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BWQUE - INTERACTIVE PROGRAM FOR COMPUTER PERFORMANCE EVALUATION

Ricardo F. Garzia
The Babcock & Wilcox Company
North Canton, Ohio 44720

BWQUE is an interactive queueing modeling package for computer performance evaluation; similar packages are available on the market, but BWQUE have special features, e.g., more general channel configuration, class priorities to any device, etc. The program is written in APL and carries some FORTRAN subroutines. This combination has been selected to make a more efficient program. It is completely interactive and also allows the automatic execution of commands stored in TSO files. It allows the user to enter descriptions of several job classes which are independent of how busy the system is and calculates the queueing delays to get response times and throughputs for each class. The user can quickly see which classes and devices are causing the delays, make changes to simulate upgrading the system, heavier job loads, etc., and find out how these changes will effect performance.

1. INTRODUCTION

At the present time, there is an increasing interest in the development and use of analytical models to predict the performance of computer systems. Within this framework, those based in queueing theory received the widest attention and interest (Dunlavey, 1978). These computer models are now being used for computer systems evaluation (Buzen, 1971, 1978) after hardware and/or multiprogramming level changes. In this respect, the model must be responsive to the hardware/software characteristics and the operating system under control (Garzia, 1980).

The interactive program for computer performance evaluation (BWQUE) try to respond to the previous needs. Among its outputs are throughputs and response or turnaround times for each class of transaction, and utilization of each device (by each class of transaction).

The model can also handle priority queueing at any device and channel configuration. The main limitation is the product across all classes of the multiprogramming level plus one (PAMM). The maximum value of this index is 50,000.

2. TYPE OF TRANSACTIONS

The computer workload is made up of transactions. These transactions can be of three different types:

- Batch transactions
- TSO transactions
- Data base transactions

A batch transaction is generated either from local or remote card reader station, and its queue by its job parameters. The Job Entry Subsystem component (JES) is responsible for job acceptance and for preparing and scheduling the execution of the transactions. This is accomplished by assigning a free initiator. The number of initiators available in each installation is fixed and takes in consideration the job class.

A TSO transaction is generated by a user from a terminal (typewriter, CRT/keyboard, etc.) and is received by TCAM which handles the telecommunications component of MVS.

The data base transactions represent the various system overhead activities as well as the subsystems which control graphics, CICS, IMS, etc.

3. MODEL INPUTS

Table I briefly shows the different ways in which each type of transaction can be described. Besides the previous description of each type of transaction, the average service time for transaction type for CPU and peripheral equipment must be supplied.

For a better description of the model inputs and how to obtain these values see the following references: (Garzia, 1980) and (Rose, 1978).

4. BWQUE PROGRAM

This program is written in APL and carries some FORTRAN Subroutines. This structure allows taking advantages of both languages in those features

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Table I
Model Input - general description per type

Type of transactions	Descriptions		
Batch	MPL_1 P_1 MPL_2 P_2 • • • MPL_n P_n	MPL_{max} MPL_{min}	AVG. MPL
TSO	MPL_{max} Number of terminals Thinking time (average)	Domain number MPL_{max} Objective function Number of terminals Thinking time	
Data Base	MPL_{max} Input rate	Domain number Objective function MPL_{max} Input rate	

that are more effective. This program needs to run in an installation that supports APL, FORTRAN and TSO. There is no need of an APL keyboard in order to run it. But if we want to take full advantage of the APL command, we need an APL keyboard.

After we access the program, this will prompt us as:

PROMPT:

The first command that we would like to input is HELP. The program will give us some definitions and will list all the on-line executive commands available as well as some comments on each one. The HELP listing follows with the MAP listing, both are indicated in the top of the next column.

5. ON-LINE EXECUTIVE COMMANDS

Fourteen on-line executive commands are available. These are:

1. ANALYZE
2. APL
3. CHANNELS - 2
4. EDIT - 9
5. EXECUTE
6. HELP
7. LIST - 11
8. MAP
9. PLOT - 5
10. QUIT
11. RUN
12. SAVE
13. SETUP
14. TSO COMMANDS

The number following some of the commands indicate the number of Subcommands under it. A brief explanation about each one of them follows:

The command ANALYZE (not available yet) will allow to analyze a range of changes of one of the transaction classes assuming that the others are frozen in the giving values.

The command APL allows to use some APL commands.

```
PROMPT : HELP
-------------------------------------------------------------------------------
:     EACH COLUMN INDICATES A DIFFERENT LEVEL OF COMMANDS, E.G. THOSE :
: IN THE SECOND COLUMN ARE SUBCOMMANDS OF THOSE TO THE LEFT OF THEM.  :
: AT ANY POINT IN THE COMMAND PROCESSOR, A QUESTION MARK (?), WILL    :
: LIST THE COMMANDS ON THE NEXT LEVEL, AND ?? WILL LIST ALL LOWER     :
: LEVELS.  ANY NUMBER OF INITIAL LETTERS WILL BE ACCEPTED AS AN       :
: ABBREVIATION FOR A COMMAND (OR SUBCOMMAND), E.G. 'L', 'LI', AND     :
: 'LIS' WILL ALL BE ACCEPTED AS 'LIST'.  IF AN ABBREVIATION IS        :
: AMBIGUOUS, YOU WILL BE TOLD SO AND GIVEN A CHANCE TO REENTER THE    :
: COMMAND.                                                            :
:     ITEMS IN DIAMOND BRACKETS <> REPRESENT USER SUPPLIED NAMES WITH :
: THE COMMA (,) SEPERATING OPTIONAL CHOICES, AND:                     :
:          D = A DEVICE NAME,                                         :
:          C = A CLASS NAME,                                          :
:          BC = A BATCH CLASS NAME,                                   :
:          DC = A DATA BASE CLASS NAME,                               :
:          TC = A TSO CLASS NAME,                                     :
:          A = 'ALL' MEANING ALL CURRENT CLASSES OR DEVICES, AND      :
:          'S INDICATES THAT SEVERAL NAMES MAY BE ENTERED.            :
: IF SEVERAL NAMES ARE PLACED AFTER 'PROMPT:', THEY MUST BE ENCLOSED   :
: IN PARENTHESES.                                                     :
:     IN 'EDIT DEVICES', 'ALL' MAY BE FOLLOWED BY NEW DEVICE NAMES,   :
: BUT THE 'ALL' MUST BE FIRST.                                        :
:     'MAP' WILL LIST THE COMMANDS BELOW WITHOUT THIS HEADER.         :
-------------------------------------------------------------------------------
:                        ON-LINE EXECUTIVE COMMANDS                   :
:-----------------------------------------------------------------------------:
: COMMANDS  SUBCMD'S      SUBSUBCMD'S      :          COMMENTS          :
:-----------------------------------------------------------------------------:
: ANALYZE                                  : NOT AVAILABLE              :
: APL                                      : ALLOWS SOME APL COMMANDS   :
: CHANNELS  ON                             : OR JUST CHANNELS           :
:           OFF                            : MODEL WITHOUT CHANNELS     :
: EDIT      BATCH         <BC'S>           : CAN ADD CLASSES            :
:           CHANNEL       DEVICES <D'S,A,DEV> 'DEV IS ALL DEVICES'     :
:                         LOGICAL          : EDIT LOGICAL CHANNELS      :
:                         PHYSICAL         : EDIT PHYSICAL CHANNELS     :
:           DB            <DC'S>           : CAN ADD CLASSES            :
:           DELETE        CLASS   <C'S>    :                            :
:                         DEVICE  <D'S>    :                            :
:           DEVICES       <D'S,A> <C'S,A>: CAN ADD DEVICES              :
:           ORDER         <NUMBERS>        : REORDERS CLASSES           :
:           PRIORITIES    <D'S,A,DEV>      : 'DEV IS ALL DEVICES'       :
:           RENAME        CLASS  <OLD C'S> <NEW>                        :
:                         DEVICE <OLD D'S> <NEW>                        :
:           TSO           <TC'S>           : CAN ADD CLASSES            :
: EXECUTE   <DATA FILE>                    : FILE IS LIST OF COMMANDS   :
: HELP      MAP                            : (OR JUST 'HELP')           :
: LIST      CHANNEL       PARAMETERS       :                            :
:                         UTILIZATION      :                            :
:           CLASS         PARAMETERS       :                            :
:                         RESULTS          :                            :
:           DEGRADATION                    :                            :
:           DEVICE        PARAMETERS       : (OR JUST 'LIST DEVICE')    :
:           DISTRIBUTION  <D> <C,A>        :                            :
:           MEMORY                         :                            :
:           PRIORITIES                     : PRIORITY PARAMETERS        :
:           QLENGTH                        : INCLUDES TRANS. SERVED     :
:           RESIDENCE     DISTRIBUTION <TC> <DIVISIONS> : RESPONSE TIME
:                         PERCENT          :                            :
:                         TIME             : RESPONSE TIME FOR TSO AND DB
:           UTILIZATION                    :                            :
:           WAITING       PERCENT          :                            :
:                         QUEUE            :                            :
:                         TIME             :                            :
: MAP                                      : DISPLAYS COMMANDS          :
: PLOT      DEVICE-QUEUE  <D> <C>          : PLOTS QLENGTH DISTRIBUTION :
:           IN-MEMORY     <TC,DC>          : NO. SWAPPED IN             :
:           MEMORY-QUEUE  <TC,DC>          : NO. SWAPPED OUT BUT READY  :
:           READY         <TC,DC>          : SUM OF OUT READY AND IN    :
:           RESPONSE      <TC><DIVISIONS>: RESPONSE TIME DISTRIBUTION :
: QUIT                                     : LOGOFF (ASKS FOR SAVE)     :
: RUN                                      : EXECUTES THE PRESENT MODEL :
: SAVE                                     : SAVES THE APL SPACE        :
: SETUP                                    : STARTS A NEW MODEL         :
: TSO-COMMANDS                             : ALLOWS SOME TSO COMMANDS   :
-------------------------------------------------------------------------------
```

The command CHANNELS will turn them on or off. The two Subcommands are ON and OFF.

The command EDIT allow to edit and modify all the information in the model. There are nine Subcommands under EDIT. Some of them with Subsubcommands. The nine Subcommands are:

a. CHANNEL (DEVICES, LOGICAL, PHYSICAL)
b. DELETE (CLASS, DEVICE)
c. DEVICES
d. ORDER
e. PRIORITIES
f. RENAME (CLASS, DEVICE)
g. BATCH
h. DB
i. TSO

The command EXECUTE, will execute a list of commands contained in a data file.

The command LIST provides the numerical information contained in the specification given by the Subcommand. There are eleven Subcommands under it. These are:

a. CHANNEL (PARAMETERS UTILIZATION)
b. CLASS (PARAMETERS, RESULTS)
c. DEGRADATION
d. DEVICE (PARAMETERS)
e. DISTRIBUTION
f. MEMORY
g. PRIORITIES
h. QLENGTH
i. RESIDENCE (DISTRIBUTION, PERCENT, TIME)
j. UTILIZATION
k. WAITING (PERCENT, QUEUE, TIME)

The command PLOT allows to display several type of plots. There are five Subcommands under it. These are:

a. DEVICE-QUEUE
b. IN-MEMORY
c. MEMORY-QUEUE
d. READY
e. RESPONSE

The command QUIT allows to terminate the run.

The command RUN executes the present model.

The command SETUP allows to input a computer model.

The command TSO-COMMANDS allows some TSO commands.

6. APPLICATION

Let us assume that we have three classes of transactions in our system with the following characteristics:

Type 1 - Batch - BP Avg. MPL 4.30
Type 2 - Data Base - DBP Maximum MPL 4.0 and a rate of 2600
Type 3 - TSO - TS Maximum MPL 6.0 and 17 sec. think time

The service times of these types of transaction in each device is indicated in Table II.

Table II - Average Service Time

Device	BP	DBP	TS
CPU	14000.0	180.0	420.0
TAPE 1	800.0	94.0	110.0
TAPE 2	1700.0	130.0	197.0
TAPE 3	100.0	0.0	0.0
TAPE 4	300.0	0.0	0.0
2314.1	250.0	0.0	0.0
2314.2	470.0	0.0	0.0
3350.1	5700.0	74.0	120.0
3350.2	12000.0	0.0	0.0
3350.3	11125.0	0.0	0.0
3350.4	3270.0	84.0	42.0
3350.5	3270.0	87.0	48.0
3350.6	3012.0	220.0	130.0
3350.7	3010.0	210.0	100.0
3330.1	870.0	45.0	0.0
3330.2	1600.0	33.0	0.0

The results of BWQUE follows:

```
PROMPT : RUN
PAMM = 210
SIMPLE MODEL: 0.271 CPU SECONDS.
OUTPUT PREPARATION: 0.292 CPU SECONDS.
TOTAL MODELING TIME: 0.563 CPU SECONDS.

PROMPT : LIST CL P
-------------------------------------------------------------------
:                TYPE                                             :
:                  1    AVG MPL                                   :
:CLASS             2    MAX MPL   INPUT RATE                      :
:NAMES             3    MAX MPL   THINK TIME   NO. OF TERM.       :
:-----------------------------------------------------------------:
:BP                1      4.30          0             0          :
:DBP               2      4.00       2600             0          :
:TS                3      6.00         12            35          :
-------------------------------------------------------------------

PROMPT : L DEV
-----------------------------------------------
:DEVICE        :     BP     DBP      TS      :
:--------------:-----------------------------:
:CPU           :  14000.0   180.0   420.0    :
:TAPE1         :    800.0    94.0   110.0    :
:TAPE2         :   1700.0   130.0   197.0    :
:TAPE3         :    100.0     .0      .0     :
:TAPE4         :    300.0     .0      .0     :
:2314.1        :    250.0     .0      .0     :
:2314.2        :    470.0     .0      .0     :
:3350.1        :   5700.0    74.0   120.0    :
:3350.2        :  12000.0     .0      .0     :
:3350.3        :  11125.0     .0      .0     :
:3350.4        :   3270.0    84.0    42.0    :
:3350.5        :   3270.0    87.0    48.0    :
:3350.6        :   3012.0   220.0   130.0    :
:3350.7        :   3010.0   210.0   100.0    :
:3330.1        :    870.0    45.0      .0    :
:3330.2        :   1600.0    33.0      .0    :
:3330.3        :   1600.0    30.0      .0    :
:3330.4        :    920.0    30.0   120.0    :
-----------------------------------------------

PROMPT : L MEM
-----------------------------------------------
:MEMORY REPORT                                :
:                          DBP       TS       :
:-------------------------:-------------------:
:MAXIMUM MPL               4.000     6.000    :
:AVERAGE MPL               2.155     5.999    :
:AVERAGE MEM. QUEUE         .310    13.544    :
:AVERAGE NO. READY         2.465    19.542    :
:PROB. OF OVERC. MEM.       .132     .898     :
:MEMORY UTILIZATION         .539    1.000     :
:-------------------------:-------------------:
:P( 0 IN MEMORY)           .123      .000     :
:P( 1 IN MEMORY)           .235      .000     :
:P( 2 IN MEMORY)           .239      .000     :
:P( 3 IN MEMORY)           .173      .000     :
:P( 4 IN MEMORY)           .231      .000     :
:P( 5 IN MEMORY)           .000      .000     :
:P( 6 IN MEMORY)           .000      .998     :
:-------------------------:-------------------:
:P( 0 IN MEM. QUEUE)       .868      .001     :
:P( 1 IN MEM. QUEUE)       .057      .001     :
:P( 2 IN MEM. QUEUE)       .032      .002     :
:P( 3 IN MEM. QUEUE)       .019      .004     :
:P( 4 IN MEM. QUEUE)       .011      .007     :
:P( 5 IN MEM. QUEUE)       .006      .011     :
:P( 6 IN MEM. QUEUE)       .003      .017     :
:P( 7 IN MEM. QUEUE)       .002      .025     :
:P( 8 IN MEM. QUEUE)       .001      .036     :
:P( 9 IN MEM. QUEUE)       .001      .048     :
:P(10 IN MEM. QUEUE)       .000      .062     :
:P(11 IN MEM. QUEUE)       .000      .076     :
:P(12 IN MEM. QUEUE)       .000      .088     :
:P(13 IN MEM. QUEUE)       .000      .097     :
:P(14 IN MEM. QUEUE)       .000      .101     :
:P(15 IN MEM. QUEUE)       .000      .098     :
:P(16 IN MEM. QUEUE)       .000      .089     :
:P(17 IN MEM. QUEUE)       .000      .075     :
:P(18 IN MEM. QUEUE)       .000      .059     :
:P(19 IN MEM. QUEUE)       .000      .042     :
:P(20 IN MEM. QUEUE)       .000      .028     :
:P(21 IN MEM. QUEUE)       .000      .016     :
:P(22 IN MEM. QUEUE)       .000      .009     :
:P(23 IN MEM. QUEUE)       .000      .004     :
:P(24 IN MEM. QUEUE)       .000      .002     :
:P(25 IN MEM. QUEUE)       .000      .001     :
:P(26 IN MEM. QUEUE)       .000      .000     :
-----------------------------------------------

PROMPT : L UTIL
-------------------------------------------------------
:UTILIZATION                                           :
:DEVICE        :    BP     DBP      TS     TOTAL      :
:--------------:-------------------------------------:
:CPU           :   33.1    12.6    54.1    99.7      :
:TAPE1         :    1.9     6.5    14.2    22.6      :
:TAPE2         :    4.0     9.0    25.4    38.4      :
:TAPE3         :     .2      .0      .0      .2      :
:TAPE4         :     .7      .0      .0      .7      :
:2314.1        :     .6      .0      .0      .6      :
:2314.2        :    1.1      .0      .0     1.1      :
:3350.1        :   13.5     5.1    15.5    84.1      :
:3350.2        :   28.4      .0      .0    28.4      :
:3350.3        :   26.3      .0      .0    26.3      :
:3350.4        :    7.7     5.8     8.0    21.6      :
:3350.5        :    7.7     6.0     6.2    20.0      :
```

:3350.6	:	7.1	15.3	16.7	39.1 :
:3350.7	:	7.1	14.6	12.8	34.6 :
:3330.1	:	2.1	3.1	.0	5.2 :
:3330.2	:	3.8	2.3	.0	6.1 :
:3330.3	:	3.8	2.1	.0	5.8 :
:3330.4	:	2.2	2.1	15.5	19.7 :

PROMPT : L QL

:AVERAGE QUEUE LENGTH :DEVICE		BP	DBP	TS	TOTAL
:CPU	:	2.732	1.131	4.343	8.207 :
:TAPE1	:	.026	.084	.181	.290 :
:TAPE2	:	.067	.145	.401	.612 :
:TAPE3	:	.002	.000	.000	.002 :
:TAPE4	:	.007	.000	.000	.007 :
:2314.1	:	.006	.000	.000	.006 :
:2314.2	:	.011	.000	.000	.011 :
:3350.1	:	.202	.078	.235	.514 :
:3350.2	:	.366	.000	.000	.366 :
:3350.3	:	.333	.000	.000	.333 :
:3350.4	:	.098	.074	.102	.274 :
:3350.5	:	.096	.076	.078	.248 :
:3350.6	:	.117	.245	.273	.635 :
:3350.7	:	.109	.218	.196	.523 :
:3330.1	:	.022	.033	.000	.054 :
:3330.2	:	.040	.024	.000	.064 :
:3330.3	:	.040	.022	.000	.062 :
:3330.4	:	.027	.026	.190	.244 :
:IN SYSTEM	:	4.300	2.155	5.999	12.454 :
:MEMORY QUEUE	:	.000	.310	13.544	13.853 :
:TOTAL	:	4.300	2.465	19.542	26.307 :

PROMPT : L QI CPU

:QUEUE LENGTH DISTRIBUTION AT CPU :	ALL	BP	DBP	TS
:P(0 AT SERVER) :	.003	.037	.343	.008 :
:P(1 AT SERVER) :	.006	.121	.332	.025 :
:P(2 AT SERVER) :	.012	.244	.203	.066 :
:P(3 AT SERVER) :	.022	.317	.094	.142 :
:P(4 AT SERVER) :	.038	.232	.027	.244 :
:P(5 AT SERVER) :	.063	.049	.000	.304 :
:P(6 AT SERVER) :	.095	.000	.000	.210 :
:P(7 AT SERVER) :	.129	.000	.000	.000 :
:P(8 AT SERVER) :	.155	.000	.000	.000 :
:P(9 AT SERVER) :	.160	.000	.000	.000 :
:P(10 AT SERVER) :	.137	.000	.000	.000 :
:P(11 AT SERVER) :	.096	.000	.000	.000 :
:P(12 AT SERVER) :	.054	.000	.000	.000 :
:P(13 AT SERVER) :	.024	.000	.000	.000 :
:P(14 AT SERVER) :	.007	.000	.000	.000 :
:P(15 AT SERVER) :	.001	.000	.000	.000 :

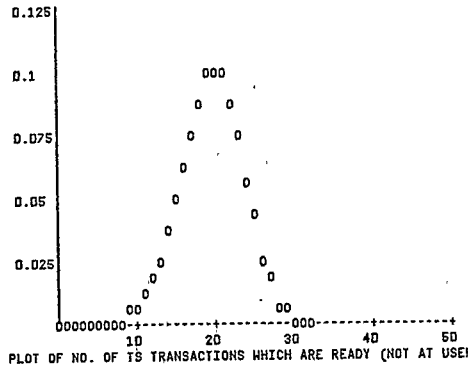
PROMPT : L QI 3350.6

:QUEUE LENGTH DISTRIBUTION AT 3350.6 :	ALL	BP	DBP	TS
:P(0 AT SERVER) :	.809	.893	.799	.783 :
:P(1 AT SERVER) :	.240	.057	.164	.172 :
:P(2 AT SERVER) :	.094	.009	.032	.036 :
:P(3 AT SERVER) :	.036	.001	.005	.007 :
:P(4 AT SERVER) :	.014	.000	.001	.001 :
:P(5 AT SERVER) :	.005	.000	.000	.000 :
:P(6 AT SERVER) :	.002	.000	.000	.000 :
:P(7 AT SERVER) :	.001	.000	.000	.000 :
:P(8 AT SERVER) :	.000	.000	.000	.000 :
:P(9 AT SERVER) :	.000	.000	.000	.000 :
:P(10 AT SERVER) :	.000	.000	.000	.000 :
:P(11 AT SERVER) :	.000	.000	.000	.000 :
:P(12 AT SERVER) :	.000	.000	.000	.000 :
:P(13 AT SERVER) :	.000	.000	.000	.000 :
:P(14 AT SERVER) :	.000	.000	.000	.000 :
:P(15 AT SERVER) :	.000	.000	.000	.000 :

PROMPT : L RES P

:RESIDENCE PERCENT :DEVICE		BP	DBP	TS
:CPU	:	63.5	45.9	22.2 :
:TAPE1	:	.6	3.4	.9 :
:TAPE2	:	1.5	5.8	2.1 :
:TAPE3	:	.1	.0	.0 :
:TAPE4	:	.2	.0	.0 :
:2314.1	:	.1	.0	.0 :
:2314.2	:	.3	.0	.0 :
:3350.1	:	4.7	3.2	1.2 :
:3350.2	:	8.5	.0	.0 :
:3350.3	:	7.7	.0	.0 :
:3350.4	:	2.3	3.0	.5 :
:3350.5	:	2.2	3.0	.4 :
:3350.6	:	2.7	8.9	1.4 :
:3350.7	:	2.5	8.8	1.0 :
:3330.1	:	.5	1.3	.0 :
:3330.2	:	.9	1.0	.0 :
:3330.3	:	.9	.8	.0 :
:3330.4	:	.6	1.1	1.0 :
:IN SYSTEM	:	100.0	87.4	30.7 :
:MEMORY QUEUE	:	.0	12.6	69.3 :
:TOTAL	:	100.0	100.0	100.0 :

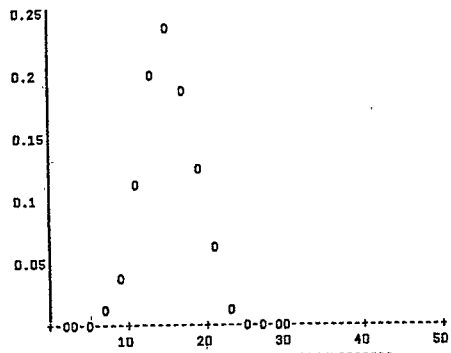
PROMPT : PLOT READY TS
PLEASE CLEAR SCREEN AND PRESS 'ENTER'.



PLOT OF NO. OF TS TRANSACTIONS WHICH ARE READY (NOT AT USER).

:	DBP	TS
:P(0 READY) :	.123	.000 :
:P(1 READY) :	.235	.000 :
:P(2 READY) :	.239	.000 :
:P(3 READY) :	.173	.000 :
:P(4 READY) :	.099	.000 :
:P(5 READY) :	.057	.000 :
:P(6 READY) :	.032	.001 :
:P(7 READY) :	.019	.001 :
:P(8 READY) :	.011	.002 :
:P(9 READY) :	.006	.004 :
:P(10 READY) :	.003	.007 :
:P(11 READY) :	.002	.011 :
:P(12 READY) :	.001	.017 :
:P(13 READY) :	.001	.025 :
:P(14 READY) :	.000	.036 :
:P(15 READY) :	.000	.048 :
:P(16 READY) :	.000	.062 :
:P(17 READY) :	.000	.076 :
:P(18 READY) :	.000	.088 :
:P(19 READY) :	.000	.097 :
:P(20 READY) :	.000	.101 :
:P(21 READY) :	.000	.098 :
:P(22 READY) :	.000	.089 :
:P(23 READY) :	.000	.075 :
:P(24 READY) :	.000	.059 :
:P(25 READY) :	.000	.042 :
:P(26 READY) :	.000	.028 :
:P(27 READY) :	.000	.016 :
:P(28 READY) :	.000	.009 :
:P(29 READY) :	.000	.004 :
:P(30 READY) :	.000	.002 :
:P(31 READY) :	.000	.001 :
:P(32 READY) :	.000	.000 :

PROMPT : PLOT RES TS CPU
RESPONSE TIME DISTRIBUTION FOR TS
MIN = 1.91, MAX = 30.7, AVE = 15.17
ENTER DIVISIONS:
PLEASE CLEAR SCREEN AND PRESS 'ENTER'.



: P(	1.91	< RESPONSE TIME <	2) =	.0000009 :
: P(	2	< RESPONSE TIME <	4) =	.0004075 :
: P(	4	< RESPONSE TIME <	6) =	.0034416 :
: P(	6	< RESPONSE TIME <	8) =	.0161058 :
: P(	8	< RESPONSE TIME <	10) =	.0401852 :
: P(	10	< RESPONSE TIME <	12) =	.1113838 :
: P(	12	< RESPONSE TIME <	14) =	.1951555 :
: P(	14	< RESPONSE TIME <	16) =	.2377711 :
: P(	16	< RESPONSE TIME <	18) =	.1825048 :
: P(	18	< RESPONSE TIME <	20) =	.1241887 :
: P(	20	< RESPONSE TIME <	22) =	.0675653 :
: P(	22	< RESPONSE TIME <	24) =	.0170242 :
: P(	24	< RESPONSE TIME <	26) =	.0036516 :
: P(	26	< RESPONSE TIME <	28) =	.0005683 :
: P(	28	< RESPONSE TIME <	30) =	.0000455 :
: P(	30	< RESPONSE TIME <	30.7) =	.0000001 :

PROMPT : QUIT
JUST HIT THE 'ENTER'/'RETURN' KEY IF YOU DO NOT WANT TO SAVE THIS SPACE.
FOR A LIST OF SPACES YOU HAVE ALREADY SAVED, ENTER '?'.
TO SAVE THIS SPACE, ENTER A NAME (8 CHARACTER MAXIMUM).

1 RUNS.

7. GENERAL COMMENTS

Some comments become appropriate at this time.

1. The on-line executive commands definition can be abbreviated. For example, LIST can be designated only with L, UTILIZATION with UTIL, etc.

2. The total model CPU time is very low. In this case is 0.563 seconds. Of course, the value of PAMM = 210 is very low. For values close to 50,000 this value will be higher. But nevertheless, it is a very fast program. RUN is the first command that needs to be run after the model is available.

3. The plotting capabilities is a very strong feature of BWQUE because a graph is more easy to understand than a series of numbers.

4. More complete analysis of a computer system can be obtained using BWQUE to calculate the impact of number of active initiators in a MVS environment (Garzia, 1982). Specifying the workload and the computer system, BWQUE allows the calculations indicated in Table III.

TABLE III - RESIDENCE TIME

Transactions

Batch			TSO			Data Base		
Aver. MPL	Resid. Time	Through-put	Aver. MPL	Resid. Time	Through-put	Aver. MPL	Resid. Time	Through-put
3.0	160.77	67.17	6.0	12.22	5202	2.0	3.21	2500
4.0	176.62	81.53	6.0	14.51	4753	2.12	3.47	2500
5.0	192.44	93.54	6.0	16.85	4367	2.24	3.75	2500
6.0	208.23	103.73	6.0	19.23	4034	2.36	4.07	2500
7.0	223.99	112.51	6.0	21.63	3746	2.47	4.42	2500
8.0	239.72	120.14	6.0	24.07	3493	2.59	4.82	2500
12.0	302.52	142.80	6.0	33.99	2739	3.07	7.30	2500
15.0	349.58	154.47	6.0	41.60	2351	3.43	11.68	2500

In this case, the average multiprogramming level and the number of initiators coincide. From the values shown in Table III, we can deduce that increasing the number of initiators:

1. Increased the residence time in batch at the same time increases the batch throughput.

2. Increases the response time on TSO and at the same time decreases the TSO throughput.

3. Increases the residence time for data base transactions while maintaining a constant throughput.

This type of behavior is what we would expect by observing the way in which the different types of transactions are processed in the system.

8. CONCLUSIONS

The brief description presented in this paper on BWQUE-Interactive Program for Computer Performance Evaluation lead to the conclusion that it is a very powerful tool for computer performance evaluation. The lead features are:

1. Small CPU time required to run models with PAMM close to 50,000.

2. On-line Executive Commands for post running display.

3. Priority Queueing at any device.

4. Physical and Logic channel configuration.

5. Plotting capabilities.

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