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DECUS NO.	8-520
TITLE	PEST/WALD/PINIT: ADAPTIVE PSYCHOPHYSICS TESTING PACKAGE
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PEST/WALD/PINIT: ADAPTIVE PSYCHOPHYSICS TESTING PACKAGE

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/THIS IS A PACKAGE CONSISTING OF THREE PROGRAM LISTINGS -
/WALD, PEST, AND PINIT. THESE PROGRAMS IMPLEMENT THE
/PROCEDURES DESCRIBED IN "PEST: EFFEICINT ESTIMATES ON
/PROBABILITY FUNCTIONS" (TAYLOR AND CREELMAN, JOURNAL OF THE
/ACOUSTICAL SOCIETY OF AMERICA, 1967, VOLUME 41, PAGES
/782-787). THE PROGRAMS ARE WRITTEN FOR A PDP-8/S COMPUTER
/BUT WILL WORK ON ANY 8-SERIES MACHINE.

/THE USE OF THE PROGRAMS IS AS FOLLOWS: ON EACH OF A NUMBER
/OF EXPERIMENTAL TRIALS, THE COMPUTER PRESENTS A STIMULUS TO
/A SUBJECT AND ASKS HIM TO MAKE SOME KIND OF DECISION. THIS
/DECISION CAN BE OBJECTIVELY SCORED AS CORRECT OR INCORRECT,
/AND THE FUNCTION OF THE PEST PACKAGE IS TO DETERMINE THAT
/STIMULUS LEVEL WHICH PRODUCES A DESIRED TARGET PROPORTION
/OF CORRECT RESPONSES.

/THIS DOCUMENTATION DEALS WITH PROGRAMMING, RATHER THAN WITH
/THEORETICAL, ASPECTS OF THE USE OF PEST. THE PACKAGE IS AN
/ENTIRELY SELF-CONTAINED SET OF SUBROUTINES FOR PROCESSING
/TRIAL-BY-TRIAL RESULTS OF AN EXPERIMENT IN CONJUNCTION WITH
/A 4-WORD WALD PARAMETER LIST AND A 7-WORD PEST HISTORY LIST
/FOR EACH EXPERIMENT BEING RUN. THE WALD PARAMETER LIST
/SPECIFIES THE TARGET PERCENTAGE AND THE DEVIATION FROM THAT
/PERCENTAGE AT WHICH A DECISION TO CHANGE LEVELS IS MADE,
/ALONG WITH THE CURRENT STATUS OF THE STATISTIC USED TO
/DECIDE IF THE CURRENT PROPORTION OF TRIALS CORRECT IS
/WITHIN THE BOUNDS ESTABLISHED IN THE PARAMETER LIST.
/THE PEST HISTORY LIST CONTAINS THE CURRENT LEVEL OF THE
/STIMULUS PARAMETER BEING ADJUSTED AND INFORMATION ABOUT
/THE RANGE OF ALLOWABLE ADJUSTMENTS, IN ADDITION TO SOME
/INFORMATION ABOUT THE MOST RECENTLY-MADE ADJUSTMENTS.
/FROM THE STANDPOINT OF THE PEST PACKAGE, AN EXPERIMENT IS
/WHATEVER REFERENCES A GIVEN PAIR OF WALD AND PEST PARAMETER
/LISTS. THUS, ANY NUMBER OF CONCURRENT EXPERIMENTS CAN BE
/RUN WITH A SINGLE 1-PAGE PEST PACKAGE, PLUS 11 CORE
/LOCATIONS PER EXPERIMENT.

/THE WALD PROGRAM IS ENTERED WITH A 1 OR Ø FOR A SUCCESS OR
/FAILURE, RESPECTIVELY. IT RETURNS A Ø IF NO DECISION HAS
/YET BEEN MADE, A +1 IF IT HAS BEEN DECIDED THAT THE
/PROPORTION OF SUCCESSES IS TOO HIGH, AND A -1 IF THE
/PROPORTION IS TOO LOW. THESE NON-Ø OUTPUTS CAN THEN BE USED
/AS INPUTS TO PEST ITSELF, WHICH DECIDES WHAT NEW STIMULUS
/VALUE TO USE AND INSTALLS THAT VALUE INTO THE PEST HISTORY
/LIST AND ALSO RETURNS IT IN THE ACCUMULATOR. IF THE CHANGE
/IN LEVEL RESULTED IN ACCUMULATOR OVERFLOW OR UNDERFLOW, THE

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/LINK IS RETURNED SET, OTHERWISE CLEAR. THE ONLY OTHER
/EXTERNALLY-CALLED ROUTINE IN THE PEST PACKAGE IS THE PEST
/INITIALIZER, PINIT, WHICH TAKES A LIST OF FOUR CONSTANTS
/AND COPIES IT IN ANOTHER LOCATION WITH THREE ØS APPENDED,
/SO THAT PEST CAN OPERATE ON A LIST OF VARIABLES WITHOUT
/DESTROYING THE LIST OF INITIALIZING CONSTANTS.

/PEST IS NORMALLY RUN IN "MOUSE" MODE (MININUM OVERSHOOT AND
/UNDERSHOOT SEQUENTIAL ESTIMATION). IN THIS MODE, WHEN
/A DECISION WOULD BE MADE TO MAKE A STEP SMALLER THAN THE
/SPECIFIED MINIMUM, THE PROGRAM MAKES A NON-STANDARD
/SUBROUTINE RETURN TO INDICATE THAT A FINAL LEVEL HAS BEEN
/REACHED. A SIMPLE PATCH ALLOWS THE PROGRAM TO BE RUN IN
/"RAT" MODE (RAPID ADAPTIVE TRACKING), IN WHICH A STEP
/SMALLER THAN THE ALLOWED MINIMUM IS SIMPLY REPLACED WITH
/A MINIMUM STEP AND THE PEST PROGRAM HAS NO STOPPING RULE.
/IN THIS MODE, HOWEVER, THE LINK CANNOT BE USED FOR OVERFLOW
/INFORMATION. DETAILS OF THE PROGRAM PATCH FOLLOW PEST IN
/THE PROGRAM LISTING.
        PAUSE
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                  *16ØØ   /          /NOMINAL -- THIS IS FULLY
                  /       /          /RELOCATABLE TO ANY CORE PAGE

             /ENTER WALD WITH ACC=+1 FOR A SUCCESS, ACC=Ø FOR A FAILURE.
             /CALLING SEQUENCE:
             /       JMS WALD
             /       WALDØ   /       /ADDRESS OF WALD PARAMETER LIST
             /       (PROGRAM RETURNS HERE, USUALLY TO A TEST FOR A
             /       NON-ZERO ACCUMULATOR, IN WHICH CASE PEST IS CALLED)
             /THE PROGRAM RETURN HAS ACC=+1 FOR TOO MANY SUCCESSES, -1
             /FOR TOO FEW, AND Ø FOR WITHIN BOUNDS. IF THE DEVIATION
             /EQUALS THE LIMIT EXACTLY, IT IS CONSIDERED OUT OF BOUNDS.
             /THE WALD PARAMETER LIST CONSISTS OF FOUR ENTRIES, THE FIRST
             /THREE OF WHICH ARE CONSTANTS USED BUT NOT CHANGED BY WALD,
             /THE LAST THE ONLY LOCATION NEEDED AS A WALD HISTORY SPACE.
             /THE FOUR LOCATIONS ARE, IN ORDER:
             /WALDØ, NUMERATOR OF EXPECTED FRACTION CORRECT
             /       COMMON DENOMINATOR OF EXPECTATION AND LIMIT
             /       NUMERATOR OF DEVIATION LIMIT
             /       SPACE FOR WALD HISTORY
             /THE WALD HISTORY LOCATION SHOULD BE INITIALIZED BY SETTING
             /IT TO Ø FOR WALD TO CONSIDER THE FIRST TRIAL IT RECEIVES,
             /OR TO -(DEVIATION LIMIT NUMERATOR), TO IGNORE THAT TRIAL.
             /ALL THREE NUMBERS MUST BE POSITIVE INTEGERS IN THE RANGE
             /FROM 1 TO 3777 OCTAL (1 TO 2Ø47 DECIMAL), AND FURTHER,
             /THE SUM OF THE LAST TWO (DEVIATION LIMIT NUMERATOR + COMMON
             /DENOMINATOR) MUST NOT EXCEED 3777 OCTAL (2Ø47 DECIMAL).
             /FOR EXAMPLE, A WALD PARAMETER LIST TO AIM FOR A TARGET
             /PERCENTAGE OF 75% WITH A DEVIATION LIMIT OF 1.5
             /TRIALS COULD HAVE ENTRIES:
             /WALDØ, 3       /NUMERATOR OF EXPECTATION
             /       4       /COMMON DENOMINATOR
             /       6       /NUMERATOR OF DEVIATION LIMIT
             /       Ø       /LOCATION FOR WALD HISTORY
             /FRACTIONS NEED NOT BE EXPRESSED IN LOWEST TERMS

             /ONCE WALD HAS BEEN RUNNING, IT WILL RESET THE HISTORY
             /LOCATION TO -(DEVIATION LIMIT NUMERATOR) WHENEVER THE
             /DEVIATION LIMIT HAS BEEN EXCEEDED, AND WILL IGNORE THE
             /NEXT TRIAL.

16ØØ  ØØØØ   WALD,   Ø
16Ø1  3315           DCA WPRES         /STORE RESULTS OF TRIAL
16Ø2  16ØØ           TAD I WALD        /GET ADDRESS OF PARAMETER LIST
16Ø3  4343           JMS WPSET7        /SETUP A LIST OF SEVEN CONSECUTIVE
                     /       /         /POINTERS TO SEVEN LOCATIONS
16Ø4  22ØØ           ISZ WALD          /CORRECT THE RETURN ADDRESS

                     /DECIDE IF THIS TRIAL SHOULD BE IGNORED
16Ø5  1766           TAD I WHISTP
16Ø6  1765           TAD I WDNUMP      /ADD HISTORY TO DEVIATION NUMERATOR
16Ø7  764Ø           SZA CLA /         /IF HISTORY = - DEV LIMIT, THAT IS
                     /       /         /THE INDICATOR THAT THIS WAS
                     /       /         /THE FIRST TRIAL OF A SET, AND
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                        /         /          /IS THEREFORE TO BE IGNORED.
1510  5213              JMP WPDOIT           /IF NOT EQUAL, GO PROCESS THE TRI
1511  3766              DCA I WHISTP         /IF EQUAL, RESET HISTORY TO Ø
1512  56ØØ              JMP I WALD           /EXIT WITH A Ø FOR NO CHANGE

                        /UPDATE THE ACCUMULATED DEVIATION FROM EXPECTATIC
1613  1315    WPDOIT,   TAD WPRES            /GET THE RESULT AGAIN
1614  764Ø              SZA CLA /            /AND, IF IT INDICATES A SUCCESS
1615  1764              TAD I WDENP          /GET THE DENOMINATOR
1616  7Ø41              CIA     /            /NEGATE THAT OR Ø
1617  1763              TAD I WENUMP         /ALWAYS ADD THE EXPECTATION
                        /         /          /NUMERATOR
162Ø  1766              TAD I WHISTP         /ADD TO CURRENT HISTORY
1621  3766              DCA I WHISTP         /AND STORE THAT HISTORY

                        /DECIDE IF THE DEVIATION EXCEEDS THE LIMIT
1622  1766              TAD I WHISTP         /NOW INSPECT IT AGAIN
1623  75ØØ              SMA
1624  7Ø41              CIA       /          /MAKE IT NEGATIVE
1625  1765              TAD I WDNUMP         /ADD TO DEVIATION LIMIT
1626  774Ø              SMA SZA CLA          /RESULT STAY NEGATIVE OR Ø?
1627  56ØØ              JMP I WALD           /IF NOT, WITHIN LIMITS, SO EXIT WI
                        /         /          /ACCUMULATOR SET TO Ø

                        /IF A DECISION HAS BEEN REACHED, RESET THE HISTORY
                        /LOCATION TO CAUSE THE NEXT TRIAL TO BE IGNORED,
                        /AND EXIT WITH +1 OR -1, AS APPROPRIATE
163Ø  1765              TAD I WDNUMP         /FIRST,
1631  7Ø41              CIA
1632  3766              DCA I WHISTP         /RESET THE HISTORY LOCATION
1633  7Ø4Ø              CMA       /          /NOW SETUP A -1
1634  1315              TAD WPRES            /AND, IF TRIAL WAS A SUCCESS,
1635  1315              TAD WPRES            /CHANGE TO +1
1636  56ØØ              JMP I WALD           /AND EXIT
                        PAUSE
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                    /ENTER PEST WITH A +1 IN THE ACCUMULATOR FOR TOO MANY
                    /SUCCESSES, A -1 FOR TOO MANY FAILURES (THE SAME AS THE
                    /OUTPUT OF WALD). DO NOT EVEN CALL PEST IF NO CHANGE IS TO
                    /BE MADE IN THE LEVEL OF THE STIMULUS. THE CALLING SEQUENCE
                    /FOR PEST IS AS FOLLOWS:
                    /       JMS PEST
                    /       PESTØ   /       /ADDRESS OF PEST PARAMETER LIST
                    /       JMP STOP        /PROGRAM RETURNS HERE IF STOPPING
                    /       /       /       /RULE CRITERION IS MET
                    /       JMS SETLEV      /PROGRAM RETURNS HERE WITH NEW LEVEL
                    /       /       /       /IN THE ACCUMULATOR IF TRIALS ARE TO
                    /       /       /       /CONTINUE

                    /THE PEST PARAMETER LIST CONSISTS OF THESE SEVEN LOCATIONS:
                    /PESTØ, (1)CURRENT STIMULUS LEVEL, NO RESTRICTIONS
                    /       (2)CURRENT STEP SIZE, POSITIVE IN RANGE 1-3777 OCTAL
                    /       (3)MINIMUM STEP SIZE, POSITIVE IN RANGE 1-3777 OCTAL
                    /       (4)MAXIMUM STEP SIZE, POSITIVE IN RANGE 1-3777 OCTAL
                    /       (5)-1 OR +1, AS LAST STEP RESULTED FROM TOO MANY
                    /       /       FAILURES OR SUCCESSES, INITIALIZED TO Ø
                    /       (6)-1 OR Ø, AS LAST STEP WAS DOUBLING OR NOT,
                    /       /       INITIALIZED TO Ø
                    /       (7)CONSECUTIVE STEPS IN SAME DIRECTION, SUBTRACT 1
                    /       /       IF REVERSAL FOLLOWED NON-DOUBLED STEP,
                    /       /       SUBTRACT 2 IF IT FOLLOWED A DOUBLING

1637  ØØØØ  PEST,   Ø
164Ø  3315          DCA WPRES       /STORE ACCUMULATOR CONTENTS
1641  1637          TAD I PEST      /GET ADDRESS OF PEST PARAMETER LIST
1642  4343          JMS WPSET7      /SETUP LIST OF SEVEN CONSECUTIVE
                    /       /       /POINTERS TO SEVEN CONSECUTIVE
                    /       /       /LOCATIONS
1643  2237          ISZ PEST        /SETUP PEST TO POINT TO RETURN IF
                    /       /       /STOPPING CRITERION MET

                    /DECIDE IF THIS IS A REVERSAL OF DIRECTION
1644  1767          TAD I PDIRPT
1645  1315          TAD WPRES       /ADD NEW DIRECTION TO LAST DIRECTION
1646  764Ø          SZA CLA /       /DO THEY CANCEL?
1647  5256          JMP PSAME       /IF NOT, CONTINUE IN SAME DIRECTION

                    /PROCESS REVERSAL OF DIRECTION
165Ø  177Ø  PDIFF,  TAD I PDUBPT    /GET DOUBLING POINTER, Ø OR -1
1651  3771          DCA I PSMCTP    /PLACE IN COUNTER OF CONSECUTIVE
                    /       /       /STEPS IN SAME DIRECTION
1652  377Ø          DCA I PDUBPT    /STORE Ø FOR NOT DOUBLED STEP
1653  1764  PDFLAT, TAD I PSSPT     /GET CURRENT STEP SIZE
1654  711Ø          CLL RAR /       /DIVIDE BY TWO AND TRUNCATE
                    /       /       /NOTE: IF A LOW-ORDER BIT IS LOST BY
                    /       /       /THIS TRUNCATION, IT CANNOT BE
                    /       /       /RESTORED BY A SUBSEQUENT STEP-SIZE
                    /       /       /DOUBLING
1655  5267          JMP PSTNSS      /GO STORE THE SIZE
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                    /PROCESS A CONTINUATION IN THE SAME DIRECTION
1656  2771  PSAME,  ISZ I PSMCTP    /INCREASE THE COUNT OF CONSECUTIVE
                    /       /       /STEPS IN THIS DIRECTION
                    /       /       /WHEN THE COUNT REACHES 2, THAT
                    /       /       /MEANS AT LEAST 3 STEPS IN THIS
                    /       /       /DIRECTION, SINCE THE FIRST STEP
                    /       /       /ONLY INITIALIZES BUT DOES NOT
                    /       /       /INCREMENT THE COUNT. IF THE SKIP
                    /       /       /OCCURS, THE RESULT IS Ø, WHICH IS
                    /       /       /NOT STRICTLY POSITIVE, AND SO IT
                    /       /       /DOES NOT MATTER THAT THE -1 ABOUT
                    /       /       /TO BE CREATED IS MISSED.
1657  724Ø          CLA CMA /       /CREATE A -1
166Ø  1771          TAD I PSMCTP    /ADD THE COUNT
1661  775Ø          SPA SNA CLA     /STRICTLY POSITIVE YET?
1662  5266          JMP PSTNSS-1    /IF NOT, DON'T DOUBLE
1663  7Ø4Ø          CMA
1664  377Ø          DCA I PDUBPT    /IF SO, STORE -1 FOR DOUBLING
1665  1764          TAD I PSSPT     /FETCH THE STEP SIZE
1666  1764          TAD I PSSPT     /EITHER ONCE OR TWICE
1667  3764  PSTNSS, DCA I PSSPT     /STORE NEW STEP SIZE

                    /IF THE STEP IS TOO LARGE, CUT IT IN HALF
167Ø  1766          TAD I PMAXPT    /FETCH MAXIMUM SIZE
1671  714Ø          CLL CMA /       /CLEAR LINK AND CREATE -(MAXIMUM+1)
                    /       /       /NOW STEP SIZE EQUAL TO MAXIMUM IS
                    /       /       /OK; STEP SIZE GREATER TRIPS LINK
1672  1764          TAD I PSSPT     /ADD CURRENT STEP SIZE
1673  763Ø          SZL CLA /       /A NONZERO LINK MEANS ONE OF TWO
                    /       /       /THINGS, EITHER THE STEP SIZE IS
                    /       /       /LARGER THAN 3777, OR LARGER THAN
                    /       /       /THE MAXIMUM ALLOWABLE, OR BOTH
1674  5253          JMP PDFLAT      /SO CUT IT DOWN AGAIN

                    /IF THE STEP IS TOO SMALL, STOP CHANGING LEVELS
1675  1765          TAD I PMINPT    /NOW TRY THE MINIMUM
1676  7Ø41          CIA
1677  1764          TAD I PSSPT
17ØØ  771Ø  PRATMD, SPA CLA /       /POSITIVE OR EQUAL MEANS STEP SIZE
                    /       /       /IS NOT TOO SMALL
17Ø1  5637          JMP I PEST      /TOO SMALL MEANS RETURN TO LOCATION
                    /       /       /MEANING STOPPING RULE IS SATISFIED

                    /THE STEP IS ALLOWABLE, SO TAKE THAT STEP AND RETURN
17Ø2  2237          ISZ PEST        /NOW MAKE RETURN ADDRESS POINT TO
                    /       /       /NORMAL LEVEL-CHANGE LOCATION
17Ø3  71ØØ          CLL     /       /PREPARE TO RECEIVE OVERFLOW
17Ø4  1315          TAD WPRES
17Ø5  3767          DCA I PDIRPT    /STORE LATEST DIRECTION
17Ø6  1764          TAD I PSSPT     /GET STEP SIZE
17Ø7  2315          ISZ WPRES       /TEST DIRECTION
171Ø  7Ø41          CIA     /       /NEGATE FOR TOO MANY SUCCESSES
1711  1763          TAD I PLEVPT    /ADD TO CURRENT LEVEL
1712  3763          DCA I PLEVPT    /STORE
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1713  1763          TAD I PLEVPT      /GET BACK AGAIN
1714  5637          JMP I PEST        /EXIT WITH IT

          /TO RUN THIS PROGRAM IN "RAT" MODE, MAKE THE FOLLOWING
          /PATCHES:
          /PRATMD,SMA CLA /       /POSITIVE OR EQUAL MEANS STEP SIZE
          /       /       /       /IS NOT TOO SMALL
          /       JMP .+3 /       /SO GO CHANGE THE LEVEL
          /       TAD I PMINPT    /IF STEP WOULD BE TOO SMALL, REPLACE
          /       /       /       /IT WITH THE MINIMUM
          /       DCA I PSSPT
          /
          /AND USE A SHORTER SUBROUTINE CALL:
          /       JMS PEST
          /       PESTØ   /       /ADDRESS OF PARAMETER LIST
          /       (SUBROUTINE RETURNS HERE WITH NEW LEVEL)
                  PAUSE
                  /THE ROUTINE PINIT IS CALLED AS FOLLOWS:
                  /         JMS PINIT
                  /         PPERM   /          /ADDRESS OF STARTING VALUES OF FIRST
                  /         /       /          /FOUR ITEMS OF PEST LIST
                  /         PESTØ   /          /ADDRESS OF A BLOCK OF 7 LOCATIONS
                  /         /       /          /INTO WHICH THE FOUR ITEMS ABOVE
                  /         /       /          /CAN BE COPIED, FOLLOWED BY 3 ZEROS
1715   ØØØØ       PINIT,    Ø
1716   1715                 TAD I PINIT        /GET ADDRESS OF PERMANENT LIST
1717   3237                 DCA PINITP         /STORE IN A POINTER
172Ø   2315                 ISZ PINIT
1721   1715                 TAD I PINIT        /GET ADDRESS OF WORKING LIST
1722   4343                 JMS WPSET7         /SETUP 7 POINTERS
1723   2315                 ISZ PINIT          /CREATE THE RETURN ADDRESS
1724   1637                 TAD I PINITP       /GET FIRST PERMANENT ITEM
1725   3763                 DCA I PLEVPT       /STORE IN WORKING LIST
1726   2237                 ISZ PINITP
1727   1637                 TAD I PINITP
173Ø   3764                 DCA I PSSPT
1731   2237                 ISZ PINITP
1732   1637                 TAD I PINITP
1733   3765                 DCA I PMINPT
1734   2237                 ISZ PINITP
1735   1637                 TAD I PINITP
1736   3766                 DCA I PMAXPT       /SAME FOR SECOND, THIRD, FOURTH
1737   3767                 DCA I PDIRPT
174Ø   377Ø                 DCA I PDUBPT
1741   3771                 DCA I PSMCTP       /NOW 3 ZEROS
1742   5715                 JMP I PINIT        /EXIT

                  /ROUTINE TO SETUP SEVEN CONSECUTIVE POINTERS TO SEVEN
                  /CONSECUTIVE CORE LOCATIONS
1743   ØØØØ       WPSET7, Ø
1744   3363                 DCA WENUMP         /STORE FIRST POINTER, GIVEN ON ENTRY
1745   1372                 TAD WPM6
1746   3373                 DCA WPCNTR         /GET A -6 AND STORE AS COUNTER
1747   1374                 TAD WPTAD          /GET A FETCHING INSTRUCTION
175Ø   3353                 DCA WPTADP         /PLACE IT IN THIS ROUTINE
1751   1375                 TAD WPDCA          /AND A DEPOSITING INSTRUCTION
1752   3355                 DCA WPDCAP         /PLACE IT IN ITS SPOT
1753   7ØØØ       WPTADP,   NOP      /         /FETCH A POINTER
1754   7ØØ1                 IAC      /         /INCREMENT THE POINTER
1755   7ØØØ       WPDCAP,   NOP      /         /DEPOSIT IT IN THE NEXT CELL AS A
                            /        /         /POINTER TO THE NEXT LOCATION
1756   2353                 ISZ WPTADP
1757   2355                 ISZ WPDCAP         /INCREMENT BOTH INSTRUCTIONS
176Ø   2373                 ISZ WPCNTR         /DO THIS LOOP SIX TIMES
1761   5353                 JMP .-6 /          /DO IT AGAIN IF NECESSARY
1762   5743                 JMP I WPSET7       /EXIT IF DONE

                  /THE SEVEN BASIC POINTERS:

                  WENUMP=.           /         /WALD EXPECTATION NUMERATOR
1763   ØØØØ       PLEVPT, Ø          /         /PEST CURRENT LEVEL
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            WDENP=. /       /       /WALD COMMON DENOMINATOR
1764  0000  PSSPT,  0       /       /PEST CURRENT STEP SIZE

            WDNUMP=.        /       /WALD DEVIATION LIMIT NUMERATOR
1765  0000  PMINPT, 0       /       /PEST MINIMUM STEP SIZE

            WHISTP=.        /       /WALD HISTORY
1766  0000  PMAXPT, 0       /       /PEST MAXIMUM STEP SIZE

1767  0000  PDIRPT, 0       /       /PEST DIRECTION
1770  0000  PDUBPT, 0       /       /PEST DOUBLING INDICATOR
1771  0000  PSMCTP, 0       /       /PEST CONSECTIVE STEPS INDICATOR

            WPRES=PINIT     /       /WHICH WILL BE FREE THEN
1772  7772  WPM6,   -6
1773  0000  WPCNTR, 0
1774  1363  WPTAD,  TAD WENUMP      /INSTRUCTION TO FETCH FIRST OF THE
                    /       /       /SEVEN POINTERS, FOR INSERTION ABOVE
1775  3364  WPDCA,  DCA WENUMP+1    /INSTRUCTION TO DEPOSIT INTO SECOND
                    /       /       /OF THE SEVEN POINTERS, FOR
                    /       /       /INSERTION ABOVE
            PINITP=PEST
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PDFLAT   1653
PDIFF    1650
PDIRPT   1767
PDUBPT   1770
PEST     1637
PINIT    1715
PINITP   1637
PLEVPT   1763
PMAXPT   1766
PMINPT   1765
PRATMD   1700
PSAME    1656
PSMCTP   1771
PSSPT    1764
PSTNSS   1667
WALD     1600
WDENP    1764
WDNUMP   1765
WENUMP   1763
WHISTP   1766
WPCNTR   1773
WPDCA    1775
WPDCAP   1755
WPDOIT   1613
WPM6     1772
WPRES    1715
WPSET7   1743
WPTAD    1774
WPTADP   1753
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                    /DEMONSTRATOR PACKAGE FOR WALD AND PEST
                    /         /HOWARD KAPLAN - 1971

/THIS PACKAGE CONSISTS OF ROUTINES THAT CAN BE USED TO
/TEST, DEMONSTRATE, AND SIMULATE THE ACTIONS OF WALD AND
/PEST. THE WALD TEST ROUTINE GETS INPUT FROM ANY SUBROUTINE
/THAT GENERATES 1 AND Ø (CORRECT AND INCORRECT) RESPONSES.
/THIS PACKAGE INCLUDES TWO SUCH ROUTINES. ONE SIMPLY ACCEPTS
/"1" OR "Ø" INPUTS FROM THE KEYBOARD. THE OTHER GENERATES
/A +1 WITH ANY SPECIFIED PROBABILITY, AFTER A USER-WRITTEN
/SUBROUTINE HAS CONVERTED THE CURRENT STIMULUS LEVEL TO A
/PROBABILITY, USING ANY DESIRED PSYCHOMETRIC FUNCTION.
/WHEN THE WALD TEST REACHES ITS DECISION, IT PRINTS ITS
/RESULT AND EITHER RECYCLES FOR A DECISION ON ANOTHER STRING
/OF INPUTS OR ELSE PASSES CONTROL TO THE PEST PACKAGE FOR
/A CHANGE OF LEVEL, AGAIN UNDER THE CONTROL OF ONE POINTER.
/IT IS ALSO POSSIBLE TO SUPPLY THE PEST PACKAGE WITH +1
/OR -1 INPUTS FROM ANY OTHER SUBROUTINE, SUCH AS THE SIMPLE
/TELETYPE INPUT ROUTINE SUPPLIED.

/THE DEMONSTRATOR PACKAGE USES A COPY OF THE PEST PACKAGE
/LOCATED AT 16ØØ, AND ITSELF OCCUPIES SPACE FROM 2ØØØ-
/2777. WHILE THE PACKAGE AS WRITTEN DOES NOT USE THE
/FLOATING POINT SYSTEM, THIS PLACEMENT INTO THE LOW END OF
/CORE ALLOWS ANY USERS TO EXTEND ITS SIMULATION CAPABILITIES
/TO USES REQUIRING FLOATING-POINT ARITHMETIC FOR SUCH
/USES AS CALCULATING NEW SUCCESS PROBABILITIES. THE ONE-PAGE
/PEST PACKAGE ITSELF MAY BE RELOCATED, WITHOUT CHANGE, TO
/ANY CORE PAGE.
/THIS PROGRAM IS DESIGNED TO BE USED WITH ODT LOW, FOR SUCH
/USES AS CHANGING TO NEW STARTING PARAMETERS AND NEW
/POINTERS BETWEEN ROUTINES. IN PARTICULAR, TO RUN THIS
/PROGRAM, THE FOLLOWING MUST BE DONE:
/1. PLACE THE APPROPRIATE CONSTANTS INTO THE WALD PARAMETER
/LIST TO SPECIFY THE TARGET PERCENTAGE AND DEVIATION LIMIT.
/THIS LIST BEGINS AT LOCATION WALDØ, AND, AS AN EXAMPLE,
/CONTAINS THE VALUES NEEDED FOR A TARGET PROPORTION OF .75
/AND A DEVIATION LIMIT OF 1.Ø.
/2. PLACE THE APPROPRITE CONSTANTS INTO THE PEST PARAMETER
/LIST TO SPECIFY THE INITIAL (STIMULUS) LEVEL, INITIAL STEP
/SIZE, MINIMUM STEP SIZE, AND MAXIMUM STEP SIZE. THIS LIST
/BEGINS AT LOCATION PESTØ, AND, AS AN EXAMPLE, CONTAINS
/THE VALUES NEEDED FOR AN INITIAL LEVEL OF 1ØØ, AN INITIAL
/STEP SIZE OF 16, A MAXIMUM STEP SIZE OF 32, AND A MINIMUM
/STEP SIZE OF 2.
/3. PLACE THE APPROPRIATE POINTERS INTO LOCATIONS WINPUT AND
/PINPUT, TO SPECIFY WHERE THE INPUTS TO WALD AND TO PEST
/WILL BE GENERATED. AS LOADED, WALD GETS ITS INPUT FROM THE
/TELETYPE, AND PEST GETS ITS INPUT FROM THE RESULT OF THE
/WALD TEST.
/4. PLACE THE APPROPRIATE POINTERS INTO LOCATIONS WNEXT AND
/PNEXT, TO SPECIFY WHETHER EACH ROUTINE SIMPLY LOOPS
/BACK TO ITSELF OR ALTERNATES WITH THE OTHER WHEN IT IS
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/DONE. ONCE THE PROGRAM IS STARTED, THE ROUTINES RE-ENTER AT
/WLOOP AND PLOOP, RESPECTIVELY. THE PROGRAM AS A WHOLE
/STARTS AT WALDGO OR AT PESTGO.
/5. IF SUBROUTINE PROBI IS BEING USED, THEN PLACE INTO
/LOCATION CONVRP A POINTER TO A SUBROUTINE WHICH WILL
/CONVERT THE CURRENT LEVEL INTO A PROBABILITY FOR ROUTINE
/PROBI TO USE. FOR EXAMPLE, IF A CLASSICAL PSYCHOMETRIC
/FUNCTION IS BEING USED (CUMULATIVE NORMAL), THEN THE
/SUBROUTINE SHOULD CONVERT THE CURRENT LEVEL TO THE
/AREA OF THE CURVE TO THE LEFT OF THE CURRENT LEVEL, IN AN
/APPROPRIATE SCALE. THE NUMERATOR AND DENOMINATOR OF THIS
/PROBABILITY SHOULD BE LEFT IN LOCATIONS PNUM AND PDEN.
/A VERY ROUGH APPROXIMATION TO SUCH A FUNCTION IS PROVIDED
/BY THE ROUTINE CALLED "CURVE", AT 260Ø.

/FOR FURTHER INSTRUCTIONS, CONSULT THE PROGRAM LISTING.
/A DEMONSTRATION OF THE USES OF THIS PROGRAM IS INCLUDED
/AFTER THE LISTING.
        PAUSE
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```
                    *2ØØØ
               /START HERE TO BEGIN WITH A WALD TEST
2ØØØ  4734     WALDGO, JMS I FIXALP    /DO INITIALIZATIONS
2ØØ1  4753     WLOOP,  JMS I RESETP    /DO AN EXTRA CARRAIGE RETURN BEFORE
                       /       /       /THE FIRST LINE OF A NEW WALD TEST
                       /       /       /RECORD
2ØØ2  4753     WLINE,  JMS I RESETP    /GO TO A NEW LINE
2ØØ3  1335             TAD M71
2ØØ4  3336             DCA LCOUNT      /ALLOW 7Ø CHARACTERS PER LINE
2ØØ5  2336     WAGAIN, ISZ LCOUNT      /LINE FULL YET?
2ØØ6  741Ø             SKP
2ØØ7  52Ø2             JMP WLINE       /IF SO, START A NEW ONE
2Ø1Ø  4775             JMS I WINPUT    /GET A Ø OR 1
2Ø11  334Ø             DCA RESULT      /SAVE TEMPORARILY
2Ø12  134Ø             TAD RESULT
2Ø13  1354             TAD C26Ø
2Ø14  4752             JMS I TYPEP     /ECHO RESULT
2Ø15  134Ø             TAD RESULT      /GO TO WALD ROUTINE
2Ø16  4747             JMS I WALDP     /WITH THE RESULT
2Ø17  22Ø4             WALDØ   /       /USING THIS PARAMETER LIST
2Ø2Ø  745Ø             SNA     /       /NON-Ø RESULT ON RETURN?
2Ø21  52Ø5             JMP WAGAIN      /IF NOT, GET MORE INPUT
2Ø22  334Ø             DCA RESULT      /SAVE RESULT
2Ø23  134Ø             TAD RESULT
2Ø24  7Ø41             CIA
2Ø25  1341             TAD C254        /PRINT "+" FOR +1, "-" FOR -1
2Ø26  4752             JMS I TYPEP
2Ø27  5773             JMP I WNEXT     /AND DO WHATEVER COMES NEXT

               /START HERE TO BEGIN PEST WITH PRINTOUT OF INITIAL LEVELS
2Ø3Ø  4734     PESTGO, JMS I FIXALP    /DO INITIALIZATIONS
2Ø31  334Ø             DCA RESULT      /NO RESULT KNOWN YET
2Ø32  4753     PPRINT, JMS I RESETP    /START A NEW LINE
2Ø33  134Ø             TAD RESULT      /GET RESULT
2Ø34  744Ø             SZA     /       /IS THERE ONE?
2Ø35  5245             JMP PRINTC      /IF SO, PRINT CHANGE OF LEVEL
2Ø36  1342             TAD M7
2Ø37  334Ø             DCA RESULT
2Ø4Ø  1337             TAD SPACE
2Ø41  4752             JMS I TYPEP
2Ø42  234Ø             ISZ RESULT
2Ø43  524Ø             JMP .-3 /       /IF NOT, TYPE 7 SPACES
2Ø44  5251             JMP PRINTL      /THEN GO PRINT STARTING LEVEL
2Ø45  1341     PRINTC, TAD C254        /PRINT "+" FOR RESULT OF -1, "-" FOR
                       /       /       /RESULT OF +1, TO GIVE PROPER
                       /       /       /SIGN TO AMOUNT OF LEVEL CHANGE
2Ø46  4752             JMS I TYPEP     /TYPE SIGN
2Ø47  1364             TAD PSTEPW      /GET CHANGE
2Ø5Ø  4746             JMS I SPRINP    /TYPE IN DECIMAL, THEN 2 SPACES
2Ø51  1363     PRINTL, TAD PLEVW
2Ø52  4746             JMS I SPRINP    /PRINT CURRENT LEVEL
2Ø53  137Ø             TAD PDUBW       /IS DOUBLING POINTER Ø?
2Ø54  765Ø             SNA CLA /       /IF SO, PRINT "N" FOR NOT DOUBLED
2Ø55  1343             TAD C56 /       /THIS CHANGES SPACE TO "N"
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2Ø56  1337          TAD SPACE       /IF NOT, PRINT BLANK
2Ø57  4752          JMS I TYPEP
2Ø6Ø  1344          TAD LETRD       /PRINT "D" IN EITHER CASE
2Ø61  4752          JMS I TYPEP
2Ø62  1337          TAD SPACE
2Ø63  4752          JMS I TYPEP
2Ø64  1337          TAD SPACE
2Ø65  4752          JMS I TYPEP     /AND 2 SPACES
2Ø66  1371          TAD PCONW       /NOW GET COUNT OF CONSECUTIVE
                    /       /       /STEPS IN THIS DIRECTION
2Ø67  77ØØ          SMA CLA
2Ø7Ø  5277          JMP POSCT       /GO AWAY IF POSITIVE
2Ø71  1345  NEGCT,  TAD MINUS
2Ø72  4752          JMS I TYPEP     /PRINT "-" SIGN
2Ø73  1371          TAD PCONW
2Ø74  7Ø41          CIA
2Ø75  4746          JMS I SPRINP    /AND PRINT NEGATIVE OF COUNT
2Ø76  53Ø3          JMP PFIX        /AND THAT'S IT
2Ø77  1337  POSCT,  TAD SPACE
21ØØ  4752          JMS I TYPEP     /TYPE A SPACE
21Ø1  1371          TAD PCONW
21Ø2  4746          JMS I SPRINP    /AND THE CONSECUTIVE STEPS
21Ø3  1363  PFIX,   TAD PLEVW       /GET CURRENT WORKING LEVEL
21Ø4  4777          JMS I CONVRP    /AND CHANGE IT TO A PROBABILITY
21Ø5  5774          JMP I PNEXT     /AND THAT'S IT

            /RE-ENTER PEST HERE TO GET NEW INPUT AND TYPE NEXT LEVEL
21Ø6  4776  PLOOP,  JMS I PINPUT    /GET A +1 OR -1
21Ø7  334Ø          DCA RESULT      /SAVE THE RESULT
211Ø  134Ø          TAD RESULT      /NOW USE IT TO CALL PEST
2111  475Ø          JMS I PESTP
2112  2163          PLEVW   /       /WITH THIS PARAMETER LIST
2113  5316          JMP PSTOP       /IF RETURN IS MADE HERE, THAT'S IT
2114  72ØØ          CLA     /       /IGNORE THE NEW LEVEL UNTIL LATER
2115  5232          JMP PPRINT      /PRINT CURRENT STATUS OF PEST

            /GO HERE IF STOPPING CRITERION MET
2116  4753  PSTOP,  JMS I RESETP    /GO TO NEW LINE
2117  1351          TAD FINALP
212Ø  334Ø          DCA RESULT      /SETUP A POINTER TO A TEXT LIST
2121  174Ø          TAD I RESULT
2122  745Ø          SNA
2123  5327          JMP FINALL
2124  4752          JMS I TYPEP
2125  234Ø          ISZ RESULT
2126  5321          JMP .-5 /       /TYPE EACH NON-Ø CHARACTER
2127  1363  FINALL, TAD PLEVW
213Ø  4746          JMS I SPRINP    /TYPE FINAL LEVEL
2131  4753          JMS I RESETP
2132  74Ø2          HLT     /       /THAT'S ALL (THIS OR THE NEXT
2133  7ØØØ          NOP     /       /LOCATION IS A GOOD PLACE FOR A
                    /       /       /BREAKPOINT, OR TO RECYCLE FOR
                    /       /       /RUN - TAKE YOUR CHOICE)
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2134  2233  FIXALP, FIXALL
2135  7671  M71,    -1Ø7
2136  ØØØØ  LCOUNT, Ø
2137  Ø24Ø  SPACE,  24Ø
214Ø  ØØØØ  RESULT, Ø
2141  Ø254  C254,   254
2142  7771  M7,     -7
2143  ØØ56  C56,    56
2144  Ø3Ø4  LETRD,  3Ø4
2145  Ø255  MINUS,  255
2146  231Ø  SPRINP, SPRINT
2147  16ØØ  WALDP,  16ØØ
215Ø  1637  PESTP,  1637
2151  23ØØ  FINALP, FINALT
2152  2215  TYPEP,  TYPE
2153  2223  RESETP, RESET
2154  Ø26Ø  C26Ø,   26Ø

2155  ØØØØ  PGETW,  Ø         /        /ROUTINE TO USE WALD RESULT FOR PEST
2156  134Ø          TAD RESULT
2157  5755          JMP I PGETW        /SIMPLE, ISN'T IT?

            /DUMMY SUBROUTINE TO CLEAR ACCUMULATOR
216Ø  ØØØØ  CDUMMY, Ø
2161  72ØØ          CLA
2162  576Ø          JMP I CDUMMY

            /WORKING PEST PARAMETER LIST SPACE
2163  ØØØØ  PLEVW,  Ø         /        /CURRENT LEVEL
2164  ØØØØ  PSTEPW, Ø         /        /CURRENT STEP SIZE
2165  ØØØØ  PMINW,  Ø         /        /MINIMUM STEP
2166  ØØØØ  PMAXW,  Ø         /        /MAXIMUM STEP
2167  ØØØØ  PDIRW,  Ø         /        /CURRENT DIRECTION, -1 OR +1 FOR
                    /         /        /LAST STEP RESULTED FROM TOO MANY
                    /         /        /FAILURES OR SUCCESSES, RESPECTIVELY
217Ø  ØØØØ  PDUBW,  Ø         /        /-1 IF LAST STEP WAS A DOUBLING,
                    /         /        /Ø OTHERWISE
2171  ØØØØ  PCONW,  Ø         /        /TALLIES +1 FOR EACH SUBSEQUENT
                    /         /        /STEP AFTER THE FIRST IN ONE
                    /         /        /DIRECTION, STARTING FROM Ø AFTER A
                    /         /        /NON-DOUBLED STEP, FROM -1 IF THE
                    /         /        /NEW DIRECTION FOLLOWED A DOUBLED
                    /         /        /STEP
                    PAUSE
                    *2173
              /ALL THOSE LOCATIONS WHICH MIGHT NORMALLY BE CHANGED VIA
              /ODT ARE HERE PLACED TOGETHER, FROM 2173 TO 22Ø7, FOR
              /THE CONVENIENCE OF THE PROGRAMMER:

2173  21Ø6    WNEXT,  PLOOP    /      /UNTIL CHANGED, THIS PROGRAM WILL
2174  2ØØ1    PNEXT,  WLOOP    /      /ALTERNATE WALD AND PEST TESTS,
2175  2245    WINPUT, WACEPT   /      /TAKING WALD INPUT FROM THE TELETYPE
2176  2155    PINPUT, PGETW    /      /AND PASSING DECISIONS TO PEST
2177  216Ø    CONVRP, CDUMMY   /      /SPACE FOR ADDRESS OF ROUTINE TO
                      /        /      /CONVERT CURRENT LEVEL TO A
                      /        /      /PROBABILITY

                      DECIMAL
              /PEST STARTING PARAMETER LIST SPACE
22ØØ  Ø144    PESTØ,  1ØØ      /      /STARTING LEVEL: EXAMPLE 1ØØ
22Ø1  ØØ2Ø            16       /      /STARTING STEP SIZE: EXAMPLE 16
22Ø2  ØØØ2            2        /      /MINIMUM STEP SIZE: EXAMPLE 2
22Ø3  ØØ4Ø            32       /      /MAXIMUM STEP SIZE: EXAMPLE 32

              /WALD PARAMETER LIST SPACE
              /REMEMBER: FRACTIONS DO NOT HAVE TO BE IN LOWEST TERMS
22Ø4  Ø113    WALDØ,  75       /      /TARGET NUMERATOR: EXAMPLE 75
22Ø5  Ø144            1ØØ      /      /COMMON DENOMINATOR: EXAMPLE 1ØØ
22Ø6  Ø226    WDEVN,  15Ø      /      /DEVIATION NUMERATOR: EXAMPLE 15Ø
22Ø7  ØØØØ    WHIST,  Ø        /      /SPACE FOR WALD HISTORY
                      OCTAL

221Ø  ØØØØ    READ,   Ø
2211  6Ø31            KSF
2212  5211            JMP .-1
2213  6Ø36            KRB
2214  561Ø            JMP I READ

2215  ØØØØ    TYPE,   Ø
2216  6Ø41            TSF
2217  5216            JMP .-1
222Ø  6Ø46            TLS
2221  72ØØ            CLA      /      /NOTE THAT THIS CLEARS ACCUMULATOR
2222  5615            JMP I TYPE

2223  ØØØØ    RESET,  Ø
2224  1231            TAD CR
2225  4215            JMS TYPE
2226  1232            TAD LF
2227  4215            JMS TYPE
223Ø  5623            JMP I RESET
2231  Ø215    CR,     215
2232  Ø212    LF,     212

              /GRAND INITIALIZER
2233  ØØØØ    FIXALL, Ø
2234  6Ø46            TLS      /      /START TELETYPE
2235  4644            JMS I PINITP    /INITIALIZE PEST
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2236  2ØØØ             PESTØ   /          /PERMENANT PARAMETER LIST
2237  2163             PLEVW   /          /WORKING PARAMETER LIST
224Ø  12Ø6             TAD WDEVN
2241  7Ø41             CIA
2242  32Ø7             DCA WHIST          /INITIALIZE WALD
2243  5633             JMP I FIXALL       /LEAVE
2244  1715   PINITP, 1715

             /TYPEWRITER WALD INPUT ROUTINE
2245  ØØØØ   WACEPT, Ø
2246  421Ø             JMS READ           /GET TYPEWRITER INPUT
2247  7Ø41             CIA
225Ø  126Ø             TAD A26Ø           /WAS IT 26Ø (ASCII Ø)?
2251  745Ø             SNA     /          /IF SO, EXIT WITH Ø
2252  5645             JMP I WACEPT
2253  7ØØ1             IAC     /          /WAS IT 261 (ASCII 1)?
2254  764Ø             SZA CLA /          /IF NOT, IGNORE IT
2255  5246             JMP WACEPT+1
2256  7ØØ1             IAC     /          /IF SO, RESTORE TO +1
2257  5645             JMP I WACEPT       /AND EXIT
226Ø  Ø26Ø   A26Ø,     26Ø
2261  7777   M1,       7777

             /SUBROUTINE TO GET KEYBOARD INPUT FOR PEST. TYPE "+" FOR TOO
             /HIGH (MAKE LEVEL LOWER), "-" FOR TOO LOW (MAKE LEVEL
             /HIGHER). THIS INPUT WILL NOT BE ECHOED.
2262  ØØØØ   PACEPT, Ø
2263  421Ø             JMS READ           /GET INPUT
2264  1276             TAD MCMPAR         /COMPARE TO "-"
2265  745Ø             SNA
2266  5274             JMP TOOLOW         /IF SO, TREAT ACCORDINGLY
2267  1277             TAD A2
227Ø  764Ø             SZA CLA /          /WAS IT PLUS, THEN?
2271  5263             JMP PACEPT+1       /IF NOT, IGNORE IT
2272  7ØØ1   TOOHI,    IAC
2273  5662             JMP I PACEPT       /EXIT WITH +1
2274  724Ø   TOOLOW,   CLA CMA
2275  5662             JMP I PACEPT       /EXIT WITH -1
2276  7523   MCMPAR,   -255
2277  ØØØ2   A2,       2

23ØØ  Ø3Ø6   FINALT, 3Ø6     /            /ASCII FOR "FINAL: "
23Ø1  Ø311           311
23Ø2  Ø316           316
23Ø3  Ø3Ø1           3Ø1
23Ø4  Ø314           314
23Ø5  Ø272           272
23Ø6  Ø24Ø   ASPACE, 24Ø
23Ø7  ØØØØ           Ø       /            /"FINAL: "

             /DECIMAL PRINTING ROUTINE
231Ø  ØØØØ   SPRINT, Ø
2311  3363             DCA NTEMP          /SAVE NUMBER
2312  1362             TAD M3
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2313  3364           DCA NHOLD         /SAVE A -3 COUNTER
2314  1366           TAD A1ØØØP
2315  3372           DCA MPOINT        /SETUP POINTER TO LIST OF MINUENDS
2316  3365           DCA SPACER        /PRINT BLANKS FOR LEADING ØS
2317  3373  NLOOP1,  DCA COUNTR        /SETUP Ø COUNT
232Ø  741Ø           SKP      /        /DON'T DESTROY THE NUMBER
2321  3363  NLOOP2,  DCA NTEMP         /SAVE THE NUMBER
2322  1772           TAD I MPOINT      /GET MINUEND
2323  7141           CLL CIA /         /CLEAR LINK AND NEGATE
2324  1363           TAD NTEMP         /ADD CURRENT VALUE OF NUMBER
2325  742Ø           SNL      /        /OVERFLOW?
2326  5331           JMP NOTFIT        /IF NOT, MINUEND WON'T FIT
2327  2373           ISZ COUNTR        /IF SO, TALLY 1
233Ø  5321           JMP NLOOP2        /AND TRY AGAIN
2331  72ØØ  NOTFIT,  CLA      /        /LEAVE NTEMP AS IS
2332  2372           ISZ MPOINT        /SETUP NEXT MINUEND
2333  1373           TAD COUNTR        /NOW TRY COUNTR
2334  745Ø           SNA      /        /IF NONZERO, ALWAYS PRINT
2335  5343           JMP NZERO         /IF ZERO, TEST FOR SPACE OR "Ø"
2336  126Ø           TAD A26Ø          /ADD DIGIT VALUE TO 26Ø
2337  4215           JMS TYPE          /OUTPUT IT
234Ø  7ØØ1           IAC
2341  3365           DCA SPACER        /MAKE SPACER NON-Ø
2342  535Ø           JMP NTALLY        /TEST FOR 3'D DIGIT
2343  1365  NZERO,   TAD SPACER        /GET SPACER
2344  765Ø           SNA CLA /         /AND, IF IT'S Ø,
2345  1374           TAD M2Ø /         /ADD -2Ø TO 26Ø, MAKING 24Ø
2346  126Ø           TAD A26Ø
2347  4215           JMS TYPE          /OUTPUT IT
235Ø  2364  NTALLY,  ISZ NHOLD         /3 DONE YET?
2351  5317           JMP NLOOP1        /IF NOT, DO MORE
2352  1363           TAD NTEMP         /IF SO, PRINT LAST DIGIT
2353  126Ø           TAD A26Ø
2354  4215           JMS TYPE          /TYPE IT
2355  13Ø6           TAD ASPACE
2356  4215           JMS TYPE
2357  13Ø6           TAD ASPACE
236Ø  4215           JMS TYPE          /TYPE 2 SPACES
2361  571Ø           JMP I SPRINT      /EXIT

2362  7775  M3,      -3
2363  ØØØØ  NTEMP,   Ø
2364  ØØØØ  NHOLD,   Ø
2365  ØØØØ  SPACER,  Ø
2366  2367  A1ØØØP,  A1ØØØ
2367  175Ø  A1ØØØ,   175Ø
237Ø  Ø144           144
2371  ØØ12           12       /        /1ØØØ, 1ØØ, 1Ø IN DECIMAL
2372  ØØØØ  MPOINT,  Ø
2373  ØØØØ  COUNTR,  Ø
2374  776Ø  M2Ø,     -2Ø
                     PAUSE
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                        *24ØØ
                /ROUTINE TO GENERATE A +1 WITH RATIONAL PROBABILITY
                /EQUAL TO PNUM/PDEN, TREATED AS 12-BIT NON-NEGATIVE INTEGERS
                /THIS ROUTINE CAN BE CALLED BY PLACING ITS ADDRESS INTO
                /LOCATION WINPUT. THE VALUES PNUM AND PDEN ARE TO BE FILLED
                /BY A ROUTINE WHOSE ADDRESS IS PLACED INTO CONVRP, AND
                /WHICH IS CALLED AFTER EACH CHANGE OF PEST LEVEL.

24ØØ   ØØØØ    PNUM,    Ø         /        /NUMERATOR AND DENOMINATOR OF
24Ø1   ØØØØ    PDEN,    Ø         /        /PROBABILITY OF GENERATING A +1

24Ø2   ØØØØ    PROB1,   Ø
24Ø3   72ØØ             CLA       /        /TO BE SAFE
24Ø4   12Ø1             TAD PDEN           /GET DENOMINATOR
24Ø5   745Ø             SNA
24Ø6   74Ø2             HLT       /        /MAKE SURE IT IS NON-Ø
24Ø7   4215             JMS RANDOM         /CHOOSE FROM 1 TO IT AT RANDOM
241Ø   7141             CLL CIA /          /NEGATE AND CLEAR LINK
2411   12ØØ             TAD PNUM           /ADD NUMERATOR - IF LINK CHANGES,
                        /         /        /THEN NEGATED RANDOM RESULT WAS
                        /         /        /NO MORE NEGATIVE THAN NUMERATOR
                        /         /        /IS POSITIVE, SO WE GENERATE A +1
                        /         /        /FOR A SUCCESS
2412   763Ø             SZL CLA
2413   7ØØ1             IAC
2414   56Ø2             JMP I PROB1        /EXIT WITH +1 OR WITH Ø

               /ROUTINE TO CHOOSE A PSEUDO-RANDOM NUMBER FROM THE RANGE
               /1 TO N, WHEN ROUTINE IS ENTERED WITH N IN THE ACCUMULATOR
               /ROUTINE EXITS WITH RANDOM NUMBER I N ACCUMULATOR

                        /IF N>1, WORK WITH RANGE Ø TO (N-1) FOR NOW
2415   ØØØØ    RANDOM,  Ø
2416   745Ø             SNA
2417   5615             JMP I RANDOM
242Ø   7Ø41             CIA
2421   7Ø4Ø             CMA
2422   745Ø             SNA
2423   5254             JMP INCSEL

                        /FIND LEFTMOST 1 BIT AND CREATE MASK OF 1 BITS FROM
                        /THERE TO THE RIGHT END OF THE ACCUMULATOR
2424   3256             DCA LIMIT
2425   3257             DCA BITTAB
2426   1256             TAD LIMIT
2427   711Ø    SHIFT,   CLL RAR
243Ø   2257             ISZ BITTAB
2431   744Ø             SZA
2432   5227             JMP SHIFT
2433   1257             TAD BITTAB
2434   7Ø41             CIA
2435   3257             DCA BITTAB
2436   712Ø    MASKER,  STL
2437   7ØØ4             RAL
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244Ø  2257             ISZ BITTAB
2441  5236             JMP MASKER
2442  326Ø             DCA MASC

                       /GET 12-BIT RANDOM NUMBER, MASK TO APPROPRIATE
                       /NUMBER OF BITS, KEEP IT IF IT IS NOT TOO LARGE,
                       /OTHERWISE TRY AGAIN
2443  4261   RNGET,    JMS FLIP
2444  Ø26Ø             AND MASC
2445  3257             DCA CHOICE
2446  1256             TAD LIMIT
2447  714Ø             CMA CLL
245Ø  1257             TAD CHOICE
2451  763Ø             SZL CLA
2452  5243             JMP RNGET
2453  1257             TAD CHOICE

                       /ADD +1 TO RESTORE TO SELECTION FROM RANGE 1 TO N
2454  7ØØ1   INCSEL,   IAC
2455  5615             JMP I RANDOM
2456  ØØØØ   LIMIT,    Ø
             BITTAB=.
2457  ØØØØ   CHOICE,   Ø
246Ø  ØØØØ   MASC,     Ø

             /SUBROUTINE TO GENERATE 12-BIT PSEUDO-RANDOM NUMBER VIA THE
             /RECURSION X(N+1)=X(N)+X(N-21), MODULUS (2↑12)
2461  ØØØØ   FLIP,     Ø
2462  72ØØ             CLA
2463  13Ø2             TAD FLPT1
2464  33Ø1             DCA FLPT
2465  13Ø2             TAD FLPT1
2466  13Ø3             TAD FLBOT
2467  764Ø             SZA CLA
247Ø  5273             JMP FLOK
2471  13Ø4             TAD FLTOP
2472  33Ø2             DCA FLPT1
2473  23Ø2   FLOK,     ISZ FLPT1
2474  17Ø1             TAD I FLPT
2475  17Ø2             TAD I FLPT1
2476  37Ø2             DCA I FLPT1
2477  17Ø2             TAD I FLPT1
25ØØ  5661             JMP I FLIP
25Ø1  25Ø5   FLPT,     LTOP
25Ø2  25Ø6   FLPT1,    LTOP+1
25Ø3  5246   FLBOT,    -LBOT
25Ø4  25Ø4   FLTOP,    LTOP-1
25Ø5  2315   LTOP,     2315
25Ø6  23Ø3             23Ø3
25Ø7  7553             7553
251Ø  3676             3676
2511  Ø655             Ø655
2512  4331             4331
2513  5255             5255
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2514  3135            3135
2515  3157            3157
2516  5704            5704
2517  3072            3072
2520  5223            5223
2521  5667            5667
2522  7262            7262
2523  3566            3566
2524  6102            6102
2525  4547            4547
2526  3505            3505
2527  6475            6475
2530  1047            1047
2531  7551            7551
2532  1132  LBOT,     1132
                      PAUSE
```

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/THIS IS AN EXAMPLE OF A SUBROUTINE TO CONVERT THE CURRENT
/LEVEL TO A PROBABILITY, FOR SIMULATING THE ACTION OF PEST.
/IT CREATES A VERY CRUDE APPROXIMATION TO A CUMULATIVE
/NORMAL OGIVE BY ADJOINING PARTS OF TWO PARABOLAS, ONE
/IN NORMAL ORIENTATION, ONE INVERTED. THIS APPROXIMATION
/GENERATES PROBABILITIES FROM A LOCATION PARAMETER, C, WHICH
/DETERMINES THE LEVEL AT WHICH PROB(SUCCESS)=.75. FOR
/LEVELS BETWEEN C-64 AND C, THE CURVE IS A SEGMENT OF THE
/RIGHT HALF OF AN UPWARD-OPENING PARABOLA WHICH IS TANGENT
/TO THE LINE PROB(SUCCESS)=.5 AT THE POINT (C-64,.5),
/AND WHICH MEETS THE LEFT HALF OF A CONGRUENT BUT INVERTED
/PARABOLA SEGMENT AT (C,.75). THIS INVERTED SEGMENT IS
/TANGENT TO THE LINE PROB(SUCCESS)=1.Ø AT THE POINT
/(C+64,1.Ø). BELOW OR ABOVE THE RANGE [C-64,C+64] THE
/PROBABILITY OF A SUCCESS IS .5 OR 1.Ø, RESPECTIVELY.
/THUS THE GRAPH IS SIMPLY .5 + THE INTEGRAL OF AN ISOCELES
/TRIANGLE WITH BASE 128, AREA .5, CENTERED AT C.
/HERE IS A GRAPH OF THE FUNCTION, AS PRODUCED BY FOCAL:

/ 1.ØØ .                                    ....+(C+64,1.)
/      .                                 ...
/ Ø.95 .                              ...
/      .                             .
/ Ø.9Ø .                           ..
/      .                          .
/ Ø.85 .                        ..
/      .                       .
/ Ø.8Ø .                      .
/      .                     .
/ Ø.75 .                    +(C,.75)
/      .                   .
/ Ø.7Ø .                  .
/      .                 .
/ Ø.65 .               ..
/      .              .
/ Ø.6Ø .            ..
/      .          ..
/ Ø.55 .        ..
/      .     ...
/ Ø.5Ø .+....
/      .(C-64,.5)
/ Ø.45 .
/      .
/   P  .*...................*...................*
/       C-64                C                C+64
/                        LEVEL

/WITHIN THE RANGE [-64,64], THE PROBABILITY FUNCTION IS
/DEFINED AS FOLLOWS:

/IF X<=C, P(SUCCESS) = .5 + [(X-(C-64))↑2]/(2↑14), AND
/IF X>=C, P(SUCCESS) = 1. - [(X-(C+64))↑2]/(2↑14).
```

```
                         /FOR COMPUTATIONAL PURPOSES EACH OF THESE CAN BE EXPRESSED
                         /AS A FRACTION WITH DENOMINATOR 2↑11 (4ØØØ OCTAL), AND
                         /THE FORMULAS FOR THE NUMERATORS REDUCE TO

                         /IF X<=C, NUMERATOR = 2↑1Ø + [(X-(C-64))↑2]/8, AND
                         /IF X>=C, NUMERATOR = 2↑11 - [(X-(C-64))↑2]/8.

                                   *26ØØ

26ØØ  ØØØØ  CURVE,   Ø          /      /ENTER WITH LEVEL IN ACCUMULATOR
26Ø1  3262           DCA CLEVEL        /SAVE LEVEL
26Ø2  1266           TAD C
26Ø3  1263           TAD A64
26Ø4  7141           CLL CIA /         /CLEAR LINK TO RECEIVE OVERFLOW
26Ø5  1262           TAD CLEVEL        /LEVEL >= C+64 ?
26Ø6  747Ø           SZL SNA /         /YES, IF LINK CHANGES OR ACC = Ø
26Ø7  5224           JMP SET1Ø         /SET PROB TO 1.Ø IF SO
261Ø  1263           TAD A64 /         /C < LEVEL < C+64 ?
2611  743Ø           SZL     /         /YES, IF LINK CHANGES NOW
2612  5226           JMP UPHALF        /IF SO, IN UPPER HALF OF CURVE
2613  1263           TAD A64 /         /C-64 < LEVEL <= C?
2614  743Ø           SZL     /         /YES, IF LINK CHANGES NOW
2615  5234           JMP LOHALF        /IF SO, IN LOWER HALF OF CURVE
2616  7332  SETØ5,   CLA STL RTR       /CREATE UNCONDITIONAL 2ØØØ NUMERATOR
2617  3664  EXIT,    DCA I NUMPTR      /STORE NUMERATOR
262Ø  1256           TAD A4ØØØ
2621  3665           DCA I DENPTR      /USE 4ØØØ DENOMINATOR ALWAYS
2622  7ØØØ           NOP     /         /REPLACE WITH JMS WRITIT TO PRINT
                     /       /         /THE NEW LEVEL IN DECIMAL
2623  56ØØ           JMP I CURVE       /RETURN
2624  733Ø  SET1Ø,   CLA STL RAR       /CLEAR ACCUMULATOR AND CREATE 4ØØØ
2625  5217           JMP EXIT          /FOR PROBABILITY OF .5
2626  7Ø41  UPHALF,  CIA     /         /ACCUMULATOR CONTAINED LEVEL - C, SO
                     /       /         /CHANGE TO C - LEVEL, THEN
2627  1263           TAD A64 /         /ADD 64 FOR (C+64) - LEVEL, WHICH IS
                     /       /         /POSITIVE BUT HAS THE SAME SQUARE AS
                     /       /         /LEVEL - (C+64)
263Ø  4237           JMS SQUARE        /GET ITS SQUARE, DIVIDED BY 8
2631  7Ø41           CIA     /         /NEGATE IT
2632  1256           TAD A4ØØØ         /ADD 2↑11
2633  5217           JMP EXIT          /AND GO
2634  4237  LOHALF,  JMS SQUARE        /ACCUMULATOR HAD L-(C-64), SO JUST
                     /       /         /GET SQUARE DIVIDED BY 8
2635  1257           TAD A2ØØØ         /ADD TO 2↑1Ø
2636  5217           JMP EXIT          /AND GO

2637  ØØØØ  SQUARE,  Ø       /         /ROUTINE TO GET 13-BIT SQUARE
                     /       /         /OF NUMBER <= 64, AND TO DIVIDE
                     /       /         /THE RESULT BY 8, WITH APPROPRIATE
                     /       /         /ROUNDING
264Ø  3262           DCA CLEVEL        /SAVE NUMBER
2641  1262           TAD CLEVEL
2642  7141           CLL CIA /         /TRY TO CLEAR LINK, AND NEGATE
2643  745Ø           SNA     /         /BUT IF NUMBER WAS Ø,
2644  5637            JMP I SQUARE      /LEAVE WITH A Ø
2645  3261            DCA COUNTX        /OTHERWISE, SAVE A COUNTER
2646  1262            TAD CLEVEL        /NOW MULTIPLY BY ITSELF
2647  2261            ISZ COUNTX
265Ø  5246            JMP .-2
2651  126Ø            TAD A4   /        /ADD 4 WHEN DONE
2652  7Ø1Ø            RAR      /        /SAVE LINK THE FIRST TIME
2653  711Ø            CLL RAR
2654  711Ø            CLL RAR /         /THEN DIVIDE BY 4 MORE
2655  5637            JMP I SQUARE      /YIELDING ROUNDED 8-BIT SQUARE

2656  4ØØØ  A4ØØØ,    4ØØØ
2657  2ØØØ  A2ØØØ,    2ØØØ
266Ø  ØØØ4  A4,       4
2661  ØØØØ  COUNTX,   Ø
2662  ØØØØ  CLEVEL,   Ø
2663  Ø1ØØ  A64,      1ØØ
2664  24ØØ  NUMPTR,   PNUM
2665  24Ø1  DENPTR,   PDEN
2666  Ø4ØØ  C,        4ØØ      /        /C MAY BE ANY INTEGER IN THE RANGE
                      /        /        /1Ø1 TO 7677, OCTAL
                      PAUSE
```

```
                /OPTIONAL SUBROUTINE TO PRINT THE CURRENT PROPORTION AS A
                /FRACTION WITH DENOMINATOR 1000

                /THIS ROUTINE BEGINS BY CALCULATING T, THE NUMBER OF
                /THOUSANDTHS EQUAL TO THE NEW PROPORTION. FROM THE FORMULA

                / T = INTEGER PART OF ((NUMERATOR * 1000 / 2048) + .5)

                /WE CAN DERIVE THE COMPUTATIONAL FORMULA

                / T = [((2048*(NUMERATOR+1) - 48*NUMERATOR) / 4096)].

                /THIS LATTER FORMULA, OF COURSE, IS VERY EASY TO IMPLEMENT
                /ON A 12-BIT COMPUTER. THE VALUE OF T IS THEN PRINTED IN
                /DECIMAL, FOLLOWED BY "/ 1000".

2667    0000    WRITIT, 0
2670    1664            TAD I NUMPTR
2671    7001            IAC     /       /ADD +1 TO NUMERATOR AND
2672    7110            CLL RAR
2673    3332            DCA TOP
2674    7010            RAR
2675    3333            DCA BOT /       /MULTIPLY BY 2048, DOUBLE PRECISION
2676    1334            TAD M48
2677    3261            DCA COUNTX      /PREPARE TO SUBTRACT 48 TIMES
2700    1664            TAD I NUMPTR
2701    7041            CIA
2702    3331            DCA COPNUM      /CREATE NEGATIVE OF NUMERATOR
2703    1333    LOOPW,  TAD BOT /       /ADD NEGATIVE TO BOTTOM 48 TIMES,
2704    1331            TAD COPNUM
2705    3333            DCA BOT
2706    7420            SNL
2707    7040            CMA     /       /SUBTRACTING 1 FROM THE TOP
2710    1332            TAD TOP
2711    3332            DCA TOP /       /EACH TIME THE LINK DOESN'T CARRY
2712    7100            CLL
2713    2261            ISZ COUNTX
2714    5303            JMP LOOPW
2715    1335            TAD OPAREN
2716    4747            JMS I TYPE2     /PRINT "("
2717    1332            TAD TOP
2720    4750            JMS I SPRIN2    /PRINT TOP
2721    1336            TAD CLOSEP
2722    3261            DCA COUNTX
2723    1661            TAD I COUNTX
2724    7450            SNA
2725    5667            JMP I WRITIT    /PRINT "/ 1000)" UNTIL DONE
2726    4747            JMS I TYPE2
2727    2261            ISZ COUNTX
2730    5323            JMP .-5

2731    0000    COPNUM, 0
2732    0000    TOP,    0
2733    0000    BOT,    0
```

```
2734  772Ø  M48,     -6Ø
2735  Ø25Ø  OPAREN,  25Ø
2736  2737  CLOSEP,  .+1
2737  Ø257           257
274Ø  Ø24Ø           24Ø
2741  Ø261           261
2742  Ø26Ø           26Ø
2743  Ø26Ø           26Ø
2744  Ø26Ø           26Ø
2745  Ø251           251
2746  ØØØØ           Ø
2747  2215  TYPE2,   TYPE
275Ø  231Ø  SPRIN2,  SPRINT
```

```
ASPACE  2306
A1000   2367
A1000P  2366
A2      2277
A2000   2657
A260    2260
A4      2660
A4000   2656
A64     2663
BITTAB  2457
BOT     2733
C       2666
CDUMMY  2160
CHOICE  2457
CLEVEL  2662
CLOSEP  2736
CONVRP  2177
COPNUM  2731
COUNTR  2373
COUNTX  2661
CR      2231
CURVE   2600
C254    2141
C260    2154
C56     2143
DENPTR  2665
EXIT    2617
FINALL  2127
FINALP  2151
FINALT  2300
FIXALL  2233
FIXALP  2134
FLBOT   2503
FLIP    2461
FLOK    2473
FLPT    2501
FLPT1   2502
FLTOP   2504
INCSEL  2454
LBOT    2532
LCOUNT  2136
LETRD   2144
LF      2232
LIMIT   2456
LOHALF  2634
LOOPW   2703
LTOP    2505
MASC    2460
MASKER  2436
MCMPAR  2276
MINUS   2145
MPOINT  2372
M1      2261
```

```
M2Ø      2374
M3       2362
M48      2734
M7       2142
M71      2135
NEGCT    2Ø71
NHOLD    2364
NLOOP1   2317
NLOOP2   2321
NOTFIT   2331
NTALLY   235Ø
NTEMP    2363
NUMPTR   2664
NZERO    2343
OPAREN   2735
PACEPT   2262
PCONW    2171
PDEN     24Ø1
PDIRW    2167
PDUBW    217Ø
PESTGO   2Ø3Ø
PESTP    215Ø
PESTØ    22ØØ
PFIX     21Ø3
PGETW    2155
PINITP   2244
PINPUT   2176
PLEVW    2163
PLOOP    21Ø6
PMAXW    2166
PMINW    2165
PNEXT    2174
PNUM     24ØØ
POSCT    2Ø77
PPRINT   2Ø32
PRINTC   2Ø45
PRINTL   2Ø51
PROB1    24Ø2
PSTEPW   2164
PSTOP    2116
RANDOM   2415
READ     221Ø
RESET    2223
RESETP   2153
RESULT   214Ø
RNGET    2443
SETØ5    2616
SET1Ø    2624
SHIFT    2427
SPACE    2137
SPACER   2365
SPRINP   2146
SPRINT   231Ø
SPRIN2   275Ø
```

```
SQUARE  2637
TOOHI   2272
TOOLOW  2274
TOP     2732
TYPE    2215
TYPEP   2152
TYPE2   2747
UPHALF  2626
WACEPT  2245
WAGAIN  2ØØ5
WALDGO  2ØØØ
WALDP   2147
WALDØ   22Ø4
WDEVN   22Ø6
WHIST   22Ø7
WINPUT  2175
WLINE   2ØØ2
WLOOP   2ØØ1
WNEXT   2173
WRITIT  2667
```

PEST DEMONSTRATOR -- ANNOTATED DEMONSTRATION

THE TYPED MATERIAL OCCUPYING, ROUGHLY, THE LEFT HALF OF THESE PAGES IS THE OUTPUT OF ODT AND THE DEMONSTRATOR. ECHOED OPERATOR INPUT IS UNDERLINED. ALL PARENTHETICAL COMMENTS ARE ANNOTATIONS ADDED LATER, AS ARE THESE VARIOUS INTRODUCTORY AND INTERSPERSED PARAGRAPHS.

TO START THESE DEMONSTRATIONS, THE PEST PACKAGE (AT 16ØØ), THE PEST DEMONSTRATOR PACKAGE, AND ODT LOW WERE LOADED USING THE BIN LOADER. FOR THE FIRST DEMONSTRATION, THE PROGRAM WAS USED AS LOADED, WITH WALD GETTING STRINGS OF "1"S AND "Ø"S FROM THE OPERATOR, MAKING A DECISION ABOUT EACH STRING, AND PASSING THE DECISION TO THE DEMONSTRATOR TO BE PRINTED AND TO PEST FOR A NEW LEVEL TO BE CHOSEN AND PRINTED.
THE PROGRAM WAS STARTED AT 2Ø3Ø BY ODT.

```
2Ø3ØG                         (START VIA ODT)

        1ØØ   ND       Ø    (THE DEMOSTRATOR TYPES THE CURRENT LEVEL,
                             WHETHER OR NOT THE STEP WAS DOUBLED, AND THE
                             VALUE OF PEST'S INTERNAL COUNTER TO DECIDE
                             WHEN TO BEGIN DOUBLING THE STEP SIZE.)

ØØØ-                         (THE OPERATOR TYPES "ØØØ" FOR THREE CONSECUTIVE
                             FAILURES, AND WALD RESPONDS WITH "TOO LOW".)
+  16   116   ND       1    (SO PEST RAISES THE LEVEL BY 16, TO 116)

ØØØ-
+  32   148    D       2    (NOTE THE DOUBLED STEP.)

ØØØ-
+  32   18Ø    D       3    (NO FURTHER DOUBLING, AS THE MAXIMUM IS 32.)

1111111+                     (OPERATOR TYPES A STRING OF SUCCESSES, TO CAUSE
-  16   164   ND    -  1    A REVERSAL OF DIRECTION. STEP SIZE DROPS TO 16.)

1111111+
-  16   148   ND       Ø

1ØØ-
+   8   156   ND       Ø

1111111+
-   4   152   ND       Ø

1111111+
-   4   148   ND       1

ØØØ-
+   2   15Ø   ND       Ø

1111111+                    (OPERATOR CAUSES CONVERGENCE AT 15Ø, BECAUSE
FINAL:  15Ø                 THE MINIMUM STEP ALLOWED WAS SET TO 2.)
```

NOW ODT IS USED TO MAKE WALD SIMPLY RETURN TO ITSELF WHEN DONE, SO THAT THE OPERATOR CAN SEE WHAT DECISION WALD MAKES ON SOME OF THE POSSIBLE INPUT STRINGS. THE OPERATOR TYPES A STRING OF 1S AND ØS, AND WALD RESPONDS "+" OR "-". WALD IS STILL SET FOR TARGET LEVEL OF 75%, DEVIATION LIMIT OF 1.5 TRIALS FROM EXPECTATION. REMEMBER THAT WALD IGNORES THE FIRST TRIAL OF ANY STRING.

```
2173/21Ø6 2ØØ1             (ODT USED TO CHANGE WALD EXIT POINTER.)

2ØØØG


ØØØ-                       (2 FAILURES IN 2 COUNTED TRIALS, WHILE ONLY
                           .5 FAILURES WERE EXPECTED. DIFFERENCE IS 1.5, SO
                           DECIDE THAT SUCCESS RATE IS TOO LOW.)

Ø1ØØØ-                     (3 FAILURES IN 4 TRIALS, EXPECTING 1.Ø, TOO LOW)

Ø11ØØØ-                    (3 FAILURES, 5 TRIALS, EXPECTING 1.25, TOO LOW)

Ø111111+                   (6 SUCCESS, 6 TRIALS, EXPECTING 4.5,
                           DIFFERENCE EXACTLY 1.5, TOO HIGH)

ØØ111111111+               (AFTER FIRST FAILURE, NEED 9 SUCCESS TO GET
                           9 SUCCESSES OUT OF 1Ø, EXPECTING 7.5, TOO HIGH)
```

NOW ODT IS USED TO CHANGE THE DEVIATION LIMIT BACK TO 1.Ø

```
22Ø6/0226 144              (144 WAS COMMON DENOMINATOR ALREADY)

2ØØØG


ØØØ-

Ø1ØØ-

Ø11ØØ-

Ø1111+

Ø111Ø111Ø111Ø111Ø111Ø111Ø1111+
                           (NOTE THAT 3 SUCCESSES PER FAILURE IS RIGHT
                           ON TARGET, AND A DECISION COULD BE POSTPONED
                           INDEFINITELY.)
```

PAGE 3

NOW ODT IS USED TO RESET THE WALD EXIT POINTER AND TO CAUSE PEST TO LOOP BACK TO ITSELF, SO THAT THE OPERATOR CAN ENTER "+" OR "-" TO PEST TO SEE THE EFFECTS OF VARIOUS SEQUENCES OF SUCH ON THE CHANGES OF PEST LEVEL. THE "+" OR "-" IS NON-ECHOING, BUT THE SIGN ON THE CHANGE OF LEVEL IS ALWAYS THE OPPOSITE OF THE INPUT SIGN, SINCE "+" INPUT MEANS LEVEL TOO HIGH, SO THE NEXT LEVEL IS LOWER, ETC.

```
2173/2ØØ1 21Ø6            (RESTORE WALD EXIT POINTER)
2174/2ØØ1 21Ø6            (PROGRAM WILL SIMPLY LOOP FOR CONSECUTIVE PEST
                          TESTS)

2Ø3ØG



        1ØØ  ND      Ø
+  16   116  ND      1    (OPERATOR HAD TYPED "-", FOR LEVEL TOO LOW)
+  32   148   D      2
-  16   132  ND  -   1
-  16   116  ND      Ø
-  16   1ØØ  ND      1
-  32    68   D      2    (NOTICE THAT IT IS NOT UNTIL THE 4'TH
                          CONSECUTIVE STEP AFTER A DOUBLING THAT THE
                          STEP SIZE IS DOUBLED.)
-  32    36   D      3
-  32     4   D      4
+  16    2Ø  ND  -   1
-   8    12  ND      Ø
-   8     4  ND      1
-  16  4Ø84   D      2    (TWO THINGS TO NOTICE HERE: FIRST, SINCE THE
                          LAST REVERSAL DID NOT FOLLOW A DOUBLED STEP, THE
                          THIRD CONSECUTIVE STEP IN THIS DIRECTION WAS
                          DOUBLED. SECOND, THE LEVEL UNDERFLOWED, AN
                          EVENT WHICH THE DEMONSTRATOR IGNORES.)

+   8  4Ø92  ND  -   1
+   8     4  ND      Ø
+   8    12  ND      1
-   4     8  ND      Ø
+   2    1Ø  ND      Ø
FINAL:   1Ø               (CONVERGENCE TO LEVEL OF 1Ø)
```

PAGE 4

NOW THE PROGRAM IS SET TO MAKE USE OF THE AUTOMATIC INPUT SIMULATOR, WHICH GENERATES SUCCESSES AND FAILURES ACCORDING TO A SIMPLE PSYCHOMETRIC FUNCTION, IMPLEMENTED BY SUBROUTINE "CURVE". THE DEVIATION LIMIT REMAINS AT 1.Ø TRIALS.

```
2174/21Ø6 2ØØ1            (AFTER PEST, GO BACK TO WALD)
2175 /2245 24Ø2           (WALD GETS ITS INPUT FROM ROUTINE "PROB1")
2176 /2262 2155           (PEST GETS ITS INPUT FROM WALD)
2177 /231Ø 26ØØ           (THE ROUTINE "CURVE" IS TO BE CALLED
                          AFTER EACH CHANGE OF LEVEL, TO COMPUTE THE
                          NEW PROBABILITY OF SUCCESS)

 2Ø3ØG                    (FROM THIS POINT ON, THE OPERATOR ENTERS
                          NOTHING. THE ROUTINES "CURVE" AND "PROB1" SUPPLY
                          WALD WITH ITS SUCCESSES AND FAILURES. THE
                          CALIBRATION OF CURVE IS PRESENTLY SET SO THAT A
                          LEVEL OF 256 GENERATES THE TARGET 75% CORRECT.
                          A LEVEL OF 192 OR LOWER GENERATES SUCCESSES
                          WITH PROBABILITY 5Ø%, 32Ø OR HIGHER GENERATES
                          1ØØ% SUCCESSES.)

          1ØØ  ND      Ø

Ø1ØØ-
+  16    116  ND      1

1ØØ-
+  32    148   D      2

1Ø1Ø-
+  32    18Ø   D      3

ØØ111Ø111ØØ-
+  32    212   D      4

11111+
-  16    196  ND  -   1

1Ø1111Ø11ØØ-
+   8    2Ø4  ND      Ø

ØØØ-
+   8    212  ND      1

ØØ11Ø-
+  16    228   D      2

11111+
-   8    22Ø  ND  -   1

11ØØ-
+   4    224  ND      Ø  (CONTINUED ON NEXT PAGE)
```

```
PAGE 5

1Ø1Ø-
+   4   228  ND      1

11Ø111Ø1Ø-
+   8   236   D      2

111Ø11Ø11Ø1Ø-
+  16   252   D      3

1ØØ-
+  32   284   D      4

11111+
-  16   268  ND  -   1

111Ø111Ø1111+
-  16   252  ND      Ø

1Ø1111Ø1Ø-
+   8   26Ø  ND      Ø

1Ø11111Ø111Ø11Ø111Ø11111+
-   4   256  ND      Ø

11110111+
-   4   252  ND      1

ØØØ-
+   2   254  ND      Ø

11ØØ-
+   2   256  ND      1

11Ø11111Ø111Ø11111+
FINAL:  256               (SHEER LUCK)

NOW THREE CHANGES ARE MADE:
1. THE DEVIATION LIMIT IS RAISED TO 1.5 AGAIN.
2. THE TARGET PERCENTAGE IS CHANGED TO 85%.
3. THE "CURVE" ROUTINE PRINTS THE SUCCESS PROBABILITY CORRESPONDING TO
EACH NEW LEVEL THAT IT SETS. THIS IS PRINTED IN PARENTHESES -- THE
FRACTIONS WITH 1ØØØ IN THE DENOMINATOR ARE NOT ANNOTATIONS ADDED
LATER.

A
22Ø4/Ø113 125             (CHANGE TARGET NUMERATOR FROM 75 TO 85)
22Ø6/Ø144 226             (CHANGE DEVIATION LIMIT TO 1.5)
2622/7ØØØ 4267            (IMPLEMENT PROBABILITY-PRINTING ROUTINE)

2Ø3ØG                     (AGAIN, OPERATOR IS "HANDS-OFF" AFTER THIS)

        1ØØ  ND      Ø  ( 5ØØ  / 1ØØØ)  (CONTINUED ON NEXT PAGE)
```

```
ØØ1111Ø1Ø-
+  16   116  ND        1  ( 5ØØ  / 1ØØØ)

1Ø1Ø-
+  32   148   D        2  ( 5ØØ  / 1ØØØ)

11Ø1ØØ-
+  32   18Ø   D        3  ( 5ØØ  / 1ØØØ)

ØØ11ØØ-
+  32   212   D        4  ( 524  / 1ØØØ)

Ø1Ø1Ø1Ø-
+  32   244   D        5  ( 665  / 1ØØØ)

1Ø11Ø1Ø-
+  32   276   D        6  ( 882  / 1ØØØ)

1111111111+
-  16   26Ø  ND  -     1  ( 78Ø  / 1ØØØ)

ØØ1Ø-
+   8   268  ND        Ø  ( 835  / 1ØØØ)

1111Ø111111Ø1111111Ø111Ø1111111111Ø11Ø111ØØ1Ø-
+   8   276  ND        1  ( 882  / 1ØØØ)

11Ø11111ØØ-
+  16   292   D        2  ( 952  / 1ØØØ)

11Ø111111111111Ø1111111+
-   8   284  ND  -     1  ( 921  / 1ØØØ)

1Ø1111111111111Ø1111Ø111111111+
-   8   276  ND        Ø  ( 882  / 1ØØØ)

111111111Ø11111Ø111111111+
-   8   268  ND        1  ( 835  / 1ØØØ)

11Ø1111Ø11111111ØØ1111Ø-
+   4   272  ND        Ø  ( 859  / 1ØØØ)

Ø111111111+
-   2   27Ø  ND        Ø  ( 847  / 1ØØØ)

11Ø1111111Ø11Ø11111111111111Ø11111111+
-   2   268  ND        1  ( 835  / 1ØØØ)

Ø11Ø111111111111Ø1111ØØ1111Ø1111111111111111Ø11Ø11ØØ1Ø-
FINAL:  268
```

NOT TOO BAD -- THE SUCCESS PROPORTION AT CONVERGENCE IS 83.5%, COMPARED TO A TARGET OF 85%. TO GET MORE INFORMATION ABOUT THE DISTRIBUTION OF FINAL LEVELS AND THEIR CORRESPONDING SUCCESS PROPORTIONS, THE MOST EFFICIENT USE OF THIS SIMULATOR WOULD BE TO DELETE MOST OF THE TYPED OUTPUT, RETAINING ONLY THE TERMINAL LEVELS AND, POSSIBLY, INFORMATION ABOUT THE NUMBER OF TRIALS NEEDED TO ACHIEVE CONVERGENCE. BUT HERE ENDS OUR PART OF THE DEMONSTRATION.