460.26	2304.64			27.00	128.62	23.39
SEPT		2236.60	2106.92			22.50	107.18	21.44
ØCT		2012.94	1906.84			18.41	87.69	19.49
NØV		1789.28	1704.40			14.73	70.15	17.54
DEC		1565.62	1499.60			11.46	54.56	15.59
1973								
JAN		1341.96	1292.44			8.60	40.92	13.64
FEB		1118.30	1082.92			6.15	29.23	11.69
MAR		894.64	871.05			4.10	19.49	9.74
APR		670.98	656.83			2.46	11.69	7.80
MAY		447.32	440.25			1.23	5.84	5.85
JUNE		223.66	221.31			0.41	1.94	3.90
JULY		0.00	0.00			0.00	0.00	1.94

TØTAL INTEREST PAID IN 1972 IS 97.45

TØTAL INTEREST PAID IN 1973 IS 54.57

This BASIC program calculates the effective interest rate compounded over any desired period. Included is the option to compound over the shortest period between payments, a compliance required of Regulation Z (Truth in Lending) of the Federal Reserve System.

METHOD

The user need only type RUN to use the program. All the necessary data is input while the program is running. However, the program method is best illustrated in the following example.

A lender is negotiating a customer loan for $5000. The customer requests repayment be made over a 72-week period, paying $100 on the 15th of each month, and $200 on the 30th of each month for the next 15 months, followed by a final payment of $1000 at the end of 13 months (3 months after the last $200 payment). However, the lender offers a repayment plan of $150 every 15 days for the next 38 months, according to standard loan policy.

In order to check the compound interest rates of the alternatives, INTRSTZ is run. Initial input is the loan amount, $5000, and the shortest period between payments of HALF MONTH. Next input is the payments schedule, $200 for the 2nd, 4th, etc., through the 29th period, and $1000 for the 36th period. Note that a 0 is the final entry, which signals the end of the payments schedule. This 0 must be in the last line of the entries.

The compounding period for this loan is semimonthly, and a complete printout of the schedule of payments is requested. The program provides the schedule of payments, the interest rate compounded annually, the interest rate compounded over the period specified (semimonthly, for example), and the excess of payments over the loan amount.

SAMPLE RUN

```
SYSTEM ?BASIC
ØLD ØR NEW-ØLD INTRSTZ
READY
*RUN
```

```
1.  AM0UNT 0F L0AN                                          ?5000

2.  SH0RTEST PERI0D BETWEEN PAYMENTS
(DAY,WEEK,HALF M0NTH, M0NTH,QUARTER,
HALF YEAR,YEAR)                                             ?HALF M0NTH

3.  AM0UNT 0F PAYMENT AND PERI0D(S) 0F PAYMENT
(E.G. 100,1,2,3,4,5,6)
INPUT 0 AFTER ALL PAYMENTS HAVE BEEN ENTERED                ?200,2,4,6,8,10
                                                            ?200,12,14,16,18
                                                            ?200,20,22,24
                                                            ?200,26,28,30
                                                            ?100,1,3,5,7,9,11
                                                            ?100,13,15,17,19
                                                            ?100,21,23,25,27
                                                            ?100,29
                                                            ?1000,36
                                                            ?0

4.  C0MP0UNDING PERI0D
(DAILY,WEEKLY,SEMIM0NTHLY,M0NTHLY,
QUARTERLY,SEMIANNUALLY,ANNUALLY,
TIME T0 PAYMENT)                                            ?SEMIM0NTHLY

5.  W0ULD Y0U LIKE T0 HAVE
THE SCHEDULE 0F PAYMENTS PRINTED                            ?YES
```

PAYMENT NUMBER	PAYMENT AM0UNT	END 0F HALF M0NTH
1	200.00	2
2	200.00	4
3	200.00	6
4	200.00	8
5	200.00	10
6	200.00	12
7	200.00	14
8	200.00	16
9	200.00	18
10	200.00	20
11	200.00	22
12	200.00	24
13	200.00	26
14	200.00	28
15	200.00	30

```
   16            100.00             1
   17            100.00             3
   18            100.00             5
   19            100.00             7
   20            100.00             9
   21            100.00            11
   22            100.00            13
   23            100.00            15
   24            100.00            17
   25            100.00            19
   26            100.00            21
   27            100.00            23
   28            100.00            25
   29            100.00            27
   30            100.00            29
   31           1000.00            36

ANNUAL INTEREST RATE C0MP0UNDED ANNUALLY =  12.9 %

ANNUAL INTEREST RATE C0MP0UNDED SEMIM0NTHLY =  12.2 %

 THE EXCESS 0F PAYMENTS 0VER L0AN AM0UNT IS       $500.00
```

Since the lender also wants to compute the interest rates for the alternate repayment schedule, YES is the reply to the program question: WOULD YOU LIKE TO CHANGE SOME OF THE INPUT DATA. Only payments schedule is changed, so a 3 is entered indicating such. Then the payments schedule of $150 for the 36 semimonthly payments is entered, and a 0 to signal the end of the schedule. The program provides the same output as for the first repayment alternative, but the schedule of payments printout is suppressed. The alternate calls for a lower interest rate.

```
W0ULD Y0U LIKE T0 CHANGE S0ME 0F THE INPUT DATA     ?YES

W0ULD Y0U LIKE T0 CHANGE
   1. AM0UNT
   2. PERI0D BETWEEN PAYMENTS
   3. PAYMENTS SCHEDULE
   4. C0MP0UNDING PERI0D
   5. AM0UNT & PAYMENTS SCHEDULE
   6. ALL 0F THE INPUT DATA

ENTER 1,2,3,4,5 0R 6                                ?3
```

```
3.  AM0UNT 0F PAYMENT AND PERI0D(S) 0F PAYMENT
(E.G. 100,1,2,3,4,5,6)
INPUT 0 AFTER ALL PAYMENTS HAVE BEEN ENTERED        ?150,1,2,4,5,6
                                                    ?150,7,8,9,10,11,12
                                                    ?150,13,14,15,16,17
YES                                                 ?18,19,20,21,22,23

ENTER 1,2,3,4,5 0R 6                                ?3

3.  AM0UNT 0F PAYMENT AND PERI0D(S) 0F PAYMENT
(E.G. 100,1,2,3,4,5,6)
INPUT 0 AFTER ALL PAYMENTS HAVE BEEN ENTERED        ?150,1,2,3,4,5,6,7
                                                    ?150,8,9,10,11,12,13
                                                    ?150,14,15,16,17,18
                                                    ?150,19,20,21,22,23,24
                                                    ?150,25,26,27,28,29,30
                                                    ?150,31,32,33,34,35,35
                                                    ?0

5.  W0ULD Y0U LIKE T0 HAVE
THE SCHEDULE 0F PAYMENTS PRINTED                    ?N0

ANNUAL INTEREST RATE C0MP0UNDED ANNUALLY =  10.8 %

ANNUAL INTEREST RATE C0MP0UNDED SEMIM0NTHLY =  10.3 %

 THE EXCESS 0F PAYMENTS 0VER L0AN AM0UNT IS      $400.00

W0ULD Y0U LIKE T0 CHANGE S0ME 0F THE INPUT DATA    ?N0
```

INVANL, a business program written in FORTRAN, analyzes return-on-investment by computing a payback period and a discounted rate of return for a series of cash flows resulting from capital expenditures. The program follows a standardized procedure and can be particularly useful in making capital appropriation requests for machinery, equipment, computers, etc.

Specifically, INVANL is useful in determining profitability and economic justification for investments. There are two parts to the program: cash flow analysis and return-on-investment analysis. The objective of cash flow analysis is to compute the yearly cash flow resulting from the investment and to determine its payback period. The objective of the return-on-investment analysis is to compute the average annual rate of return from the investment based on a discounted cash flow method.

INSTRUCTIONS

The program asks the user to enter the data. Input data includes:

Net Initial Investment — initial cost in dollars of requested investment. The expenditure is made at some point in time called year zero. All other income and outlays begin in year one. Enter investment as minus dollars.

Weighted Cost of Capital — average cost or charge for obtaining investment capital. The percentage figure represents an average cost of the source of funds, weighted by the company debt/equity ratio.

Project Life — the number of years for which you are analyzing cash flows. Project life may represent depreciable life, lease agreement or an unspecified length of time. Year zero merely represents the point in time at which you make the investment. The next day is the first day of year one (no income can be credited to year zero). The program is designed to handle flows for up to 100 years.

Outlays — yearly investment or rental expenditure as part of total capital investment (excludes operating expenses). All outlays and expenditures must be entered as minus numbers. If no outlay is made, enter zero for the year.

Income — yearly operating savings or earnings (losses) before interest and depreciation charges. Losses should be entered as minus dollars.

Cash Flow Analysis

A = year
B = opening balance = closing balance from previous year
C = investment or rental outlay
D = operating income or savings
E = average net investment for year
F = cost of capital = X% of E (X is percentage rate)
G = closing balance = B+C+D+F

Cost of capital charges are subtracted from income to obtain a net cash flow figure (income-outlay-interest). A payback period is then determined by crossover of net cash flow from negative to positive. After payback, the cost of capital figures are added to income on the assumption that earnings are reinvested at a rate at least equal to the cost of capital.

Discounted Rate of Return

Present Value Equation: present value of cash flows = $R/(1+i)^x$

Cumulative P. V. of Cash Flows = $\Sigma\ Ro/(1+i)^1 + \ldots\ Rn/(1+i)^n$

where

- R is operating cash flow (income-outlay)
- i is some interest rate (the discounted rate of return is that interest rate which equates the present value of future returns to the present investment outlay)
- n is project life in years
- x is a given year in project life investment

The discounted rate of return can be compared with the cost of capital to determine the profitability of the investment and with desired rates of return for purposes of ranking investments. At the end of the report a choice is provided:

- If 1 is typed, it is possible to change selected years outlay/income for the same investment and/or cost of capital or project life (see second printout).
- If 2 is typed, it is possible to analyze a whole new capital investment (i.e., a new project may be entered).
- If 3 is typed, it will end the run.

All dollar figures must be entered as whole numbers, with no commas or decimals. All outlays and losses should be negative numbers. The cost of capital may be carried to two decimal places. The project life must be a whole number between 1 and 100. If there is no outlay for a year, type 0. Hit the RETURN key (carriage return) after each line of input.

SAMPLE PROBLEM

Analyze the return on a net initial investment of $1 million over five years when the weighted cost of capital is 8.0%. Outlay and income are as indicated in the Sample Solution.

SAMPLE SOLUTION

```
*RUN=(C@RE=20K)

D@ Y@U WANT DESCRIPTI@N @F R@I PR@GRAM? 1=YES  2=N@
=1
THIS PR@GRAM CALCULATES THE DISC@UNTED RATE @F RETURN
WHICH EQUATES THE PRESENT VALUE @F THE @PERATING CASH
FL@W T@ ZER@. A PAYBACK PERI@D IS AL$@ C@MPUTED, BASED @N
NET CASH FL@W. INTEREST IS C@MPUTED @N THE AVERAGE BALANCE
F@R THE YEAR. THE PR@GRAM @FFERS SENSITIVITY ANALYSIS BY
ALL@WING THE USER T@ CHANGE SELECTED FIGURES F@R THE
THE SAME CAPITAL INVESTMENT.



ENTER INPUT DATA:
NET INITIAL INVESTMENT IN D@LLARS @NLY(EG. -5000)
=-1000000
WEIGHTED C@ST @F CAPITAL IN % (EG. 8.0)
=8.0
PR@JECT LIFE IN YEARS
=5
@UTLAY, INC@ME(SEPARATE BY C@MMA;MINUS F@R @UTLAY)
INPUT IN D@LLARS @NLY(E.G. -1000,3000)


YEAR     1
=-500000,300000
YEAR     2
=-100000,700000
YEAR     3
=0,1000000
YEAR     4
=0,1000000
YEAR     5
=0,1000000
```

INVANL-4

INPUT DATA SUMMARY

YEAR	@UTLAY @	INC@ME I	INTEREST X
0	-1000000.00	0.	0.
1	-500000.00	300000.00	-88000.00
2	-100000.00	700000.00	-79040.00
3	0.	1000000.00	-21363.20
4	0.	1000000.00	56927.74
5	0.	1000000.00	141481.96

IS DATA C@RRECT 1=YES 2=N@
=1

YEAR	NET CASH FL@W @+I+X	CUMULATIVE FL@W END @F PERI@D
0	-1000000.00	-1000000.00
1	-288000.00	-1288000.00
2	520960.00	-767040.00
3	978636.80	211596.80
4	1056927.75	1268524.55
5	1141481.97	2410006.53

PAYBACK @F INI. INV. IS 2 YEARS 10 M@NTHS

YEAR	@PERATING CASH FL@W @+I	PRESENT VALUE @F @PERATING CASH FL@W
1	-200000.00	-143900.29
2	600000.00	310609.38
3	1000000.00	372473.16
4	1000000.00	267994.97
5	1000000.00	192822.77

CUMULATIVE PRESENT VALUE @F CASH FL@WS 1000000.00

RATE @F RETURN EQUATING P.V. @F FL@W T@ ZER@ IS 38.99 %

ENTER 1,2,@R 3: 1=CHANGE SELECTED DATA, 2=CHANGE ALL DATA, 3=ST@P.
=3

Assuming the results of the previous run are unsatisfactory, typing 1 allows changes to be made. In the following example, the same investment is changed to six years, different data is entered for year 2, and additional data is entered for year 6. Note the period after each income figure.

```
*

ENTER 1,2,ØR 3: 1=CHANGE SELECTED DATA, 2=CHANGE ALL DATA, 3=STØP.
=1
ENTER INPUT DATA:
NET INITIAL INVESTMENT IN DØLLARS ØNLY(EG. -5000)
=-1000000
WEIGHTED CØST ØF CAPITAL IN % (EG. 8.0)
=8.0
PRØJECT LIFE IN YEARS
=6
TØ CHANGE DATA,TYPE YEAR CØMMA ØUTLAY CØMMA INCØME
PERIØD   THEN CR
MINUS FØR ØUTLAY; PERIØD MUST APPEAR(EG. 4,-1000,5000.)
TØ STØP TYPE 'END'  THEN CR
=2,-200000,600000.
=6,0,500000.
=END
INPUT DATA SUMMARY

                  ØUTLAY          INCØME          INTEREST
YEAR                Ø               I               X
 0          -1000000.00            0.              0.
 1           -500000.00       300000.00       -88000.00
 2           -200000.00       600000.00       -87040.00
 3                 0.        1000000.00       -38003.20
 4                 0.        1000000.00        38956.54
 5                 0.        1000000.00       122073.07
 6                 0.         500000.00       191838.91
IS DATA CØRRECT 1=YES 2=NØ
=1
```

YEAR	NET CASH FLØW Ø+I+X	CUMULATIVE FLØW END ØF PERIØD
0	-1000000.00	-1000000.00
1	-288000.00	-1288000.00
2	312960.00	-975040.00
3	961996.80	-13043.20
4	1038956.55	1025913.34
5	1122073.06	2147986.41
6	691838.91	2839825.31

PAYBACK ØF INI. INV. IS 3 YEARS 1 MØNTHS

YEAR	ØPERATING CASH FLØW Ø+I	PRESENT VALUE ØF ØPERATING CASH FLØW
1	-200000.00	-145163.56
2	400000.00	210724.59
3	1000000.00	382369.13
4	1000000.00	277530.32
5	1000000.00	201436.44
6	500000.00	73103.08

CUMULATIVE PRESENT VALUE ØF CASH FLØWS 1000000.00

RATE ØF RETURN EQUATING P.V. ØF FLØW TØ ZERØ IS 37.78 %

ENTER 1,2,ØR 3: 1=CHANGE SELECTED DATA, 2=CHANGE ALL DATA, 3=STØP.
=1

Assume the cost of capital has been increased to 10.0% and the project life decreased to five years (see example below). In addition, changed data is submitted for year 2 and year 6.

By typing 1 at this point, the investor can handle these assumptions. Since the life has been set for five years, the data for year 6 is ignored and the warning message PROGRAM IS DESIGNED FOR AT LEAST ONE YEAR is printed. In this instance, the program still continues processing after END is typed.

```
ENTER INPUT DATA:
NET INITIAL INVESTMENT IN DØLLARS ØNLY(EG. -5000)
=-1000000
WEIGHTED CØST ØF CAPITAL IN % (EG. 8.0)
=10.0
PRØJECT LIFE IN YEARS
=5
TØ CHANGE DATA, TYPE YEAR CØMMA ØUTLAY CØMMA INCØME
PERIØD   THEN CR
MINUS FØR ØUTLAY; PERIØD MUST APPEAR(EG. 4,-1000,5000.)
TØ STØP TYPE 'END'  THEN CR
=2,-200000,650000.
=6,0,500000.
PRØGRAM DESIGNED FØR AT LEAST 1 YEAR, TRY AGAIN!
=END
INPUT DATA SUMMARY

                  ØUTLAY          INCØME          INTEREST
YEAR                Ø               I               X
 0          -1000000.00             0.              0.
 1           -500000.00        300000.00       -110000.00
 2           -200000.00        650000.00       -108500.00
 3                 0.         1000000.00        -46850.00
 4                 0.         1000000.00         48465.00
 5                 0.         1000000.00        153311.50
IS DATA CØRRECT 1=YES 2=NØ
=
```

The program informs the investor if the cumulative flow for the last period is negative by printing the statement OUTLAY EXCEEDS INCOME BY (e.g., – 500.00). If outlays exceed income, then the rate of return is zero.

```
ENTER 1,2,ØR 3: 1=CHANGE SELECTED DATA, 2=CHANGE ALL DATA, 3=STØP.
=2
ENTER INPUT DATA:
NET INITIAL INVESTMENT IN DØLLARS ØNLY(EG. -5000)
=-50000
WEIGHTED CØST ØF CAPITAL IN % (EG. 8.0)
=8.0
PRØJECT LIFE IN YEARS
=3
ØUTLAY, INCØME(SEPARATE BY CØMMA;MINUS FØR ØUTLAY)
INPUT IN DØLLARS ØNLY(E.G. -1000,3000)
```

```
YEAR     1
=-10000,20000
YEAR     2
=0,20000
YEAR     3
=0,20000

INPUT DATA SUMMARY

                    @UTLAY              INC@ME              INTEREST
YEAR                  @                   I                   X
 0                -50000.00              0.                  0.
 1                -10000.00           20000.00            -3600.00
 2                     0.             20000.00            -2688.00
 3                     0.             20000.00            -1303.04
IS DATA C@RRECT 1=YES 2=N@
=1

                    NET CASH FL@W                    CUMULATIVE FL@W
YEAR                  @+I+X                          END @F PERI@D
 0                  -50000.00                          -50000.00
 1                   6400.00                           -43600.00
 2                  17312.00                           -26288.00
 3                  18696.96                            -7591.04

@UTLAY EXCEEDS INC@ME BY       -7591.04
ENTER 1,2,@R 3: 1=CHANGE SELECTED DATA, 2=CHANGE ALL DATA, 3=ST@P.
=3
```

This BASIC program uses the Bower-Williamson[1] method of analysis to help the lessee make a lease/buy decision. LESSEE compares a lease with the alternative of borrowing the needed funds and purchasing the asset outright. The program assumes that if the asset is purchased it will be depreciated by the sum-of-the-years-digits method.

The Bower-Williamson method as used in LESSEE identifies and calculates two cost differences between owning and leasing. First, it calculates the financial advantage of the lease. This is simply the difference between the amount of debt capacity used up by the loan and that used up by the lease obligation. The financial advantage is measured by discounting the lease payments during the minimum time period of the lease (that is during the time the lessee cannot get out of the lease) at the interest rate the company would be charged on a loan, and subtracting this discounted present value from the amount that would have to be borrowed in order to purchase the asset. The Bower-Williamson method assumes that the obligations incurred in leasing use up borrowing power in the same way as loan obligations do.

Second, LESSEE calculates the discounted present value of the tax benefits associated with depreciation. This figure is clearly an advantage for ownership. To this is added the present value of all other cash flow advantages of the lease to get the operating advantage of the lease. In this calculation, the expense differences between leasing and owning in terms of the present value of the estimated salvage value of the property, and the difference in tax savings that results from the deductibility of rent payments in the case of the lease and of interest payments and property taxes when the asset is owned and financed with a loan, are included.

Beyond the minimum deviation of the lease, the rental obligation is assumed not to deplete borrowing capacity; the lease is treated as an operating lease, and the rent as an operating flow, so that during this period it enters into the operating advantage.

The cash flow difference between the lease and ownership cases is calculated for each year (the net balance in favor of the lease is designated the "basic cash flow saving with lease"), and the annual flows are discounted to give the final operating advantage of the lease.

---

[1] Bower, R. S., Herringer, F. C., Williamson, P. J., "Lease Evaluation," The Accounting Review, April 1966;
Bower, R. S., Williamson, P. J., "Lease Negotiation Using a Timing Computer," Business Quarterly, Winter 1966;
Bower, R. S., Williamson, P. J., "Computer Analysis of the Banker's Lease Investment Opportunity," Banker's Magazine, Spring 1967.

The sum of the financial advantage and the operating advantage gives the net advantage of the lease. If this figure is positive, then the lease is financially more attractive than ownership. If it is negative, then ownership is financially more attractive.

INSTRUCTIONS

To calculate the cash flow differences between leasing and borrowing and to get net advantage, the user must enter values for the following variables in lines 120 to 123.

120 DATA P, T, R1, R2

where

- P is the purchase price of the equipment
- T is the lessee's income tax rate (as a decimal)
- R1 is the interest rate that would be paid on a loan, compounded semiannually (decimal)
- R2 is the opportunity rate that can be earned, after taxes, on new investment, compounded semiannually (decimal)

121 DATA M, L, S1, S2

where

- M is the monthly rent, payable in advance
- L is the depreciable life of the equipment, in years
- S1 is the salvage value for tax purposes in dollars
- S2 is expected actual salvage value; which must be less than P, the purchase price

122 DATA E1, E2, Y, J

where

- E1 is the expenses of making the lease agreement
- E2 is the annual saving in expenses due to the lease
- Y is the expected duration of the lease in years
- J is the minimum duration of the lease in years

123 DATA X, X1, X2

where

- X is the identification of the variable for which a sensitivity analysis is to be done; 0 if no analysis, 1 if no purchase price, 2 if income tax rate, 3 if interest rate, etc., through 8 if actual salvage value
- X1 is the lowest value for the variable specified in 13
- X2 is the highest value for the variable specified in 13

R1 is the interest rate applicable to a loan incurred to finance the purchase of the asset and comparable in quality to a lease obligation. R1 is an annual rate, compounded semi-annually and expressed as a decimal, e.g., 06.

R2 is the after tax rate of return the lessee is making on investments similar to the asset being considered, also expressed as a decimal.

J is the length of the minimum duration of the lease; it is the number of years which the lessee is obligated to rent the asset. Y, the expected length of the lease, contains the minimum period plus the length of any renewals expected. Neither the expected lease life nor the minimum rental period contains any assumption about the ability of the lessee to "buy his way out" of the lease with the payment of a penalty before the end of the minimum rental period.

X offers options of listing the cash flows and doing a sensitivity analysis, just as LESSOR does. The listing of the cash flows shows annually the rent, depreciation, loan interest, operating flow difference with the lease, the basic cash flow saving with the lease, and the basic cash flow discounted at the opportunity rate for each year. From these flows, LESSEE calculates the financial and operating advantage of the lease and sums them to yield the net advantage.

SAMPLE PROBLEM

Assume an asset costing $60,000, where the lessee's tax rate is 48%, the interest rate on a loan would be 4-3/4%, and the lessee's opportunity rate is 10% after taxes. The asset can be leased for $900 a month, the salvage claimed for tax purposes is $5,000, and salvage actually expected is $10,000. The expense of arranging a lease is $1,000, and the annual saving in operating expenses due to leasing (rather than owning) the asset is $3,500. The total life of the lease is expected to be 8 years, and the minimum commitment is 6 years. Call for a sensitivity analysis on depreciable life over a range of 8 to 18 years. Request an entire printout rather than just a sensitivity analysis.

SAMPLE SOLUTION

Type in the following:

```
*120 DATA 60000,.48,.0475,.1
*121 DATA 900,10,5000,10000
*122 DATA 1000,3500,8,6
*123 DATA 6,8,18
```

```
*RUN

 DØ YØU WANT THE SENSITIVITY ANALYSIS ØNLY ?NØ

 CØMPARISØN ØF LEASE WITH PURCHASE

 PURCHASE PRICE $        60000    TAX RATE  .48
 INTEREST RATE         .0475    ØPPØRTUNITY RATE    .1
 MØNTHLY RENT           900    DEPRECIABLE LIFE    10 YEARS
 SALVAGE FØR TAX $         5000    EXPECTED SALVAGE $    10000
 EXPENSE ØF ARRANGING LEASE $ 1000
 ANNUAL EXPENSE SAVING DUE TØ LEASE $ 3500
 EXPECTED DURATIØN ØF LEASE     8 YEARS
 MINIMUM DURATIØN ØF LEASE     6 YEARS
 SENSITIVITY ANALYSIS ØN DEPRECIABLE LIFE WITH A RANGE ØF     8 TØ    18

 DØ YØU WANT TØ SEE THE FLØWS ?YES
```

YEAR	RENT	DEPREC'N	LØAN INTEREST	ØP'G FLØ DIFF'CE WITH LEASE	BASIC CASH FLØ SAVING WITH LEASE	BASIC CASH FLØW DISC. AT .1
1	10800	10000	2588	2500	442	421
2	10800	9000	2162	3500	1646	1422
3	10800	8000	1715	3500	2341	1834
4	10800	7000	1247	3500	3045	2164
5	10800	6000	757	3500	3761	2424
6	10800	5000	243	3500	4487	2624
7	10800	4000	0	3500	-5716	-3031
8	10800	3000	0	-6500	-14276	-6867
TØTAL	86400	52000	8712	17000	-4270	991

FINANCIAL ADVANTAGE ØF LEASE	$3415.92
ØPERATING ADVANTAGE ØF LEASE	$990.83
NET ADVANTAGE ØF LEASE	$4406.74

SENSITIVITY ANALYSIS ØN DEPRECIABLE LIFE

DEPRECIABLE LIFE	NET ADVANTAGE ØF LEASE
8	3387.12
9	3924.85
10	4406.74
11	4836.28
12	5219.10
13	5561.05
14	5867.54
15	6143.33
16	6392.49
17	6618.48
18	6824.26

This BASIC program calculates the rate of return the lessor receives for investing in an asset and then leasing it to someone else. Unlike LESSOR, this program recognizes that the rental payments from the lessee and the salvage value of the asset are uncertain. Business failure or financial stringency may cause the lessee to default or discontinue payments and may force the lessor to reclaim and sell the asset while taking his claim against the lessee to court. What the lessor will recover in these circumstances or what salvage will be, even without default, depends on chance. Using an estimate of the chance of default or discontinuance in any year and an estimate of the possible variation of actual salvage from expected salvage, this program simulates the experience a lessor might have with a lease contract. It generates a set of cash flows for the lessor letting the estimated chance factors determine whether there is a default, when the default occurs and what salvage will be. It calculates the lessor's rate of return on this set of cash flows. It repeats the process — generating a new set of cash flows which varies from the first due to chance and which therefore, gives the lessor a different rate of return. This repetition continues. The 25, 50, or 100 trials of this lease investment that result (the user specifies the number of trials he wants) then provide an indication not only of the lessor's expected return but also of the possibility of substantial loss and the distribution of outcomes from which realized experience will be drawn.

INSTRUCTIONS

The user must enter values for the following variables in lines 120-122.

120 DATA P, L, C1, R1

where

1. P is investment
2. L is rent payment (L is 0 if the lease rate is given in item 4 below)
3. C1 is number of times per year that rent payments are made
4. R1 is lease rate, (R1 is 0 if the rent payment rather than the lease rate is given, otherwise, a decimal representation of an annual rate compounded C1 times a year)

121 DATA M, N1, S1, S2

where

- M is life of lease in years
- N1 is depreciable life of investment in years
- S1 is dollar amount of salvage claimed for tax purposes
- S2 is dollar amount of salvage actually expected

122 DATA T1, D, N2

where

- T1 is the lessor's tax rate (as a decimal)
- D is method of depreciation: 1 if straight line, 2 if double declining balance, and 3 if sum-of-the-years digits
- N2 is the number of trails that the user wants to have performed in the simulation.

The chance elements in the program are contained in lines 2280 to 2520, which are shown below and the user may change to fit the conditions with which he is dealing.

```
* LIST 2280

2280 LET M = 1
2290 LET U=RND(-1)
2300 IF M = N THEN 2330
2310 LET M = M + 1
2320 IF U > .005 THEN 2290
2330 LET U=RND(-1)
2340 IF U > .3 THEN 2370
2345REM           BANKRUPTCY
2350 LET Q=2
2360 GØ TØ 2380
2365REM           REØRGANIZATIØN
2370 LET Q=6
2375REM           EXTRA SALVAGE VALUE
2380 LET Ø=(P-S2)*.5↑(.5*M)
2390 IF Q<N-M THEN 2430
2400 LET Q = N-M
2410 IF Q>0 THEN 2430
2420 LET Ø = 0
2430 LET U=RND(-1)-.5
2440 LET S = (S2+Ø+(P/10)*U)
2450 LET S = S + L*Q
2460 IF (N-M) = 0 THEN 2520
2470 LET K = L*(N-M)
2480 IF K>S THEN 2520
2490 LET S = K
2520 RETURN
2530 END
```

Lines 2280 and 2320 determine if there is a default and when it occurs. In this example, the figure .005 in line 2320 indicates that there is assumed to be a chance of 5 in 1000 that default will occur in any year after the first year. If there is a default, lines 2330 to 2370 establish whether it involves bankruptcy or reorganization. With bankruptcy, the court is taken to award a payment of two years' rent, with reorganization, six years' rent. The chance that default is associated with bankruptcy, rather than reorganization, is assumed here to be

three in ten and is established by the figure .3 in line 2340. The realized salvage or terminal recovery in the case of default is calculated in lines 2380 to 2490. For trials in which no default occurs, actual salvage is set equal to expected salvage plus or minus an amount which can range from -5 to 5% of the value of the original investment. For default, terminal recovery is the sum of the salvage just described, an additional salvage amount which is larger if default is earlier, the court award already determined, and an overall chance element.

LESSIM adds to LESSOR by helping the user consider the risk, as well as the return, that the lessor may find in a leasing arrangement.

SAMPLE PROBLEM

The figures in the data lines below constitute a sample problem. The 50 in line 122 calls for 50 simulations.

```
* 120 DATA 60000, 900, 12, 0
* 121 DATA 8, 10, 0, 20000
* 122 DATA .7, 3, 50
```

SAMPLE SOLUTION

```
READY

*RUN


                SUMMARY ØF INPUT DATA

INVESTMENT              60000   RENT PAYMENT                      900
PAYMENTS        12 TIMES PER YR                LEASE LIFE     8
DEPRECIATIØN    SØYD            DEPRECIABLE LIFE                   10
TAX SALVAGE                 0   ACTUAL SALVAGE                 20000
-------------------------------------------------------------------

                RESULTS ØF CALCULATIØN

LEASE RATE:     10.09938 PER CENT PER YEAR, CØMPØUNDED    12 TIMES A YEAR


                SUMMARY ØF SIMULATIØN
                ---------------------
```

```
NUMBER ØF RUNS                                50
AVERAGE RETURN PER RUN                5.538767 PER CENT
STANDARD DEVIATIØN ØF RETURNS         .2736524

SUMMARY ØF RUNS IN WHICH A DEFAULT ØCCURS
        RUN        PERIØD          RETURN
          28                36        5.434857
          33                60        4.020228


SUMMARY ØF THE   48 RUNS IN WHICH NØ DEFAULT ØCCURS


                              NUMBER ØF RUNS
 5.26 < RETURN <= 5.31    ******
 5.31 < RETURN <= 5.36    ***
 5.36 < RETURN <= 5.42    *
 5.42 < RETURN <= 5.47    ****
 5.47 < RETURN <= 5.52    *****
 5.52 < RETURN <= 5.58    *****
 5.58 < RETURN <= 5.63    *
 5.63 < RETURN <= 5.68    *******
 5.68 < RETURN <= 5.74    ******
 5.74 < RETURN <= 5.79    ***********

MEAN  =  5.45435
RANGE =    5.258627 -    5.788092
STD D =  1.34669
```

This BASIC program calculates the rate of return that the lessor receives for investing in an asset and then leasing it to someone else, i.e., the interest rate that discounts all of the net cash flows back to the initial investment the lessor must make.

By comparing the after-tax rate of return with the returns expected from alternative investments, the lessor can determine the desirability of the lease. The rate of return is calculated from the lessor's cash flows based on lease receipts and tax payments.

INSTRUCTIONS

To calculate cash flows and rate of return, the user must enter values for the following variables in lines 120-123.

120 DATA P, L, C1, R1

where

1. P is investment
2. L is rent payment (L is 0 if the lease rate is given in item 4 below, rather than the rent payment)
3. C1 is number of times per year that rent payments are made
4. R1 is lease rate (R1 is 0 if the rent payment rather than the lease rate is given, otherwise a decimal representation of an annual rate compounded C1 times a year)

121 DATA M, N1, S1, S2

where

- M is life of lease in years
- N1 is depreciable life of investment in years
- S1 is dollar amount of salvage claimed for tax purposes
- S2 is dollar amount of salvage actually expected

122 DATA T1, D

where

- T1 is the lessor's tax rate (as a decimal)
- D is method of depreciation (D is 1 if straight line, 2 if double declining balance, and 3 if sum-of-the-years digits)

123 DATA Tn, R8, R9

where

- Tn is identification of the variable for which a sensitivity analysis is to be done (0 for no analysis, 1 if investment, 2 if rent payment, 3 if lease life, 4 if lease rate, 5 if depreciable life, 6 if tax salvage, or 7 if actual salvage)
- R8 is the lowest value for the variable specified in 11
- R9 is the highest value for the variable specified in 11

By typing YES to the question DO YOU WANT TO SEE THE FLOWS?, the user receives a list of the flows generated from inputs. This list includes each year's depreciation, rent receipt, tax payment, and cash flow. The cash flow is the difference between the rent receipt and the tax payment. The rate of return is calculated from these cash flows.

By providing the appropriate information in data statements, the user determines the effect a change in a variable has on the calculated rate of return, i.e., the sensitivity of the rate of return to the variable in question.

SAMPLE PROBLEM

Assume a $60,000 investment in an asset to be leased for $900 a month (12 rent payments a year) on an 8-year lease with depreciation taken over 10 years, assuming $5000 salvage is claimed for tax purposes and $20,000 is actually expected as salvage value. The lessor's tax rate is 70%, and sum-of-the-years digits depreciation is to be used for tax purposes. Call for a sensitivity analysis on the salvage value actually realized at the end of the lease, over a range up to $25,000.

Request the entire report, rather than simply a sensitivity analysis, given a summary of the data he supplied and a rate of return on the lease of 5.2% per year compounded monthly.

SAMPLE SOLUTION

```
*120 DATA 60000,900,12,0
*121 DATA 8,10,5000,20000
*122 DATA .7,3
*123 DATA 7,0,25000
```

```
READY

*RUN

DØ YØU WANT THE SENSITIVITY ANALYSIS ØNLY ?NØ

                SUMMARY ØF INPUT DATA

INVESTMENT              60000   RENT PAYMENT                          900
PAYMENTS      12 TIMES YEARLY   LIFE ØF LEASE                           8
DEPRECIATIØN    SØYD            DEPRECIABLE LIFE                       10
TAX SALVAGE              5000   ACTUAL SALVAGE                      20000
LESSØR'S TAX RATE                        .7
SENSITIVITY ØF LEASE RATE AND LESSØR'S AFTER TAX RETURN TØ
ACTUAL SALVAGE WILL BE ANALYZED WITH A RANGE ØF     0 TØ   25000 .
-------------------------------------------------------------

                RESULTS ØF CALCULATIØN

LEASE RATE:     10.09938 PER CENT PER YEAR, CØMPØUNDED   12 TIMES YEARLY

LESSØR'S AFTER TAX RETURN:    5.233479 PER CENT PER YEAR CØMPØUNDED
                                                 12 TIMES YEARLY
-------------------------------------------------------------

DØ YØU WANT A LISTING ØF THE FLØWS ?YES

                    LISTING ØF CASH FLØWS
                    ---------------------

 YEAR          LEASE          DEPRECIATIØN      TAX            CASH
               RECEIPT        PAYMENT           FLØW
          0        -60000                 0             0         -60000
          1         10800             10000      560.0001         10240
          2         10800          8999.999          1260       9539.999
          3         10800              8000          1960          8840
          4         10800              7000          2660          8140
          5         10800              6000          3360          7440
          6         10800              5000          4060          6740
          7         10800              4000          4760          6040
          8         30800          10999.99      13860.01      16939.99

TØTAL               46400          59999.99      32480.01      13919.99

-------------------------------------------------------------
```

SENSITIVITY ANALYSIS ØN ACTUAL SALVAGE

ACTUAL SALVAGE	LEASE RATE	LESSØR'S AFTER TAX RETURN
0	10.09938 %	3.276176 %
2500	10.09938 %	3.548423 %
5000	10.09938 %	3.796494 %
7500	10.09938 %	4.04511 %
10000	10.09938 %	4.294272 %
12500	10.09938 %	4.531465 %
15000	10.09938 %	4.769171 %
17500	10.09938 %	5.007373 %
20000	10.09938 %	5.233479 %
22500	10.09938 %	5.447453 %
25000	10.09938 %	5.661807 %

This BASIC program is designed to help a manufacturer decide whether to buy a certain component for a product, or make the component in the plant. The cost of buying the component is compared with the discounted stream of cash flows that would result if the necessary investments were made to produce the component.

INSTRUCTIONS

Type RUN to use this program, and it then asks for the method of data input (interactive or by line). After the question:

WOULD YOU LIKE INSTRUCTIONS FOR ENTERING DATA

type YES or NO, and enter the following data items:

1. The cost to buy a component F.O.B. your plant.
2. The cost to manufacture a component in your plant, including direct materials and labor, but not including overhead.
3. The initial investment (cost of the extra machinery that would be needed if you were going to manufacture the components).
4. The life of the investment in years.
5. The salvage value of this investment.
6. Method of depreciation to be used (sum-of-the-years-digits (1), straight line (2), or double declining balance (3).
7. The annual fixed costs (such as supervision and maintenance) involved in your making the components.
8. Corporate tax rate in percent.
9. The local tax on the extra investment in dollars per thousand.
10. Cost of capital in percent.
11. Estimate of the yearly demand for the components.

SAMPLE PROBLEM

Perform a make/buy analysis where a component cost $175 F.O.B. the plant, on $175 to be manufactured in the plant, an initial investment of $10,000 is needed, and the life of the investment is five years after which the salvage value will be $2000. Straight line depreciation is used. The plant's annual fixed costs are $12,000, the corporate tax rate is 25%, there is a local tax rate of $5 per thousand, capital costs 12.5%, and the estimated yearly demand for the component is $5000.

SAMPLE SOLUTION

```
* RUN


WØULD YØU LIKE INSTRUCTIØNS FØR ENTERING DATA(YES ØR NØ) ?NØ
ENTER ITEMS 1 THRØUGH 11
?175, 175, 10000, 5, 2000, 2, 12000, 25, 5, 12.5, 5000

**********************************************************

THE PRESENT VALUE ØF THE CØST TØ MAKE IS  3051346
THE PRESENT VALUE ØF THE CØST TØ BUY IS   2992873

YØU SHØULD BUY THE CØMPØNENTS AT A SAVINGS ØF    $58473

DØ YØU WANT TØ SEE THE CASH FLØWS ?YES

 **** THE FLØWS ****

          IF BUY**********            IF MAKE*********          ***NET***
 YEAR    EXPENSE      CASH FLØW      EXPENSE      CASH FLØW     CASH FLØW
    1     875000       656250         888634       664875        -8625
    2     875000       656250         888626       664869        -8619
    3     875000       656250         888618       664863        -8613
    4     875000       656250         888610       664857        -8607
    5     875000       656250         886602       663351        -7101

--------------SENSITIVITY CHECK=========================

WØULD YØU LIKE TØ SEE THE EFFECT ØF CHANGING
 A VARIABLE ( YES ØR NØ) ?NØ
```

```
*---------SENSITIVITY CHECK=========================

W0ULD Y0U LIKE T0 SEE THE EFFECT 0F CHANGING
 A VARIABLE ( YES 0R N0) ?YES
WHAT IS THE NUMBER 0F THE ITEM Y0U W0ULD LIKE
T0 CHANGE ?1
WHAT IS THE NEW VALUE ?235
W0ULD Y0U LIKE T0 MAKE FURTHER CHANGES ?N0

**********************************************************

THE PRESENT VALUE 0F THE C0ST T0 MAKE IS  3051346
THE PRESENT VALUE 0F THE C0ST T0 BUY IS   4019001

Y0U SH0ULD MAKE THE C0MP0NENTS AT A SAVINGS 0F   $967655

D0 Y0U WANT T0 SEE THE CASH FL0WS ?YES

 **** THE FL0WS ****

        IF BUY**********          IF MAKE*********        ***NET***
YEAR   EXPENSE     CASH FL0W     EXPENSE     CASH FL0W    CASH FL0W
   1    1175000      881250       888634      664875       216375
   2    1175000      881250       888626      664869       216381
   3    1175000      881250       888618      664863       216387
   4    1175000      881250       888610      664857       216393
   5    1175000      881250       886602      663351       217899

-------------SENSITIVITY CHECK=========================

W0ULD Y0U LIKE T0 SEE THE EFFECT 0F CHANGING
 A VARIABLE ( YES 0R N0) ?N0
```

This FORTRAN program simulates the competitive interaction of companies. Decision choices with respect to product price, advertisement expenses, product development investments, etc., are used to calculate each company's share of a product market. The program outputs the asset status of each company at the end of each quarter of operation.

MGSIM-IN is an online instruction file.

METHOD, GENERAL INFORMATION AND USAGE

MGSIM[1] is a program for simulating a multifirm, one-product industry in which participants make top-level management decisions. The participants must be grouped into company teams having complete responsibility for its company's performance.

A team begins play by taking over the management of an existing company that has been operating in the marketplace for four quarters. Every company markets the same product in the industry. Each period of decision-making simulates one quarter of operations in the business world. For every quarter of operation each team makes decisions on the following items:

1. Price of the product
2. Production volume this quarter in units
3. Advertising expense
4. Research and development expense (R&D)
5. Investments in plant and equipment
6. Dividends paid

After the management decisions have been made for a quarter, they are entered into MGSIM. The decisions are input serially from a single console. If it is desired that each team's decision be confidential, someone not on the teams should be appointed to handle input and output.

MGSIM analyzes the decisions along with the history of previous quarters decisions. MGSIM then prints for each team a detailed performance report and financial statement. (These are described in the Sample Solution.)

[1] This management simulation game is based on a game originally conceived at U. C. L. A. and further refined by several other universities.

These reports are given to the teams. On the basis of this new information, the teams repeat the decision process and submit the next quarter's decisions. Usually, the simulation is run for six to eight quarters, but can be run up to a maximum of fifty quarters. It is also possible to save the history file so a simulation may be stopped and then continued at a later time.

Note that certain decisions are modified in the competitive environment to reflect the consistency of these decisions. All things being equal, relatively stable policies are more effective than policies with high fluctuations. For instance, suppose the price of a product was raised from $6.00 to $7.00 during a particular quarter. The reaction of customers in the market would be more pronounced than if the $1.00 raise had taken place over three or four quarters.

Both advertising and R&D expenses have time lags that reflect a delayed reaction in the marketplace. While both advertising and R&D expenses take effect over several quarters of play, advertising impact is relatively intense and short-lived; however, R&D builds up value during increased investment at a slower rate and lingers longer when expenditures are cut back. Beyond a certain point, the incremental yield of R&D and advertising expenses becomes significant. The benefit from higher and higher expenses becomes increasingly less in an exponential fashion, so that at very high expenditures, the sales revenue gained does not compensate for the money spent.

The total sales of any company depends upon its own price, advertising, and R&D decisions, and upon all of its competitor's decisions for these three variables.

Some suggested criteria for corporate evaluation are given below:

1. Return on capital investment
2. Total equity and dividends
3. Profit
4. Production capacity
5. Percent share of industry sales
6. Growth rate of sales or profit

Companies are expected to select some combination of the above criteria as goals before they start playing. How well companies meet their goals will serve as the standards for evaluating company performance.

INSTRUCTIONS

MGSIM writes a history file so that the simulation may be continued at a later time. If a game is a continuation from an earlier run, the output history file from that run becomes

the input history file for the current run; another file must be provided for the new output history.

The output history file must be created prior to executing the program. It should also be accessed with alternate name "10" prior to execution. If the game is a continuation from an earlier run, the previously written history file should be accessed with alternate name 20. The program will ask questions such as the following:

QUARTER NUMBER	(enter 1 unless continuing an old game)
NUMBER OF FIRMS	(2 to 4)
INDUSTRY NUMBER	(1 to 32768)
COMPANY NUMBER	1, 2, 3, or 4
PRICE OF PRODUCT	(4.00 to 9.00)
PRODUCTION VOLUME (UNITS)	(200000 to 600000)
ADVERTISING EXPENSE	(100000 to 500000)
R&D EXPENSE	(0 to 500000)
INVESTMENT IN PLANT AND EQUIPMENT	(0 to 500000)
TOTAL DIVIDEND DECLARED	(0 to 500000)
COMPANY NUMBER	2
PRICE OF PRODUCT	6.75
ETC.	

After the last team's decisions have been entered, the program prints a performance report and financial statement for each company. The following is a complete outline and explanation of the progress report and financial statements.

Performance Indices

Sales Volume — The number of units sold in the current quarter.

Percent of Industry Sales — The ratio of company sales this quarter to total industry sales this quarter expressed as a percent.

Current Inventory Quantity — The number of unsold units remaining in inventory at the end of the quarter.

Production Capacity Next Quarter — The maximum number of units available for production next quarter (at approximately $3.00 per unit). Production above this capacity limit incurs costs of approximately $6.00 per unit.

Profit and Loss Statement

Income Sales Revenue — The volume of sales in units multiplied by the product price.

Manufacturing Costs — The variable cost of manufacturing products at the production volume indicated. Costs at or below production capacity are approximately $3.00 per unit, while the costs above production capacity are approximately $6.00 per unit. The actual cost is influenced by the amount of money previously spent for R&D.

Reduction in Inventory Value — The value of inventory from the previous quarter minus the value of inventory this quarter, both of which are valued on the Financial Condition Statement at the standard cost of $3.00 per unit.

Research and Development Expense — A company decision each quarter.

Depreciation Expense — A noncash expense of 2.5% of production capacity each quarter (measured in dollars).

Advertising and Selling Expense — A company decision each quarter.

Miscellaneous Expenses — This includes four expense items:

1. Fixed costs of manufacturing — $70,000 plus 18% of plant capacity (measured in dollars).
2. Inventory Carrying Costs — 25 cents for each unit of inventory unsold at the end of the quarter.
3. Plant Expansion Costs — The company decision to invest in Plant and Equipment incurs increased expansion costs exponentially, depending upon the amount of the decision.
4. Negative Net Cash Assets — Companies will be assessed an interest expense which increases exponentially with the magnitude of the cash borrowed to pay expense.

Administration Expense — $200,000 plus 32% of plant capacity (measured in dollars).

Total Expenses — The sum of all operating expenses per quarter.

Profit Before Income Tax — Income from sales revenue minus the total operating expenses.

Addition to Income Tax Fund — The taxes paid at the rate of 48% per quarter.

Net Profit After Income Tax — The profit before taxes minus the tax paid.

Dividends Paid — A company decision.

Additions to Owners Equity — The net profit after income taxes minus the Dividends Paid.

Receipts and Disbursements Statement

Receipts - Sales Revenue — The number of units sold this quarter times the product price.

Cash Expenses — The sum of all expenses paid for in cash during the current quarter. This includes all operating expenses in the profit and loss statement except reduction in inventory value and depreciation.

Additions to Income Tax Fund — The tax expense of 48 percent of profit before income tax.

Dividends Paid — A company decision each quarter.

Investment in Plant and Equipment — The company decides each quarter to expand plant capacity. This includes the cash expense to compensate for depreciation losses and any new investment to increase plant capacity. (Plant capacity is increased at a cost of $20 per unit.)

Total Disbursements — The sum of all cash expenses during the current quarter.

Net Addition to Cash Assets — Sales revenue minus total disbursements. This amount is added to net cash assets on the financial condition statement each quarter.

Financial Condition Statement

Net Cash Assets — The total cash on hand at the end of the quarter. Net cash assets this quarter is the sum of Net Cash Assets last quarter and Net Additions to Cash Assets, which is the residual account found on the Receipts and Disbursements Statement.

Inventory Value — The number of unsold units remaining in inventory at the end of the quarter times the standard cost of $3.00 per unit.

Plant Net Book Value — The production capacity available for next quarter times the original cost of $20 per unit of capacity. This is the residual of the loss in capacity due to depreciation plus the gain in capacity from Investment in Plant and Equipment.

Owners Equity — The total of all company assets.

After this report is printed, the game may be continued or discontinued.

RESTRICTIONS

MGSIM can handle up to four company teams. A maximum of fifty quarters can be played.

SAMPLE PROBLEM

Two teams play for two quarters. The two quarters will be run as separate executions of MGSIM. Before the program is executed, two history files are created using the ACCESS subsystem. Q1-HIST is the history file written for the first quarter and used as input for the second quarter. Q2-HIST is the history file written for the second quarter.

Before the first execution, the file Q1-HIST is accessed with the alternate name "10". Before the second execution, Q1-HIST is accessed with the alternate name "20" and Q2-HIST is accessed with the alternate name "10".

SAMPLE SOLUTION

```
*ACCESS

 FUNCTIØN?  CREATE FILE
    CATALØG STRUCTURE TØ WØRKING LEVEL?
   /
    FILE NAME,SIZE(IN BLCKS),MAX SIZE?  Q1-HIST,1,48*
 SUCCESSFUL!
    FILE NAME,SIZE(IN BLCKS),MAX SIZE?  Q2-HIST,1,48*
 SUCCESSFUL!
    FILE NAME,SIZE(IN BLCKS),MAX SIZE?  DØNE
*GET Q1-HIST"10"
*GET LIBRARY/MGSIM,R
*RUN MGSIM
REV 0
LIST FILE MGSIM-IN FØR MØRE INFØRMATIØN

QUARTER NUMBER
=1

NUMBER ØF FIRMS
=2

INDUSTRY NUMBER
=1
```

C@MPANY NUMBER 1

PRICE @F PR@DUCT
=6.30

PR@DUCTI@N V@LUME (UNITS)
=440000

ADVERTISING EXPENSE
=250000

R&D EXPENSE
=150000

INVESTMENT IN PLANT AND EQUIPMENT
=250000

T@TAL DIVIDEND DECLARED
=100000

C@MPANY NUMBER 2

PRICE @F PR@DUCT
=6.75

PR@DUCTI@N V@LUME (UNITS)
=440000

ADVERTISING EXPENSE
=400000

R&D EXPENSE
=200000

INVESTMENT IN PLANT AND EQUIPMENT
=200000

T@TAL DIVIDEND DECLARED
=0

FIRM 1 QUARTER 1 INDUSTRY 1

SALES V@LUME	513763
PERCENT @F INDUSTRY SALES	50.06
CURRENT INVENT@RY QUANTITY	41583
PR@DUCTI@N CPY NEXT QUARTER	441500

PR@FIT AND L@SS

INC@ME SALES REVENUE 3236706.72

EXPENSE		
MANUFACTURING C0STS	1156050.95	
REDUCTI0N IN INVENT0RY VALUE	221238.91	
RESEARCH AND DEVEL0PMENT	150000.00	
DEPRECIATI0N	220000.00	
ADVERTISING AND SELLING	250000.00	
MISCELLANE0US	161158.25	
ADMINISTRATI0N	340800.00	2499298.12
PR0FIT BEF0RE INC0ME TAX		737408.59
ADDITI0N T0 INC0ME TAX FUND	353956.12	
NET PR0FIT AFTER INC0ME TAX		383452.47
DIVIDENDS PAID	100000.00	
ADDITI0N T0 0WNERS EQUITY		283452.47

RECEIPTS AND DISBURSEMENTS

RECEIPTS SALES REVENUE		3236706.72
DISBURSEMENTS		
CASH EXPENSE	2058009.21	
ADDITI0N T0 INC0ME TAX FUND	353956.12	
DIVIDENDS PAID	100000.00	
INVESTMENT IN PLANT	250000.00	2761965.34
ADDITI0N T0 CASH ASSETS		474741.38

FINANCIAL C0NDITI0N

ASSETS		
NET CASH ASSETS	3116311.38	
INVENT0RY VALUE	124749.08	
PLANT NET B00K VALUE	8830000.01	
0WNERS EQUITY		12071060.48

FIRM 2 QUARTER 1 INDUSTRY 1

SALES V0LUME	512404
PERCENT 0F INDUSTRY SALES	49.93
CURRENT INVENT0RY QUANTITY	42942
PR0DUCTI0N CPY NEXT QUARTER	439000

PR0FIT AND L0SS

INC0ME SALES REVENUE	3458724.83

EXPENSE		
MANUFACTURING C0STS	1155520.50	
REDUCTI0N IN INVENT0RY VALUE	217211.03	
RESEARCH AND DEVEL0PMENT	200000.00	
DEPRECIATI0N	220000.00	
ADVERTISING AND SELLING	400000.00	
MISCELLANE0US	160735.58	
ADMINISTRATI0N	340800.00	2694267.12
PR0FIT BEF0RE INC0ME TAX		764457.71
ADDITI0N T0 INC0ME TAX FUND	366939.70	
NET PR0FIT AFTER INC0ME TAX		397518.01
DIVIDENDS PAID	0.00	
ADDITI0N T0 0WNERS EQUITY		397518.01

RECEIPTS AND DISBURSEMENTS

RECEIPTS SALES REVENUE		3458724.83
DISBURSEMENTS		
CASH EXPENSE	2257056.08	
ADDITI0N T0 INC0ME TAX FUND	366939.70	
DIVIDENDS PAID	0.00	
INVESTMENT IN PLANT	200000.00	2823995.79
ADDITI0N T0 CASH ASSETS		634729.04

FINANCIAL C0NDITI0N

ASSETS		
NET CASH ASSETS	3276299.04	
INVENT0RY VALUE	128826.96	
PLANT NET B00K VALUE	8780000.01	
0WNERS EQUITY		12185126.02

2 FIRMS HAVE BEEN PR0CESSED IN PERI0D 1 INDUSTRY 1

D0 Y0U WANT T0 C0NTINUE
=N0

```
*GET Q2-HIST"10",Q1-HIST"20"
*GET LIBRARY/MGSIM,R
*RUN MGSIM
REV 0
LIST FILE MGSIM-IN FOR MORE INFORMATION

QUARTER NUMBER
=2

NUMBER OF FIRMS
=2

INDUSTRY NUMBER
=1


COMPANY NUMBER    1


PRICE OF PRODUCT
=6.00

PRODUCTION VOLUME (UNITS)
=500000

ADVERTISING EXPENSE
=250000

R&D EXPENSE
=150000

INVESTMENT IN PLANT AND EQUIPMENT
=350000

TOTAL DIVIDEND DECLARED
=100000


COMPANY NUMBER    2


PRICE OF PRODUCT
=7.00

PRODUCTION VOLUME (UNITS)
=440000

ADVERTISING EXPENSE
=400000

R&D EXPENSE
=300000

INVESTMENT IN PLANT AND EQUIPMENT
=300000

TOTAL DIVIDEND DECLARED
=0
```

FIRM 1 QUARTER 2 INDUSTRY 1

SALES VOLUME	541583
PERCENT OF INDUSTRY SALES	52.93
CURRENT INVENTORY QUANTITY	0
PRODUCTION CPY NEXT QUARTER	447963

PROFIT AND LOSS

INCOME SALES REVENUE		3249498.19
EXPENSE		
MANUFACTURING COSTS	1486768.64	
REDUCTION IN INVENTORY VALUE	124749.08	
RESEARCH AND DEVELOPMENT	150000.00	
DEPRECIATION	220750.00	
ADVERTISING AND SELLING	250000.00	
MISCELLANEOUS	153757.49	
ADMINISTRATION	341280.00	2727305.23
PROFIT BEFORE INCOME TAX		522192.95
ADDITION TO INCOME TAX FUND	250652.62	
NET PROFIT AFTER INCOME TAX		271540.33
DIVIDENDS PAID	100000.00	
ADDITION TO OWNERS EQUITY		171540.33

RECEIPTS AND DISBURSEMENTS

RECEIPTS SALES REVENUE		3249498.19
DISBURSEMENTS		
CASH EXPENSE	2381806.14	
ADDITION TO INCOME TAX FUND	250652.62	
DIVIDENDS PAID	100000.00	
INVESTMENT IN PLANT	350000.00	3082458.76
ADDITION TO CASH ASSETS		167039.42

FINANCIAL CONDITION

ASSETS		
NET CASH ASSETS	3283350.80	
INVENTORY VALUE	0.00	
PLANT NET BOOK VALUE	8959250.02	
OWNERS EQUITY		12242600.83

FIRM 2 QUARTER 2 INDUSTRY 1

SALES VOLUME	481525
PERCENT OF INDUSTRY SALES	47.06
CURRENT INVENTORY QUANTITY	1417
PRODUCTION CPY NEXT QUARTER	443025

PRØFIT AND LØSS

INCØME SALES REVENUE		3370675.30
EXPENSE		
MANUFACTURING CØSTS	1170898.60	
REDUCTIØN IN INVENTØRY VALUE	124575.12	
RESEARCH AND DEVELØPMENT	300000.00	
DEPRECIATIØN	219500.00	
ADVERTISING AND SELLING	400000.00	
MISCELLANEØUS	152074.32	
ADMINISTRATIØN	340480.00	2707528.05
PRØFIT BEFØRE INCØME TAX		663147.25
ADDITIØN TØ INCØME TAX FUND	318310.68	
NET PRØFIT AFTER INCØME TAX		344836.57
DIVIDENDS PAID	0.00	
ADDITIØN TØ ØWNERS EQUITY		344836.57

RECEIPTS AND DISBURSEMENTS

RECEIPTS SALES REVENUE		3370675.30
DISBURSEMENTS		
CASH EXPENSE	2363452.92	
ADDITIØN TØ INCØME TAX FUND	318310.68	
DIVIDENDS PAID	0.00	
INVESTMENT IN PLANT	300000.00	2981763.60
ADDITIØN TØ CASH ASSETS		388911.69

FINANCIAL CØNDITIØN

ASSETS		
NET CASH ASSETS	3665210.73	
INVENTØRY VALUE	4251.84	
PLANT NET BØØK VALUE	8860500.02	
ØWNERS EQUITY		12529962.60

2 FIRMS HAVE BEEN PRØCESSED IN PERIØD 2 INDUSTRY 1

DØ YØU WANT TØ CØNTINUE
=NØ

This BASIC program provides quick comparisons of different mortgage terms. The program computes and prints monthly payments, total interest, and differences for all possible combinations of input data.

INSTRUCTIONS

Type RUN to enter the following data:

1. Amounts to be borrowed (dollars only).
2. Interest rates (i.e., 6.5, 6, 10, 10.0).
3. Mortgage lives (years).

As each set of input is completed, the program asks a YES or NO reply to consider another set of terms. A YES allows another set of data to be input. A NO concludes the program.

SAMPLE PROBLEM

Compare mortgage terms for $19,500 and $30,000 at 6 and 7.5% over 20 and 30 years.

SAMPLE SOLUTION

```
*RUN

AMØUNTS TØ BE CØNSIDERED ?19500,30000
RATES TØ BE CØNSIDERED ?6,7.5
YEARS TØ BE CØNSIDERED ?20,30
```

FØR A LØAN ØF 19500.00

INTEREST RATE	NUMBER ØF YEARS	MØNTHLY PAYMENT	TØTAL INTEREST	DECREASE MØNTHLY PAYMENT	INCREASE TØTAL INTEREST
6.000%	20.00	139.70	14028.99		
6.000%	30.00	116.91	22588.46	22.79	8559.47
7.500%	20.00	157.09	18201.77		
7.500%	30.00	136.35	29584.87	20.74	11383.09

FØR A LØAN ØF 30000.00

INTEREST RATE	NUMBER ØF YEARS	MØNTHLY PAYMENT	TØTAL INTEREST	DECREASE MØNTHLY PAYMENT	INCREASE TØTAL INTEREST
6.000%	20.00	214.93	21583.05		
6.000%	30.00	179.87	34751.47	35.06	13168.42
7.500%	20.00	241.68	28002.73		
7.500%	30.00	209.76	45515.18	31.91	17512.45

DØ YØU WISH TØ CØNSIDER ANØTHER SET ØF TERMS ?NØ

This FORTRAN program calculates a mortgage repayment schedule.

INSTRUCTIONS

To use this program, type RUN, and enter the following data as requested:

1. Amount of the loan (e.g., 37600 or 37600.50, etc.).
2. Interest rate per annum (e.g., 7 or 7.00 or 7.5, etc.).
3. Number of years of the mortgage (e.g., 30 or 20 or 10, etc.).

At this point, the minimum monthly payment is printed out. Then enter data as requested:

4. Actual monthly payments (i.e., amount of minimum monthly payment may be entered — 225.44 or some other desired payment — 275.00).
5. Payment start date (MO, YR.) (i.e., for September 1972 enter 9, 1972).
6. Number of months of payments to be listed, (i.e., for every month, type "1," for every year, type "12", for every two years, type "24", etc.).

If only the last payment line and summary is desired, enter some high figure such as 999.

7. Maximum number of lines: enter a figure of YRS. of mortgage by 12 divided by figure entered in item 6 above (e.g., 30 YRS by 12 ÷ 24 = 15). If only the summary line was requested in 6 above (e.g., 999, enter 999 here).

The program types out payment schedule for amounts paid on interest, on principal, total interest, the reducing balance, and a last payment date and amount.

SAMPLE PROBLEM

Calculate the 30-year repayment schedule for a $37,600 mortgage at a 6% per year interest rate. The minimum and actual monthly payment is $225.44. Payment is started in January 1965 and a line for every 24 payments is desired.

SAMPLE SOLUTION

```
READY
*RUN
LØAN AMØUNT
= 37600.00
INTEREST RATE (% PER YEAR)
= 6
YEARS
= 30
MIN MØNTHLY PAYMENT 225.44
ACTUAL MØNTH PAYMENT
= 225.44
PAYMENTS START(MT,YR)
= 1,1965
PRINT LINE EVERY ? PAYMENTS
= 24
PRINT MAX ØF ? LINES
= 15
```

MØRTGAGE REPAYMENT SCHEDULE (6.00%)
MØNTHLY PAYMENTS $225.44

M-YR	INT PAY	PRIN PAY	TØT INT	BAL.		
0-65				37600.00		
12-66	183.45	41.99	4458.39	36647.82		
12-68	178.11	47.33	8795.69	35574.56		
12-70	172.09	53.35	12996.53	34364.83		
12-72	165.31	60.13	17043.53	33001.27		
12-74	157.66	67.78	20917.14	31464.32		
12-76	149.04	76.40	24595.31	29731.93		
12-78	139.33	86.11	28053.19	27779.26		
12-80	128.38	97.06	31262.77	25578.28		
12-82	116.03	109.41	34192.48	23097.42		
12-84	102.12	123.32	36806.71	20301.10		
12-86	86.44	139.00	39065.37	17149.20		
12-88	68.77	156.67	40923.23	13596.51		
12-90	48.84	176.60	42329.34	9592.05		
12-92	26.39	199.05	43226.23	5078.40		
12-94	1.08	215.15	43549.18	0.	LAST PAYMENT	216.22

```
*RUN
LØAN AMØUNT
= 37600
INTEREST RATE (% PER YEAR)
= 6.00
YEARS
= 30
MIN MØNTHLY PAYMENT 225.44
ACTUAL MØNTH PAYMENT
= 225.44
PAYMENTS START(MT,YR)
= 1,1965
PRINT LINE EVERY ? PAYMENTS
= 999
PRINT MAX ØF ? LINES
= 999
```

MØRTGAGE REPAYMENT SCHEDULE (6.00%)
MØNTHLY PAYMENTS $225.44

M-YR	INT PAY	PRIN PAY	TØT INT	BAL.		
0-65				37600.00		
12-94	1.08	215.15	43549.18	0.	LAST PAYMENT	216.22

This BASIC program computes effective annual rates of interest.

INSTRUCTIONS

Call out NOM-EFF and type RUN. Enter nominal interest rates (the limit is 20) in decimal form (i.e., 6, 6.5, 7.5, 8.75).

Then enter the number of times per year each rate is to be compounded. Enter (up to 20 whole numbers), i.e., 12, 365, 24, etc., or 0 for continuous compounding.

SAMPLE RUN

```
SYSTEM ?BASIC
OLD OR NEW-OLD NOM-EFF
READY
*RUN

NOMINAL ANNUAL INTEREST RATES--UP TO 20 DIFFERENT RATES
?12.61,12.98,6,6.5,12,12.5

EACH RATE COMPOUNDED HOW MANY TIMES PER YEAR?
FOR EACH RATE YOU CAN TYPE IN UP TO 20 DIFFERENT COMPOUNDING
TIMES (TYPE IN A ZERO FOR CONTINUOUS COMPOUNDING)
FOR    12.61  ?21
FOR    12.98  ?30
FOR        6  ?0
FOR      6.5  ?2,4,6
FOR       12  ?12
FOR     12.5  ?0
```

NOMINAL ANNUAL %	TIMES COMP./ANNUM	EFFECTIVE ANNUAL %
12.610	21	13.3968
12.980	30	13.8282
6.000	CONT. COMP.	6.1837
6.500	2	6.6056
6.500	4	6.6602
6.500	6	6.6786
12.000	12	12.6825
12.500	CONT. COMP.	13.3148

```
READY
```

This BASIC program computes annual rates of return compounded for an investment given the closing price for each year of data. Annual returns are computed every year, starting with the base year, and up to the last year in the data. Arithmetic average rates of return are computed for various holding periods starting with the same year. Also average rates of return, standard deviations, and coefficients of variation are computed for each possible holding period length within the years of data supplied.

METHOD

Data Entry Options

Data can be entered into RETURN in one of the two following options:

1. In DATA statements beginning at line 1000
2. Interactively

NOTE: Sample data is already imbedded in the program at line 1000-1100.

Data Content

Data entered into RETURN consists of:

1. The number of years for which annual data is provided (to a maximum of 25).
2. The annual return (dividend) and the annual closing price of the security for each of the years, starting with the base year and 0 annual return (i.e., 0, 1969).

INSTRUCTIONS

Type RUN, and the program asks DO YOU WANT INSTRUCTIONS FOR SUPPLYING DATA? The responses are:

DATA — Data is already entered in statements, use it and run.

YES — The program will print instructions, and the user will enter data interactively.

NO — The user enters data interactively with no program instructions printed.

SAMPLE PROBLEM

For this problem, the sample output is identical for all three input modes.

Find the annual rate of return compounded for an investment made in 1962 and held to the present. The dividend per share and closing security price over that period are as follows:

1962:	0, $39.25
1963:	$1.02, $43.65
1964:	$1.10, $46.75
1965:	$1.20, $60.125
1966:	$1.30, $60.00
1967	$1.30, $58.00
1968:	$1.30, $50.25
1969:	$1.30, $49.125
1970:	$1.30, $47.25
1971:	$1.40, $66.50

Input Example 1

```
*RUN

DØ YØU WANT INSTRUCTIØNS FØR SUPPLYING DATA ?DATA
```

Input Example 2

```
READY
*RUN

DØ YØU WANT INSTRUCTIØNS FØR SUPPLYING DATA ?YES

FØR HØW MANY YEARS DØ YØU WISH TØ ENTER PRICE AND DIVIDEND
DATA, REMEMBERING THE NEED FØR A BASE YEAR. E.G., 10 YEARS
ØF DATA ARE NEEDED TØ GIVE 9 ANNUAL RETURNS. THE MAXIMUM
NUMBER ØF YEARS IS 25.   ?10

WHAT IS THE FIRST YEAR FØR WHICH YØU WISH TØ ENTER DATA ?1962

ENTER THE DIVIDEND PER SHARE (DPS) AND THE CLØSING SECURITY
PRICE (CSP), SEPARATED BY A CØMMA, FØR EACH ØF THE FØLLØWING
YEARS:

             DPS, CSP

YEAR 1962  ?0,39.25
YEAR 1963  ?1.02,43.65
YEAR 1964  ?1.10,46.75
YEAR 1965  ?1.20,60.125
YEAR 1966  ?1.30,60.00
YEAR 1967  ?1.30,58.00
YEAR 1968  ?1.30,50.25
YEAR 1969  ?1.30,49.125
YEAR 1970  ?1.30,4725
YEAR 1971  ?1.40,66.50
```

Input Example 3

```
DØ YØU WANT INSTRUCTIØNS FØR SUPPLYING DATA ?NØ

NØ. ØF YEARS, FIRST YEAR ?10,1962

            DPS, CSP

YEAR 1962  ?     ENTER AS ABØVE
```

SAMPLE SOLUTION

RETURNS ØN INVESTMENTS

(ANNUAL RATES CØMPØUNDED ANNUALLY)

TØ FRØM	1963	1964	1965	1966
1962	.13808	.1172	.17721	.13695
1963		.09621	.19796	.13655
1964			.31176	.15799
1965				.01954

TØ FRØM	1967	1968	1969	1970
1962	.10694	.06957	.06063	.05218
1963	.09883	.05535	.04709	.03916
1964	.09974	.04474	.03678	.02908
1965	.00398	-.0351	-.02594	-.02325
1966	-.01167	-.0622	-.04132	-.03427
1967		-.11121	-.05632	-.04204
1968			.00348	-.00405
1969				-.01171

TØ FRØM	1971
1962	.08553
1963	.07842
1964	.07565
1965	.03794
1966	.04189
1967	.05648
1968	.1221
1969	.18897
1970	.43703

AVERAGE RETURN FRØM 1962 = .1049211

AVERAGE RETURN FRØM 1963 = .0936962

AVERAGE RETURN FRØM 1964 = .1079628

AVERAGE RETURN FRØM 1965 =-.003805

AVERAGE RETURN FRØM 1966 =-.021514

AVERAGE RETURN FRØM 1967 = -.0382725

AVERAGE RETURN FRØM 1968 = .04051

AVERAGE RETURN FRØM 1969 = .08863

AVERAGE RETURN FRØM 1970 = .43703

AVERAGE RETURN FØR ALL
PØSSIBLE HØLDING PERIØDS = .0644873

	AVERAGE RETURN	STANDARD DEVIATIØN	CØEFF. VARIATIØN
FØR ALL 1 YEAR HØLDING PERIØDS:	.0968344	.1650436	1.70439
FØR ALL 2 YEAR HØLDING PERIØDS:	.0679412	.1023104	1.505867
FØR ALL 3 YEAR HØLDING PERIØDS:	.0595914	.0884425	1.484148
FØR ALL 4 YEAR HØLDING PERIØDS:	.0461316	.0616345	1.336057
FØR ALL 5 YEAR HØLDING PERIØDS:	.043542	.0416374	.9562584
FØR ALL 6 YEAR HØLDING PERIØDS:	.04592	.0150662	.3280959
FØR ALL 7 YEAR HØLDING PERIØDS:	.0548	.0149744	.2560594
FØR ALL 8 YEAR HØLDING PERIØDS:	.0653	.01312	.2009188
FØR ALL 9 YEAR HØLDING PERIØDS:	.08553	0	0
FØR ALL PØSSIBLE HØLDING PERIØDS:	.0644873	.0991855	1.538062

This BASIC program is based on David B. Hertz's article, "Risk Analysis in Capital Investment."[1] Considering the factors that affect a set of cash flows, a business person is usually unable to project the value of each factor with certainty. However, he or she may be able to project a range of possible future values, attaching probabilities to several intervals within this range. For example, a business person may believe that there is a 60% chance of a new product selling at a price between $X and $Y, and only a 40% chance of it selling between $Y and $Z.

METHOD

RISKIT allows you to design your own model to project a set of cash flows. Instead of supplying one value for each factor in the model, you supply as data a number of possible values of each factor and your best guess as to the percentage change of the actual value lying between each pair of actual values. The program uses this information with a random number draw to calculate a value for a particular factor. The process continues until the model is complete, and one complete set of cash flows has been calculated. From the set of cash flows, a rate of return and a net present value is calculated.

This entire procedure is repeated for each different set of cash flows and, thus, a different rate of return and net present value is calculated. The end results are histograms, which indicate how many sets of flows have generated rates of return or net present values that fall into certain intervals. Calculating cash flows in this manner allows for entrance of the element of chance.

For most problems, you are required to have some knowledge of BASIC in order to write a routine that describes or models the interactions of the factors involved. Therefore, two requirements of RISKIT are the data on the factors involved, and the model of the interactions.

In order to simplify the instructions for this program, we have chosen, as an example, the case described in the original Harvard Business Review article. Familiarity with the article will help you understand the following information.

[1] Hertz, D. B., "Risk Analysis in Capital Investment," Harvard Business Review, Volume 42, No. 1, January/February 1964.

INSTRUCTIONS

Entering Data

There are two ways to enter the data and model into the program. Entering data requires substitution of your own data for the library program, DATA, in lines 100-130. Entering a model requires that you substitute your model for lines 1000-1999 in the library program. In addition, a conversational routine is built into RISKIT to allow some of the input data to be provided by you while the program is running. Nevertheless, insertion of some data statements is required before a run.

Lines 100-199 are reserved for data; when entering your own data, overwrite or delete this program data in the library program. The following is a sample of the data entries that correspond to the case described in the Harvard Business Review article:

```
SYSTEM ?BASIC
ØLD ØR NEW-ØLD RISKIT
READY
*LIST 100-130

100 DATA 100
101 DATA 15
102 DATA 0
103 DATA 9
104 DATA LIFE,5
105 DADA 5,8,10,12,15
106 DATA 0,.10,.40,.40,.10
107 DATA MARKET SIZE,5
108 DATA 100000,170000,250000,295000,340000
109 DATA 0,.10,.30,.40,.20
110 DATA MARKET GRØWTH RATE,7
111 DATA 0,.01,.02,.03,.04,.05,.06
112 DATA 0,.05,.15,.30,.30,.15,.05
113 DATA SHARE ØF MARKET,6
114 DATA .03,.06,.09,.12,.15,.17
115 DATA 0,.10,.15,.40,.30,.05
116 DATA SELLING PRICE,5
117 DATA 385,450,510,540,575
118 DATA 0,.10,.45,.35,.10
119 DATA ØPERATING CØSTS,6
120 DATA 370,400,435,470,505,545
121 DATA 0,.15,.35,.35,.10,.05
122 DATA INVESTMENT,6
123 DATA 7000000,8000000,9000000,9500000,10000000,10500000
124 DATA 0,.05,.15,.35,.35,.10
125 DATA RESIDUAL VALUE,4
126 DATA 3500000,4000000,4500000,5000000
127 DATA 0,.20,.40,.40
128 DATA FIXED CØST,6
129 DATA 250000,275000,300000,325000,350000,375000
130 DATA 0,.10,.30,.30,.20,.10
```

The data is defined as follows:

Line 100: Number of iterations or trials to be used to generate the cash flows.

Line 101: Number of discrete increments wanted in histogram. With 100 iterations this probably should be somewhere between 12 and 20 — in this case 15.

Line 102: Number of constants or nonrandom variables in model. This refers to any item in the model whose value remains the same for all sets of cash flows generated.

NOTE: If this data item is not zero, the user will have data on the constants in lines 103 and thereafter. For example, if the particular case contained two constants, months equal to 12 and purchase price equal to 250, lines 102-104 would be:

```
102 DATA, 2
103 DATA MONTHS, 12
104 DATA PURCHASE PRICE, 250
```

And the data now in lines 103 and thereafter would begin with line 105.

Line 103: Number of random variable categories in model. These are the items whose ultimate values are selected randomly by the program.

NOTE: If this data item is zero, this program is not for you!

Line 104: Name of the first variable factor, number of steps for this factor (no more than 8).

Line 105: The upper limits for each step. Must be equal in number to the value stated in line 104 — in this case 5.

Line 106: Estimates of the percentage chance of the future value falling into each step. The first number must <u>always</u> be 0, i.e., no chance of LIFE being less than 5. The rest of the data line reads: a 10% chance of LIFE between 5 and 8, a 40% chance of its being between 8 and 10, and 40% chance of its being between 10 and 12, and only a 10% chance of its being between 12 and 15. The chances should total 1.00, and there should be as many chances including the 0 — as there are data items in the line above.

Line 107: See above, line 104. Lines 104-106 should be repeated for as many random variable factors as called for in line 103 — in this case 9.

The DATA statements must appear even if conversational mode is used. All of the numeric values can be dummy numbers. However, the DATA statements are read and the names of the constants and the random variable categories are used in the questioning process.

Programming the Model

The library program contains the model, described below:

```
*LIST 985-2000

985REM ** MØDEL IS ENTERED IN LINES 1000-1999  **
990REM    NØ. ØF YEARS ØF LIFE
1000 LET N3 = INT(FNR(1) + .5)
1005REM   MARKET SIZE IN PERIØD 0
1010 LET A1=FNR(2)
1015REM   INVESTMENT CASH FLØW IN PERIØD 0
1020 LET F(0)=-1*FNR(7)
1030 LET G1=1
1035REM   FØR EACH YEAR ØF LIFE
1040 FØR I=1 TØ N3
1045REM   MULTIPLICATIVE GRØWTH RATE  PERIØD I
1050 LET G1 = G1*(1+FNR(3))
1055REM   MARKET SIZE  PERIØD I
1060 LET A2 = A1*G1
1065REM   QUANTITY  PERIØD I
1070 LET A3 = A2*FNR(4)
1075REM       VALUE ØF SALES  PERIØD I
1080 LET A4 = A3*FNR(5)
1085REM     ØPERATING CØSTS PERIØD I
1090 LET C1 = FNR(6)
1095REM    IS VALUE>=QTY * ØP.CØST
1100 IF A4>=A3*C1 THEN 1130
1110  LET A3 = 0
1120  LET A4 = 0
1125REM     TØTAL CØST  PERIØD I
1130 LET A5 = FNR(9)+A3*C1
1135REM    CASH FLØW  PERIØD I
1140 LET F(I) = A4-A5
1150 NEXT I
1155REM    ADD RESID. VALUE TØ CASH FLØW  LAST PERIØD
1160 LET F(N3) = F(N3)+FNR(8)
2000REM   ***** END ØF MØDEL *****
```

Values Within the Model

Dimensioned Variables — The dimensioned variables in the program are C(20), F(50), G(50), H(20), R(500), V(500), X(20,8), Y(20,8), Z(500), C$(20), and X$(20). These variables, with the exception of F(I), should not appear in your model.

Undimensioned Variables — Undimensioned variables that are not used in the program and that are available to the user are: A0, A1, A2, ... , A9; B0, B1, B2, ... , B9; and C0, C1, ... , C9.

F(I) — The subscripted F represents the cash flow for a given or calculated period. You must write your program in such a way that you end up with a value for F(0) – cash flow in period 0 — and values for F(1) through F(N3) — cash flow in period 1 through cash flow in last period (see lines 1020, and 1140).

N3 — Your model must calculate a value for N3, the number of periods of cash flow, excluding period 0, (see line 1000).

Function

FNR(M) is a function which, using a random number generator, selects a value for a random variable factor given your value intervals and probabilities for that factor. Recall that in our example the DATA statements contain nine random variable factors. Looking at these DATA statements one can conclude that category #1 is LIFE, category #2 is MARKET SIZE, category #3 is MARKET GROWTH RATE, etc. In place of the M in FNR(M) substitute the number, or index, of the factor whose value you want calculated. Thus the statement:

```
1010 LET A1 = FNR(2)
```

sets A1 equal to some MARKET SIZE, which falls within one of the intervals set by you.

The function is defined in lines 500-511, where X(MK, 9) is the actual value for factor M, step K9; and Y(M, K9) is the probability for category M, step K9, K9 = 1 to the number of steps in factor M.

Model's Location in RISKIT

When the model is confined to lines 985-1999, it is automatically embedded in the loop:

```
970 FOR IO = 1 TO N2
```

where N2 is the number of iterations specified in DATA line 100 — in our case it is 100. Thus, it is necessary to program the model as if it were to be run only once. RISKIT effects the iteration procedure. Use the variables I, J, K, and L with the FOR-NEXT statements in the model.

An explanation of what the model in our example is computing might be helpful in demonstrating how you would go about programming your own model. Remember that the model must provide values for N3, the number of periods, and F(0) through F(N3), the cash flows for every period including period 0.

The example used by Hertz in the Harvard Business Review article concerns introduction of a new product. A firm's management has provided the data on the nine key factors shown in DATA lines 104-130 and the relationships among these variables as described below.

Line 1000: The number of periods is computed by rounding off, using the intergerizing function INT, the random draw for the LIFE of the project. LIFE is the first category or factor; therefore, FNR(1) provides the random draw for LIFE.

Line 1010: The market size in period 0, A1, is set equal to the random draw for MARKET SIZE, the second category.

Line 1020: The cash flow in period 0, F(0), is set equal to the negative of the random draw for INVESTMENT, the seventh category. If the values in DATA line 123 had been typed in as negatives, then line 1020 would read: 1020 LET F(0)=FNR(7).

Line 1030: This line simply initializes the variable G1 to 1, since it represents the market growth rate in each period and is considered to be 1 in period 0.

Line 1040: The cash flows, F(I), are computed for each period from 1 to N3 in a loop which extends from line 1040 to line 1150. I represents the index number of the period.

Line 1050: The multiplicative market growth rate in period 1, G1, is set equal to the growth rate in the previous period times one plus the MARKET GROWTH RATE in period I, the third category.

Line 1060: The total market size in period I, A2, is set equal to the market size in period 0, A1, times the multiplicative market growth rate.

Line 1070: The quantity to be sold by the firm in period I, A3, is set equal to the total market size, A2, times the random draw for SHARE OF MARKET, the fourth category.

Line 1080: The total value of the sales of the firm in period I, A4, is set equal to the quantity sold, A3, times the random draw for SELLING PRICE, the fifth category.

Line 1090: The operating cost per item in period I, C1, is set equal to the random draw for OPERATING COSTS, the sixth category.

Lines 1100-1120: If the total value of the sales by the firm, A4, are greater than or equal to the total operating costs, A3 times C1, then the firm will produce the product in period I and both the quantity to be sold, A3, and the total value of sales, A4, will retain their values previously computed. If A4 is less than total operating costs, then both A3 and A4 are set equal to 0, that is, in period I the firm will not produce or sell any of the product thus avoiding all marginal costs.

Line 1130: The total costs in period I, A5, is set equal to the random draw for FIXED COST, the ninth category, plus the total operating costs, A3 times C1.

Line 1140: The cash flow in period I, F(I), is set equal to the value of sales in period I, A4, minus the total period costs, A5.

Line 1160: The cash flow in the last period, F(N3), is set equal to the value previously computed in line 1140 for F(N3) plus the random draw for RESIDUAL VALUE, the eighth category.

Changes in RISKIT

Sometimes it is necessary to eliminate the rate of return routine because it can be programmed in too simple a manner to allow for all the solutions possible in calculating rate of return. Thus if the model creates a set of flows that never change sign, the error message OVERFLOW is typed; the model should be reprogrammed or the rate of return eliminated. To eliminate the rate of return routine, type: 214 LET Z8+0.

Net present values are currently set to be discounted at 10%. If you desire another rate, change line 216 to: LET Z9+.10 (10% discounting — any other discount rate may be used here). For no discounting, change line 216 to 0: 216 LET Z9+0.

In the following example, the output begins with the set of cash flows generated during the first iteration. These flows allow you to perform a quick check to see if they appear reasonable. Flows for the remaining iterations are not printed because the output would be too long.

Following the first iteration's cash flows are histograms for the rates of return, net present values and ratios of net present values (i.e., the ratios of positive flows to negative flows). Following each histogram are the mean and standard deviation of the particular measure plotted in the histogram.

SAMPLE RUN

```
*
SYSTEM ?BASIC
ØLD ØR NEW-ØLD RISKIT
READY
*RUN


DØ YØU WANT TØ USE DATA; (YES ØR NØ ) ?YES

FLØWS FØR THE FIRST ITERATIØN FØR   12  PERIØDS

PERIØD          FLØW

            0       -9216754
            1         3227312
            2         1029929
            3       -282727.8
            4         1326603
            5         2133060
            6         3264068
            7         5674858
            8        878938.6
            9        981559.9
           10         4040488
           11         9438514


RATES ØF RETURN FØR  100 SAMPLES

-.011  LESS THAN .022          ***                          3
 .022  LESS THAN .055          ******                       6
 .055  LESS THAN .088          ***********                 11
 .088  LESS THAN .121          ************                12
 .121  LESS THAN .154          ******************          18
 .154  LESS THAN .187          ********************        19
 .187  LESS THAN  .22          ***********                 11
  .22  LESS THAN .253          *******                      7
 .253  LESS THAN .286          ******                       6
 .286  LESS THAN .319          ****                         4
 .319  LESS THAN .352          **                           2
 .352  LESS THAN .385                                       0
 .385  LESS THAN .418                                       0
 .418  LESS THAN .451          *                            1
 .451  LESS THAN .484                                       0


MEAN    .1585

STANDARD DEVIATIØN    .0809
```

NET PRESENT VALUES FØR 100 SAMPLES

FØR ACTUAL VALUE MULTIPLY BY 1000

-5391	LESS THAN -3962	**	2
-3962	LESS THAN -2533	******	6
-2533	LESS THAN -1104	**********	10
-1104	LESS THAN 325	******	6
325	LESS THAN 1754	**********	16
1754	LESS THAN 3183	**********	12
3183	LESS THAN 4612	**********	11
4612	LESS THAN 6041	**********	16
6041	LESS THAN 7470	********	8
7470	LESS THAN 8899	*****	5
8899	LESS THAN 10328	***	3
10328	LESS THAN 11756	*	1
11756	LESS THAN 13185	**	2
13185	LESS THAN 14614	*	1
14614	LESS THAN 16043	*	1

MEAN 3101307

STANDARD DEVIATIØN 4108050

RATIØS ØF NET PRESENT VALUE FØR 100 SAMPLES

.4592	LESS THAN .6222	**	2
.6222	LESS THAN .7852	*********	9
.7852	LESS THAN .9482	*********	9
.9482	LESS THAN 1.1112	**********	11
1.1112	LESS THAN 1.2742	**********	18
1.2742	LESS THAN 1.4372	**********	12
1.4372	LESS THAN 1.6002	**********	12
1.6002	LESS THAN 1.7632	**********	11
1.7632	LESS THAN 1.9262	*********	9
1.9262	LESS THAN 2.0892	**	2
2.0892	LESS THAN 2.2522	***	3
2.2522	LESS THAN 2.4152		0
2.4152	LESS THAN 2.5782	*	1
2.5782	LESS THAN 2.7412		0
2.7412	LESS THAN 2.9042	*	1

MEAN 1.3327

STANDARD DEVIATIØN .4334

SAMPLE RUN 2

Sample Run 2 shows a run of RISKIT using the conversational mode, which is activated by answering NO to the first question. The DATA statements used in the Sample Run are still in the program, but only the names of the nine categories will be used, and the remaining data could be replaced by 0. As the output in Sample Run 2 shows, conversational mode forces the range of values for each random variable category into five steps rather than allowing you to specify the number of steps, as is the case with DATA statements. Also, conversational mode permits you to make changes to any of the inputs both before and after the histograms are printed.

```
READY
*Ø
SYSTEM ?BASIC
ØLD ØR NNEW-ØLD RISKIT
READY
*RUN

DØ YØU WANT TØ USE DATA; (YES ØR NØ ) ?NØ

HØW MANY CØNSTANTS IN YØUR MØDEL ?0

HØW MANY RANDØM VARIABLE CATEGØRIES IN YØUR MØDEL ?9

     FØR THE FØLLØWING ITEMS THE USER SHØULD
ENTER THE EXPECTED VALUE, THE LØWEST REASØNABLE
VALUE AND THE HIGHEST REASØNABLE VALUE.
SEPARATE BY CØMMAS.

     FØLLØWING THE USER'S ENTRIES A RANGE ØF VALUES
WILL BE TYPED ØUT.  UNDER THIS WILL BE THE PERCENTAGE
CHANCE THAT THE VALUE WILL FALL WITHIN A GIVEN RANGE.

***NØTE***IF THE USER IS UNHAPPY WITH THESE FIGURES,
          HE WILL HAVE AN ØPPØRTUNITY TØ CHANGE THEM
          LATER ØN.

                         EXPECTED, LØW, HIGH

    1 LIFE               ?10,510,15

      5              8              10             13             15
             .1             .5             .3             .1

    2 MARKET SIZE        ?250000,100000,340000

    100000         175000         250000         295000         340000
             .1             .225           .575           .1
```

```
3 MARKET GRØWTH RATE ?.035,0,.06

  0              .0175          .035            .0475          .06
          .1               .2833333        .5166667        .1


4 SHARE ØF MARKET     ?.12,.03,.17

.03             .075            .12             .145           .17
          .1               .1999999        .6000001        .1


5 SELLING PRICE       ?510,365,575

365             438             510             543            575
          .1               .1380952        .6619048        .1


6 ØPERATING CØSTS     ?450,370,545

370             410             450             498            545
          .1               .4624999        .3375001        .1


7 INVESTMENT          ?9500000,7000000,10500000

 7000000        8250000         9500000         1.00000E 07
1.05000E 07
          .1               .0999999        .7000001        .1


8 RESIDUAL VALUE      ?4500000,3500000,5000000

3500000         4000000         4500000         4750000        5000000
          .1               .1666666        .6333334        .1


9 FIXED CØST          ?325000,250000,375000

250000          287500          325000          350000         375000
          .1               .2599999        .5400001        .1
```

```
DØ YØU WANT TØ CHANGE ANYTHING ?YES

INDEX NUMBER ØF ITEM TØ CHANGE ?5

DØ YØU WANT NEW VALUES ?YES

INPUT 5 NEW VALUES ?385,448,510,543,575

DØ YØU WANT NEW PERCENTAGES ?YES

INPUT 4 NEW PERCENTAGES ?.1,.5,.3,.1

    385             448             510             543             575
            .1              .5              .3              .1

DØ YØU WANT TØ CHANGE ANYTHING ?YES

INDEX NUMBER ØF ITEM TØ CHANGE ?9

DØ YØU WANT NEW VALUES ?YES

INPUT 5 NEW VALUES ?250000,275000,300000,325000,375000

DØ YØU WANT NEW PERCENTAGES ?NØ

    250000          275000          300000          325000          375000
            .1              .2599999        .5400001        .1

DØ YØU WANT TØ CHANGE ANYTHING ?NØ

HØW MANY TIMES DØ YØU WANT TØ ITERATE.  (0 WILL STØP PRØGRAM)
? 0
```

This BASIC program provides a summary presentation of inventory turnover and profit margin information for each department of a firm. The user enters the sales, purchases, and beginning and ending inventories for each department.

INSTRUCTIONS

To use, type RUN, and enter the following information as requested:

1. Number of departments
2. Number of months to be analyzed
3. Company name
4. For each department:
   - sales
   - beginning inventory
   - ending inventory
   - purchases

SAMPLE PROBLEM

Joe Doe Co., a relatively unprofitable company, has three departments with the following statistics over the past 12 months:

Dept. 1: $300,000 in sales, $400,000 in initial inventory, $300,000 in final inventory, and $300,000 in purchases.

Dept. 2: $200,000 in sales, $300,000 in initial inventory, $200,000 in final inventory, and $200,000 in purchases.

Dept. 3: $500,000 in sales, $600,000 in initial inventory, $500,000 in final inventory, and $500,000 in purchases.

Summarize the departments' inventory turnover and profit margin.

SAMPLE RUN

```
*RUN


HØW MANY DEPARTMENTS DØ YØU HAVE ?3
PERIØD LENGTH(MØS) ?12
CØMPANY NAME ?JØE DØE CØ.


FØR EACH DEPARTMENT ENTER:
    SALES,BEGINNING INVENTØRY, ENDING INVENTØRY, PURCHASES

    1  ?300000,400000,300000,300000
    2  ?200000,300000,200000,200000
    3  ?500000,600000,500000,500000
```

JØE DØE CØ.

		SALES	C/G/S	%C/G/S	GRØSS PRØFIT	% GRØSS PRØFIT
DEPT	1	300000	400000	133.33	-100000	-33.33
DEPT	2	200000	300000	150	-100000	-50
DEPT	3	500000	600000	120	-100000	-20
TØTALS		1000000	1300000	130	-300000	-30

		PERCENT ØF SALES	PERCENT ØF C/G/S	PERCENT GRØSS PFT	PERCENT INVENTØRY	DAYS INVENTØRY
DEPT	1	30	30.77	33.33	30	315 DAYS
DEPT	2	20	23.08	33.33	20	300 DAYS
DEPT	3	50	46.15	33.33	50	330 DAYS

ØVERALL INVENTØRY TURNØVER 276.92 DAYS

The BASIC program calculates the amount of money that would accumulate after N years at an annual interest rate R compounded T times per year, when the initial amount is P and an amount D is added at the beginning of each subsequent year.

INSTRUCTIONS

To use this program, type RUN and enter the data as requested.

RESTRICTIONS

P and D must be given in dollars, N and T in integers, and R as a percentage. For additional instructions, list the program.

SAMPLE PROBLEM

Calculate the amount of money that would accumulate after four years at an interest rate of 6% if the original amount was $6000, if $200 is added at the beginning of the second, third, and fourth year. Interest is compounded four times per year.

SAMPLE SOLUTION

```
*RUN

SAVING

    THIS PR0GRAM CALCULATES THE AM0UNT 0F M0NEY THAT
W0ULD ACCUMULATE AFTER N YEARS AT AN ANNUAL INTEREST
RATE R C0MP0UNDED T TIMES PER YEAR, WHEN THE INITIAL
AM0UNT IS P AND AN AM0UNT D IS ADDED AT THE BEGINNING
0F EACH SUBSEQUENT YEAR.  N0TE THAT P AND D ARE GIVEN
IN D0LLARS, N AND T MUST BE INTEGERS, AND R IS GIVEN
AS A PERCENTAGE.

WHAT ARE P,D,N,T,R ?6000,200,4,4,6

   AFTER     4 YEARS,  6000 D0LLARS INVESTED AT    6
   PERCENT C0MP0UNDED     4 TIMES PER YEAR, WITH THE
   ADDITI0N 0F   200 D0LLARS PER YEAR, YIELDS A T0TAL
   0F    8290.608 D0LLARS.

M0RE DATA (1=YES, 0=N0) ?1
WHAT ARE P,D,N,T,R ?6000,0,4,4,6

   AFTER     4 YEARS,  6000 D0LLARS INVESTED AT    6
   PERCENT C0MP0UNDED     4 TIMES PER YEAR, WITH THE
   ADDITI0N 0F     0 D0LLARS PER YEAR, YIELDS A T0TAL
   0F    7613.913 D0LLARS.

M0RE DATA (1=YES, 0=N0) ?1
WHAT ARE P,D,N,T,R ?0,200,4,4,6

   AFTER     4 YEARS,     0 D0LLARS INVESTED AT    6
   PERCENT C0MP0UNDED     4 TIMES PER YEAR, WITH THE
   ADDITI0N 0F   200 D0LLARS PER YEAR, YIELDS A T0TAL
   0F    676.6948 D0LLARS.

M0RE DATA (1=YES, 0=N0) ?1
WHAT ARE P,D,N,T,R ?6000,200,4,1,5.25

   AFTER     4 YEARS,  6000 D0LLARS INVESTED AT 5.25
   PERCENT C0MP0UNDED     1 TIMES PER YEAR, WITH THE
   ADDITI0N 0F   200 D0LLARS PER YEAR, YIELDS A T0TAL
   0F    8027.977 D0LLARS.

M0RE DATA (1=YES, 0=N0) ?0
```

This BASIC program simulates the future performance of an investment fund.[1] SIMFUND is linked to a plotting program, SIMPLOT, which draws histograms. Before running SIMFUND, you must save an empty file called ENDFUND.

METHOD

In running SIMFUND, specify the annual rate of return you expect the fund to earn (this is total return, made up of income and appreciation), that is, the most likely rate of return in any future year, and the standard deviation you expect the future rates of return to show. In addition, SIMFUND permits you to specify a rate at which new money will be added to the fund, and a rate at which money will be withdrawn from it. The program applies these two rates to the average of the three preceding year-end values of the fund.

The program assumes the fund begins with $100 and compounds this $100 forward for 50 years. For each year it selects a rate of return from a log normal distribution (specified by the expected rate of return and standard deviation you have called for) and uses this rate to compound the fund. For each year it adds new money and subtracts withdrawals, using the rates you provided and applying them to the average of the three preceding year-end values of the fund. Selection of a rate from a log normal distribution involves a random element, so that rarely will the program draw two identical rates of return over the 50 years. The rates can be expected, however, to form a pattern that closely approximates a log normal distribution. The choice of this particular distribution is discussed in the text referenced previously. It is perhaps not the ideal distribution for forecasting fund returns, but it is simple and seems to work fairly well. The formulas used can be seen by listing them from the program:

```
*LIST 190-250, 1020-1080
```

A single series of 50 rates of return, calculated as described above, does not tell much about what may happen over those years — it represents only a single draw from a random distribution for each year. So the program repeats the 50-year compounding 100 times and displays the results of these 100 simulations.

[1] For a discussion of simulation as a device for testing and comparing investment strategies, see Williamson, Peter, J., New Analytical Techniques, Amos Tuck School, Dartmouth University, Hanover, New Hampsire, Chapters 3 and 9.

SAMPLE PROBLEM 1

For Sample Problem 1, we have specified an expected return of 15% with a standard deviation of 13%. We have specified no additions or withdrawals, and asked for a display of terminal fund values (TV's) every five years. The program responds by running 100 simulations over 50 years, and printing a summary of results, a year at a time for the first five years, and then at five year intervals. (The interval called for must divide evenly into 50.) At the end of year 20, the lowest and highest values were $245.37 and $5868.67, and the average was $1716.58.

The table helps illustrate the results that are possible and probable if future returns are characterized by a means of 15% with a standard deviation of 13%. However, a histogram gives a better picture. As the run of the program proceeds, provide a name for your fund, for future identification of histograms, and the year at which you want a histogram printed (which must be one of the years in the table above). In the example, a histogram at twenty years has been called for, with no respacing (discussed below).

Histograms can be called, for any time period listed in the initial table, and the expected results of an investment strategy can be compared over future years and with the expected results of a different strategy.

SAMPLE PROBLEM 2

Sample Problem 2 shows a run in which the user specified an expected return of 8%, a standard deviation of 7%, and also called for new money to be added at 1% a year and withdrawals to be made at 4.5%. As in Sample Problem 1, a table is printed, this time showing under AVERAGE SPENDING, the average withdrawal calculated in the 100 simulations. (For the first year, each simulation calculates spending of exactly $4.50 because of the averaging.)

The first histogram called for is at one year, and shows about a one-third chance that the $100 investment will have depreciated over the first year, with $85 the lowest result of any simulation. A second histogram shows the distribution of fund values at ten years, and the distribution of withdrawals at ten years. This second distribution is the result of applying the 4.5% spending rule to average fund values over three years — averages that vary from simulation to simulation. The example suggests little likelihood of a withdrawal for spending in the tenth year below about $4 or above approximately $8 per $100 initial investment.

As Sample Problem 2 continues, the user has asked again for histograms at ten years, but has requested respacing, indicating intervals of 0-250 for fund values, and 0-10 for withdrawals. If no respacing is called for, the program automatically divides the range from the smallest value to the largest by 10, and the histogram follows these ten intervals. Respacing allows you to choose your own range and interval size to be used in the histograms. In this example, the histogram for fund values has been set to cover the range 0 to $250 in steps of $25. The single asterisk between 250 and 280 indicates that one value fell above the 0 to 250 range. The histogram for withdrawals has been set to cover the range 0 to $10 in steps of $1, and no values fell outside this range.

The histograms are actually drawn by the program SIMPLOT, to which SIMFUND chains. SIMPLOT operates from the file ENDFUND, created by SIMFUND. The simulations run by SIMFUND are very time-consuming, and if you are interrupted in calling for histograms it is not necessary to run the simulation again. Just call out SIMPLOT and run it.

SAMPLE RUN 1

```
BASIC
ØLD ØR NEW-ØLD SIMFUND
READY
*RUN

WHAT ARE EXPECTED RATE ØF RETURN AND STANDARD DEVIATIØN ?.15,.13
AT WHAT RATE DØ YØU EXPECT NEW MØNEY TØ BE ADDED ?0
WHAT RATE ØF SPENDING IS BUDGETED ?0
AT WHAT INTERVALS DØ YØU WISH TV'S ?5


TØTAL RETURN FUND AT END ØF:

                                                        AVERAGE
PERIØD        UPPER BØUND        MEAN        LØWER BØUND SPENDING
 1              141.15          115.35          80.41      .00
 2              210.33          134.16          84.03      .00
 3              235.50          152.57          87.51      .00
 4              290.92          176.12          97.47      .00
 5              406.55          202.09         100.82      .00
10             1024.97          421.27         115.70      .00
15             2298.53          842.70         223.54      .00
20              5868.67         1716.58         245.37      .00
25             16643.58         3798.55         499.89      .00
30             33823.20         7677.73         736.18      .00
35             87232.97        15754.43        1117.45      .00
40            157535.17        30699.46        2294.71      .00
45            333111.65        61627.30        6005.92      .00
50            640792.34       126456.81        8064.77      .00
```

```
WHICH FUND ?ABC
AT WHICH PERIØD DØ YØU WANT A HISTØGRAM ?20
DØ YØU WISH TØ RESPACE ?NØ


        FUND ABC DISTRIBUTIØN ØF FUND VALUES AT   20 YEARS

  245       :
            :***************
  807       :
            :************************
 1369       :
            :*********************************
 1931       :
            :***************
 2494       :
            :*******
 3056       :
            :***
 3618       :
            :**
 4181       :
            :**
 4743       :
            :*
 5305       :
            :*
 5868       :


AT WHICH PERIØD DØ YØU WANT A HISTØGRAM ?0
```

```
SYSTEM ?BASIC
ØLD ØR NEW-ØLD SIMFUND
READY
*RUN


WHAT ARE EXPECTED RATE ØF RETURN AND STANDARD DEVIATIØN ?.08,.07
AT WHAT RATE DØ YØU EXPECT NEW MØNEY TØ BE ADDED ?.01
WHAT RATE ØF SPENDING IS BUDGETED ?.045
AT WHAT INTERVALS DØ YØU WISH TV'S ?10


TØTAL RETURN FUND AT END ØF:

                                                        AVERAGE
PERIØD        UPPER BØUND       MEAN        LØWER BØUND SPENDING
  1            118.18          104.69        84.57        4.50
  2            144.53          110.23        83.37        4.57
  3            149.62          114.60        82.01        4.72
  4            163.51          120.25        84.33        4.94
 10            280.73          160.99        74.11        6.51
 20            556.70          254.66        79.37       10.51
 30           1103.35          424.64       106.62       17.33
 40           1936.71          668.20       145.28       27.75
 50            3111.87         1063.14       212.58       43.30


WHICH FUND ?BCD
AT WHICH PERIØD DØ YØU WANT A HISTØGRAM ?1
DØ YØU WISH TØ RESPACE ?NØ


        FUND BCD DISTRIBUTIØN ØF FUND VALUES AT     1 YEARS

  84        :
            :*
  87        :
            :***
  90        :
            :**
  94        :
            :**********
  97        :
            :**********
 100        :
            :**********
 104        :
            :**********
 107        :
            :**********
 110        :
            :*********
 114        :
            :*********
 117        :
```

```
AT WHICH PERIØD DØ YØU WANT A HISTØGRAM ?10
DØ YØU WISH TØ RESPACE ?NØ


        FUND BCD DISTRIBUTIØN ØF FUND VALUES AT    10 YEARS

  74        :
            :***
  94        :
            :******
 115        :
            :******************
 135        :
            :**************************
 156        :
            :*****************
 177        :
            :*************
 197        :
            :***********
 218        :
            :***
 239        :
            :**
 259        :
            :*
 280        :


        FUND BCD DISTRIBUTIØN ØF WITHDRAWALS AT    10 YEARS

3.38        :
            :**
4.07        :
            :*****
4.76        :
            :*************
5.46        :
            :************************
6.15        :
            :**********************
6.85        :
            :**************
7.54        :
            :***********
8.24        :
            :*******
8.93        :
            :**
 .63        :
            :*
10.32       :
```

```
AT WHICH PERIØD DØ YØU WANT A HISTØGRAM ?10
DØ YØU WISH TØ RESPACE ?YES
WHAT ENDPØINTS ?0,250,0,10


        FUND BCD DISTRIBUTIØN ØF FUND VALUES AT    10 YEARS

  0       :
          :*
 25       :
          :*
 50       :
          :*
 75       :
          :**
100       :
          :***********
125       :
          :****************************
150       :
          :****************************
175       :
          :****************
200       :
          :***********
225       :
          :****
250       :
          :*
280       :


        FUND BCD DISTRIBUTIØN ØF WITHDRAWALS AT    10 YEARS

  0       :
          :*
  1       :
          :*
  2       :
          :*
  3       :
          :**
  4       :
          :**********
  5       :
          :*************************
  6       :
          :*********************************
  7       :
          :******************
  8       :
          :**********
  9       :
          :**
 10       :
          :*
 10       :


AT WHICH PERIØD DØ YØU WANT A HISTØGRAM ?0
```

This BASIC program computes and prints a monthly payments schedule for a Small Business Administration (SBA) loan. At the end of each calendar year and at the final retirement of the loan, it also prints a comprehensive summary statement giving the beginning principal, ending principal, principal repayments made, and total interest paid during the year. The program first computes the monthly interest charges on the two respective shares of the loan. The residual of the monthly payment after deduction of these interest charges is then used to repay the loan principals of the two shares. The program assumes that the service fee charged by the bank will be reimbursed by the SBA.

INSTRUCTIONS

Type RUN and enter the following data as requested.

1. Borrower's name: enter the name without using commas such as before JR.
2. Original principal: enter the amount without a dollar sign or without commas.
3. SBA share: enter the SBA share expressed as a percent, (e.g., 40% is entered as 40).
4. Bank rate: enter the interest rate charged by the bank expressed as a percent.
5. SBA rate: enter the interest rate charged by the SBA expressed as a percent.
6. Loan date: enter the month and year of the loan. The month should be expressed as the number of the month (i.e., January = 1, February = 2, etc.) and the year as a four digit number. The month and the year should be separated by a comma.
7. Monthly payment: enter the monthly payment without a dollar sign and without commas.
8. Service fee: enter the annual service charge expressed as a decimal part of 1%. For example, 1/4 of 1% is entered as .25.
9. Number of calendar years for schedule: enter the number of years for which you wish the schedule printed.

SAMPLE PROBLEM

Print a one-year monthly payment schedule for an SBA loan of $30,000 to J.R. Craig, dated September 1972. The bank rate is 8.5%, the SBA rate is 6%. The SBA assumes 40% of the loan and a service fee is 1/4 of 1%. Do not list the program for instructions.

SAMPLE SOLUTION

```
* RUN

PLEASE LIST THIS PRØGRAM FØR INSTRUCTIØNS.

BØRRØWER'S NAME ?J.R.CRAIG
ØRIGINAL PRINCIPAL ?30000
SBA SHARE ?40
BANK RATE ?8.5
SBA RATE ?6
LØAN DATED (MØ,YR) ?9,1972
MØNTHLY PAYMENT ?500
SERVICE FEE(%) ?.25
FØR HØW MANY CALENDAR YEARS DØ YØU WISH THE SCHEDULE ?1

        ****SBA LØAN SCHEDULE****

BØRRØWER:  J.R.CRAIG
AMØUNT ØF LØAN    30000.00
SBA PARTICIPATIØN:    40 %
SBA INTEREST RATE:     6 %
BANK INTEREST RATE:  8.5 %
MØNTHLY PAYMENT:     500.00

                BEGINNING    INTEREST     PRINCIPAL    SERVICE      TØTAL
                PRINCIPAL    PAYMENT      REPAYMENT      FEE        PAYMENT

==========================================================

PMT #     1 ØCT, 1972

TØTAL LØAN      30000.00       187.50       312.50                  500.00
SBA SHARE       12000.00        60.00       125.00        -2.50     182.50
BANK SHARE      18000.00       127.50       187.50         2.50     317.50

==========================================================

PMT #     2 NØV, 1972

TØTAL LØAN      29687.50       185.54       314.46                  500.00
SBA SHARE       11875.00        59.37       125.78        -2.47     182.68
BANK SHARE      17812.50       126.17       188.68         2.47     317.32

==========================================================

PMT #     3 DEC, 1972

TØTAL LØAN      29373.04       183.59       316.41                  500.00
SBA SHARE       11749.22        58.75       126.57        -2.45     182.87
BANK SHARE      17623.82       124.84       189.84         2.45     317.13

==========================================================

FØR 1972 :
  BEGINNING PRINCIPAL   30000.00
  ENDING PRINCIPAL      29056.63
  PRINCIPAL REPAYMENT     943.37
  TØTAL INTEREST PAID     556.63


==========================================================
```

This BASIC program calculates the true annual interest rate charged on an installment loan.

INSTRUCTIONS

To use this program, type RUN and supply values for the four variables:

- A, amount of loan in dollars
- P, amount of each payment in dollars
- N, the total number of payments due
- K, the number of payments due in one year

For additional instructions, list the program.

SAMPLE PROBLEM

Determine the true interest charged on these two loans:

Loan 1 is for $600 for 21 months with a payback of $31.99 per month. Loan 2 is for $1400 for 30 months with a payback of $54.90 per month. The bank's stated rate is 6%. The input data would be:

Loan 1

A = Amount of Loan = $600.00
P = Amount of each payment = $31.99
N = Total Number of Payments = 21
K = Number of Payments in one year = 12

Loan 2

A = $1400.00
P = $54.90
N = 30
K = 12

SAMPLE SOLUTION

```
*RUN

 TRUINT

 THIS PRØGRAM WILL CALCULATE THE TRUE ANNUAL INTEREST
 RATE CHARGED ØN AN INSTALLMENT LØAN.  YØU SUPPLY THE
 VALUES ØF FØUR VARIABLES:  A = AMØUNT ØF LØAN (IN $),
 P = AMØUNT ØF EACH PAYMENT ($), N = THE TØTAL NUMBER
 ØF PAYMENTS DUE, AND  K = THE NUMBER ØF PAYMENTS DUE
 IN ØNE YEAR.  WHAT ARE A,P,N,K ?600.00,31.99,21,12

 TRUE ANNUAL INTEREST RATE (NØMINAL)=    12.61
 TRUE ANNUAL INTEREST RATE (EFFECTIVE)=    13.36

 ANØTHER CASE?  (TYPE 'S' TØ STØP NØW).
 WHAT ARE A,P,N,K ?1400.00,54.90,30,12

 TRUE ANNUAL INTEREST RATE (NØMINAL)=    12.98
 TRUE ANNUAL INTEREST RATE (EFFECTIVE)=    13.78

 ANØTHER CASE?  (TYPE 'S' TØ STØP NØW).
 WHAT ARE A,P,N,K ?S
```

The BASIC program calculates the intrinsic value of stock.

The intrinsic value of a stock, according to the theory described by John Burr Williams in The Theory of Investment Value,[1] and by Nicholas Molodovsky in a number of articles in the Financial Analysts Journal, is the discounted present value of the stream of dividends the shareholder expects to receive:

$$V = \frac{d_1}{1+r} + \frac{d_2}{(1+r)^2} + \frac{d_3}{(1+r)^3} + \cdots$$

where

- V is the intrinsic value
- d_1 is the dividend expected next year
- d_2 is the dividend expected the year after, and so on indefinitely
- r is the discount rate (rate of return the investor expects to earn on purchase of the stock)

The expected dividends d_1, d_2, and so on, can be replaced by the expected earnings e_1, e_2, and so on, multiplied by the payout rate p. The earnings estimates can be further replaced by the present normalized earnings, e_0, and the expected growth rate g.

$$V = e_0 p \left(\frac{1+g}{1+r} + \frac{(1+g)^2}{(1+r)^2} + \frac{(1+g)^3}{(1+r)^3} + \cdots \right)$$

The normalized current earnings figure is simply the earnings per share that could be expected in this year apart from unusual conditions. One way to estimate normalized earnings is to extrapolate a trend line of earnings per share. The point is that since the forecasts of all future earnings are based on e_0, it is important that e_0 not be influenced by temporary factors.

Molodovsky has suggested the use of two growth rates: one relatively short term (perhaps extending twenty or thirty years) and another long term. His reasoning is that even high growth companies reach a level of maturity when growth stabilizes at the long term growth rate of the industry. He suggests that approximately 4% a year is an appropriate long term growth rate for most companies.

[1] For a more complete review of the intrinsic value approach, see Williamson, J. Peter, Investments: New Analytic Techniques, Hanover, New Hampshire, Amos Tuck School, Dartmouth University, Chapter VI.

Both Williams and Molodovsky prefer to calculate intrinsic value from dividend projections alone, implicitly assuming that if a shareholder anticipates selling stock in the future, the best estimate of what will be received for it then is the forecasted intrinsic value at that time. Since this forecasted intrinsic value will be just the value at that time of the stream of dividends to come, and since this is precisely the value that the calculations described above make use of to account for the value at that future time in deducing the present intrinsic value, there is no need to consider separately the results of a future sale.

Some analysts, however, are more comfortable predicting the price/earnings ratio of a stock at some future time than they are predicting earnings growth rates indefinitely into the future. For them, the appropriate formula is:

$$V = e_0 p \left(\frac{(1+g_1)}{1+r} + \frac{(1+g_1)(1+g_2)}{(1+r)^2} + \frac{(1+g_1)(1+g_2)(1+g_3)}{(1+r)^3} + \ldots + \frac{(1+g_1)(1+g_2)\ldots(1+g_n)}{(1+r)^n} \right)$$

$$c_0 + \frac{(1+g_1)(1+g_2)\ldots(1+g_n)\ R}{(1+r)^n}$$

where g_1, g_2, and so on to g_n are the predicted growth rates in earnings for the first, second, up to nth years, and R is the price/earnings ratio forecasted for the nth year.

The program RETURN can be useful in determining past rates of return experienced on a stock, which can serve as a guide to the discount rate.

VALSTK can be used to calculate intrinsic value, given normalized current earnings per share, growth rates in earnings, dividend payout rates, discount rates, and either a long term growth rate in earnings continuing indefinitely into the future, or a price/earnings ratio forecast for some future point in time. In addition, the program calculates the time period for which a forecasted growth rate must persist, or the price/earnings ratio that must be achieved at a future point in time, in order to make the intrinsic value equal to the current market price.

VALSTK offers some additional flexibility to the formulas given above in forecasting growth rates. The user can forecast growth rates for various time spans in the future and

can also forecast periods of adjustment from one growth rate to another, choosing one of three kinds of adjustment: straight line, which implies that the rate changes by the same amount during each year of the adjustment period; fast, which implies that the adjustment follows a sum-of-the-years digits formula, where the rate changes quickly at the beginning of the adjustment period and slowly at the end; and slow, which implies a reverse sum-of-the-years digits formula, where the rate changes slowly at the beginning of the adjustment period and quickly at the end.

SAMPLE PROBLEM 1

The user requests instructions for supplying data. (Sample Problems 2 and 3 show other ways of responding to the first question.) The answer to item 0 indicates than an intrinsic value is to be calculated. Items 1 through 5 deal with data already referred to. Item 6 asks for a choice between forecasting a long-term growth rate and a future price/earnings ratio, and the user has chosen the former. Hence item 7, the long-term rate, is called for.

Next, the user is asked for item 9, the current year (the year as of which the analysis is being made). The answer to item 9 is 1973.

Finally, growth estimates in earnings per share and estimates of dividend payout ratios and discount rates must be supplied. Each estimate consists of up to eight numbers: the predicted growth rate, the duration of that rate, the dividend payout ratio for that period, the discount rate for that period, the type of adjustment to the next rate, the duration of the adjustment period, the dividend payout ratio for the adjustment period, and the discount rate for the adjustment period. The adjustment period may be zero, implying that there is an immediate shift from one growth rate to another.

In the example, the user has predicted a growth of 25% a year for the 10 years 1974-1983, with a dividend payout of 35% and a discount rate of 20%, followed by a "slow" adjustment over the five years 1984-1988 to a second rate. The second rate is 22%, predicted to last for the five years 1989-1993, with a dividend payout of 40% and a discount rate of 18%, followed by a "slow" adjustment of the two years 1994-1995. Since the user supplied no further forecast, the rates beginning in 1996 will be the long-term growth, divided payout and discount rates, specified earlier as 5%, 40%, and 16%, respectively. The computer responds with a summary of some of the data supplied and a calculation of the intrinsic value of the stock. The user may have a table of values in future years deduced from the forecasts supplied.

The table shows the forecasted growth rates (the rates in the adjustment periods have been rounded so that the form of the adjustment is obscure), and the earnings-per-share calculated from these rates. The last column shows the intrinsic value year-by-year, and the next-to-last column shows the ratio of intrinsic value to earnings (analogous to a price/earnings ratio).

Next, the user is offered an opportunity to change any of items 0 to 9 and to supply a new set of growth forecasts. A modified set of forecasts gives a different intrinsic value in the problem.

SAMPLE RUN 1

```
SYSTEM ?BASIC
ØLD ØR NEW-ØLD VALSTK
READY
*RUN


DØ YØU WANT INSTRUCTIØNS FØR SUPPLYING DATA ?YES
ENTER THE INFØRMATIØN AS CALLED FØR

DØ YØU WANT TØ DETERMINE INTRINSIC VALUE (ANSWER '1') ØR THE
REQUIRED DURATIØN ØF A SPECIFIC GRØWTH RATE (ANSWER '2'), ØR
THE REQUIRED FUTURE PRICE/EARNINGS RATIØ (ANSWER '3')
                                        ITEM 0      ?1

CURRENT MARKET PRICE IN $               ITEM 1      ?302
CURRENT EARNINGS PER SHARE IN $         ITEM 2      ?6.85
NØRMALIZED EARNINGS THIS PERIØD IN $    ITEM 3      ?7.00
LØNG TERM DISCØUNT RATE(AS A DEC.)      ITEM 4      ?.16
LØNG TERM DIVIDEND PAYØUT RATIØ
(AS A DECIMAL)                          ITEM 5      ?.4

DØ YØU WANT TØ FØRECAST A LØNG TERM GRØWTH RATE (1), ØR A
PRICE/EARNINGS RATIØ AT A FUTURE PØINT IN TIME (2)
                                        ITEM 6      ?1

LØNG TERM GRØWTH RATE(AS A DECIMAL)     ITEM 7      ?.05
ITEM 8, P/E RATIØ AT FUTURE, IS NØT NEEDED FØR THIS CASE.

CURRENT YEAR (E.G. 1969)                ITEM 9      ?1973

     YØU WILL NØW BE ASKED TØ FØRECAST A GRØWTH RATE
IN EARNINGS, THE DURATIØN ØF THAT RATE IN YEARS, THE
DIVIDEND PAYØUT RATIØ FØR THESE YEARS,DISCØUNT RATE FØR THE
YEARS, THE TYPE ØF ADJUSTMENT FRØM THIS TØ THE NEXT GRØWTH
RATE (ANSWER '1' FØR STRAIGHT LINE ADJUSTMENT, '2' FØR FAST
AND '3' FØR SLØW ADJUSTMENT), THE DURATIØN ØF THE ADJUSTMENT
PERIØD IN YRS.,THE DIVIDEND PAYØUT RATIØ FØR THE ADJUSTMENT
PERIØD, AND THE DISCØUNT RATE FØR THE ADJUSTMENT PERIØD.
THIS WILL BE REPEATED, AND YØU MAY MAKE FØRECASTS REACHING
UP TØ SEVENTY FIVE YEARS FRØM THE CURRENT YEAR.
WHEN YØU HAVE PREDICTED ALL THE SPECIFIC GRØWTH RATES YØU
CARE TØ, TYPE A      0  AND DØ A CARRIAGE RETURN........
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```
FØR YEARS BEGINNING IN THE YEAR PRINTED ØUT BELØW, ENTER THE
EARNINGS GRØWTH RATE (AS A DECIMAL), THE DURATIØN ØF
THE GRØWTH RATE IN YEARS, THE DIVIDEND PAYØUT RATIØ FØR
THESE YEARS, THE DISCØUNT RATE FØR THESE YEARS, THE TYPE ØF
ADJUSTMENT, THE DURATIØN ØF THE ADJUSTMENT IN YEARS, AND THE
DIVIDEND PAYØUT RATIØ AND DISCØUNT RATE FØR THIS ADJUSTMENT
PERIØD.

 1974      ?.25,10,.35,.2,3,5,.35,.2
 1989      ?.22,5,.4,.18,3,2,.4,.18
 1996      ?0

 1973 VALUES

PRICE         302
EARNINGS     6.85
P/E RATIØ     44.09

LØNG TERM GRØWTH RATE  .05

INTRINSIC VALUE   170.4


DØ YØU WANT A LIST ØF VALUES IN FUTURE YEARS ?YES

      YEAR          EARNINGS       GRØWTH       VALUE/EARNS.        INTR.VAE
                    PER SHARE        RATE          RATIØ       BEG. ØF YR.
        1974          8.75           .25          19.47           170.4
        1975         10.94           .25           18.2           199.04
        1976         13.67           .25          16.98           232.21
        1977         17.09           .25          15.83           270.55
        1978         21.36           .25          14.73           314.77
        1979          26.7           .25          13.69           365.63
        1980         33.38           .25           12.7           423.96
        1981         41.72           .25          11.76           490.65
        1982         52.15           .25          10.86           566.59
        1983         65.19           .25          10.01           652.71
        1984          81.4           .25           9.21           749.88
        1985         101.4           .25           8.47           858.91
        1986        125.88           .24           7.79            980.5
        1987        155.55           .24           7.17          1115.19
        1988         191.1           .23           6.61          1263.32
        1989        233.15           .22           6.11          1424.95
        1990        284.44           .22           5.58          1588.18
        1991        347.02           .22           5.07          1760.28
        1992        423.36           .22           4.58          1938.32
        1993         516.5           .22            4.1          2117.88
        1994        615.49           .19           3.72          2292.49
        1995        698.59           .13           3.52           2458.94
        1996        733.52           .05           3.57           2622.12

DØ YØU WANT TØ CHANGE ANY ØF ITEMS 0 TØ 9 ?NØ

 1974      ?.25,10,.3,.2,3,5,.3,.2
 1989      ?.22,5,.35,.18,3,5,.35,.18
 1999      ?.18,5,.35,.16,3,5,.35,.16
 2009      ?0

INTRINSIC VALUE  360.22


DØ YØU WANT A LIST ØF VALUES IN FUTURE YEARS ?NØ
```

The user now tries a different estimate of the long term discount rate, 15%, and a different estimate of the long term dividend payout ratio, 50%, together with original growth forecasts.

Next, item 0 is changed to call for a calculation of the required duration of a forecasted growth rate in order to make the intrinsic value the same as the current price. First, a single growth rate, 25%, is forecasted to begin in 1974, and the response, that this rate must continue to 1991 to justify the current price, means that the intrinsic value, assuming a growth rate of .25 to 1991 and the long-term growth rate thereafter, is the current market price. Second, a growth forecast through 1988 is supplied, followed by the single growth rate of 22% to begin in 1989. In this case, the 22% rate must continue to 1989 to make the intrinsic value equal the market price.

```
DØ YØU WANT TØ CHANGE ANY ØF ITEMS 0 TØ 9 ?YES
WHICH ITEMS ?4,5
WHAT ARE THE NEW VALUES ?.15,.5

 1974      ?.25,10,.5,.15,3,5,.5,.15
 1989      ?.22,5,.5,.15,3,2,.5,.15
 1996      ?0

 1973 VALUES

PRICE          302
EARNINGS     6.85
P/E RATIØ      44.09

LØNG TERM GRØWTH RATE   .05

INTRINSIC VALUE  380.43
```

The user next changes item 0 to call for a calculation of intrinsic value, and item 6 to specify a calculation based on a forecast of a price/earnings ratio rather than a long-term growth rate. The ratio forecast, 30, is entered as a new item 8. The growth forecast extends to 2013 (no adjustment is specified because no succeeding growth rate will be used — the price/earnings ratio will be applied as of 2013). The computer responds with an intrinsic value and the actual forecasted price in 2013, based on the ratio and the earnings growth projections.

A second forecasted price/earnings ratio, 25, is tried along with a different growth forecast; another intrinsic value is calculated, and then the user changes item 0 to call for a calculation of the price/earnings ratio required to make the intrinsic value equal to the current market price.

```
 1973 VALUES

PRICE         302
EARNINGS     6.85
P/E RATIØ     44.09

INTRINSIC VALUE 1027.44

FØR YEAR 2013 FØRECASTED P/E IS   30 AND PRICE IS   182126.3

DØ YØU WANT A LIST ØF VALUES IN FUTURE YEARS ?NØ

DØ YØU WANT TØ CHANGE ANY ØF ITEMS 0 TØ 9 ?YES
WHICH ITEMS ?8
WHAT ARE THE NEW VALUES ?25

 1974      ?.18,5,.5,.15,3,5,.5,.15
 1984      ?.15,10,.5,.15


 1973 VALUES

PRICE         302
EARNINGS     6.85
P/E RATIØ     44.09

INTRINSIC VALUE   300.4

FØR YEAR 1993 FØRECASTED P/E IS   25 AND PRICE IS 3550.71

DØ YØU WANT A LIST ØF VALUES IN FUTURE YEARS ?NØ

DØ YØU WANT TØ CHANGE ANY ØF ITEMS 0 TØ 9 ?YES
WHICH ITEMS ?0
WHAT ARE THE NEW VALUES ?3

ITEM 6 ?2


 1974      ?.18,5,.5,.15,3,5,.5,.15
 1984      ?.15,5,.5,.15

REQUIRED P/E RATIØ IN 1988 TØ JUSTIFY PRICE IS   27.68
```

A table of future values can be obtained by shifting item 0 back to 1, to call for an intrinsic value calculation and by supplying the price/earnings ratio forecast as the number just calculated.

```
DØ YØU WANT TØ CHANGE ANY ØF ITEMS 0 TØ 9 ?YES
WHICH ITEMS ?0
WHAT ARE THE NEW VALUES ?1

ITEM 6 ?2
ITEM 8 ?27.68

 1974      ?.18,5,.5,.15,3,5,.5,.15
 1984      ?.15,5,.5,.15


 1973 VALUES

PRICE         302
EARNINGS     6.85
P/E RATIØ     44.09

INTRINSIC VALUE  301.96

FØR YEAR 1988 FØRECASTED P/E IS   27.68 AND PRICE IS 1954.57

DØ YØU WANT A LIST ØF VALUES IN FUTURE YEARS ?YES
```

YEAR	EARNINGS PER SHARE	GRØWTH RATE	VALUE/EARNS. RATIØ	INTR.VAB BEG. ØF YR.
1974	8.26	.18	36.56	301.96
1975	9.75	.18	35.2	343.13
1976	11.5	.18	33.89	389.73
1977	13.57	.18	32.6	442.43
1978	16.01	.18	31.35	502.01
1979	18.87	.18	30.16	569.31
1980	22.19	.18	29.08	645.27
1981	25.99	.17	28.12	730.96
1982	30.3	.17	27.31	827.61
1983	35.11	.16	26.68	936.6
1984	40.37	.15	26.24	1059.54
1985	46.43	.15	25.81	1198.28
1986	53.39	.15	25.37	1354.81
1987	61.4	.15	24.94	1531.33
1988	70.61	.15	24.5	1730.33

```
DØ YØU WANT TØ CHANGE ANY ØF ITEMS 0 TØ 9 ?END
```

SAMPLE RUN 2

Rapid input of data is shown below where the answer to the initial question is NO.

```
SYSTEM ?BASIC
ØLD ØR NEW-ØLD VALSTK

*RUN


DØ YØU WANT INSTRUCTIØNS FØR SUPPLYING DATA ?NØ
ENTER ITEMS 0 THRØUGH 6 AND ITEM 9 ?1,302,6.85,7,.16,.4,1,1973
ITEM 7 ?.05


 1974      ?.25,10,.35,.16,3,5,.35,.16
 1989      ?.22,5,.4,.16,3,2,.4,.16
 1996      ?0

 1973 VALUES

PRICE         302
EARNINGS     6.85
P/E RATIØ     44.09

LØNG TERM GRØWTH RATE   .05

INTRINSIC VALUE  241.34


DØ YØU WANT A LIST ØF VALUES IN FUTURE YEARS ?NØ

DØ YØU WANT TØ CHANGE ANY ØF ITEMS 0 TØ 9 ?END
```

SAMPLE RUN 3

Sample Run 3 shows DATA lines as alternative input. The data listed is presently in the program. The user's own data can be entered to overlay it.

```
SYSTEM ?BASIC
ØLD ØR NEW-ØLD VALSTK
READY
*LIST 3910-3930

3910 DATA 1
3920 DATA 302,6.85,7,.16,.4
3930 DATA 1,.05,30,1973

READY

*RUN


DØ YØU WANT INSTRUCTIØNS FØR SUPPLYING DATA ?DATA

 1974      ?.25,10,.4,.16,3,5,.4,.16
 1989      ?.22,5,.4,.16,3,2,.4,.16
 1996      ?0

 1973 VALUES

PRICE          302
EARNINGS      6.85
P/E RATIØ      44.09

LØNG TERM GRØWTH RATE   .05

INTRINSIC VALUE  251.31


DØ YØU WANT A LIST ØF VALUES IN FUTURE YEARS ?NØ

DØ YØU WANT TØ CHANGE ANY ØF ITEMS 0 TØ 9 ?NØ

 1974      ?END

DØ YØU WANT A LIST ØF VALUES IN FUTURE YEARS ?NØ

DØ YØU WANT TØ CHANGE ANY ØF ITEMS 0 TØ 9 ?YES
WHICH ITEMS ?Q
WHAT ARE THE NEW VALUES ?2

ITEM 6 ?1
ITEM 7 ?.05


 1974      ?.25

GRØWTH RATE  .25 MUST LAST TØ 1991 TØ JUSTIFY PRICE
```

```
DØ YØU WANT TØ CHANGE ANY ØF ITEMS 0 TØ 9 ?NØ

 1974      ?.25,10,.5,.15,3,5,.5,.15
 1989      ?.22

GRØWTH RATE  .22 MUST LAST TØ 1992 TØ JUSTIFY PRICE

DØ YØU WANT TØ CHANGE ANY ØF ITEMS 0 TØ 9 ?YES
WHICH ITEMS ?0,6
WHAT ARE THE NEW VALUES ?1,2
ITEM 8 ?30

 1974      ?.22,10,.5,.15,3,5,.5,.15
 1989      ?.18,10,.5,.15,3,5,.5,.15
 2004      ?.15,10,.5,.15
```

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