

**THE MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
ODESSA STATE ENVIRONMENTAL UNIVERSITY**

**Methodical instructions
for self-sufficient work of students
and laboratory work on discipline**

**Mathematical Methods of Operations Research
for the 3rd year students of the extramural studies and distance learning**

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Methodical instructions for self-sufficient work of students in the discipline «Mathematical Methods of Operations Research» for the 3rd year students of the extramural studies and distance learning

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PREFACE

Operational research includes a wide range of methods to solve problems and methods used in the quest to improve decision-making and efficiency, such as modeling, mathematical optimization, queuing theory and other models of the stochastic process, decision-Markov econometric methods, data envelopment analysis, neural networks, expert systems, decision analysis, and analytic hierarchy process. Almost all of these techniques include the construction of mathematical models that attempt to describe the system. A cash-statistical nature of most of these fields, operational research also has strong ties with informatics and analytics. Operational researchers are faced with a new problem must determine which of these methods are most appropriate, given the nature of the system, goals for improvement, and constraints on time and computing power. Employing techniques from other mathematical sciences, such as mathematical modeling, statistical analysis, and mathematical optimization, operations research arrives at optimal or near-optimal solutions to complex decision-making problems. Because of its emphasis on human-technology interaction and because of its focus on practical applications, operations research has overlap with other disciplines, notably industrial engineering and operations management, and draws on psychology and organization science. Operations research is often concerned with determining the maximum or minimum of some real-world objective.

Important, sprockets beside theme meant that at the end of the lesson tasks options divided into options for the first theme and options for the second theme.

Key concepts

- The game, the player strategy.
- Zero-sum game.
- Matrix game.
- Antagonistic games.
- The principles and the max/min.
- The saddle point of the game.
- The price of the game.
- Mixed strategy.
- The fundamental theorem of matrix games.
- The dynamic transportation problem.
- The simplest dynamic model.
- The simplest optimal control problem.
- Digital Pontryagin maximum principle.

CONTENT

Theoretical:

[see. 1-5 of basic literature, 2-4 of additional literature]

The mathematical formulation of optimization problems. Classification models and methods for solving problems of mathematical programming. Post optimal analysis of the solutions of the problems of programming. Canonical forms and standard linear programming problem. The dual linear programming problem. The dual method. The problem of parametric programming methods for solving problems of parametric programming and analysis of the solutions.

Tasks and integer linear programming model. Cut off method of solving problems of integer programming. Challenges and models of discrete programming. Branch and bound method of solving problems of discrete programming.

Practical:

[see. 6 of basic literature, 1 of additional literature]

Make a general description of the technology and master of the package of simulation GPSS World. Work with graphic windows. Explore dynamic simulation window. Explore GPSS expressions. Create a queue and Q-table. Forming process of redefining the matrix by means of GPSS. Simulate logic cells, human resources process. Read and write information to external files. Record a selected line of the file by using random access. Master library procedures and analysis of variance. To capture technology continued modeling in GPSS.

As a result of the discipline the student should:

know the material in volume applications;
be able:

- build mathematical models of problem situations;
- build models and solve linear programming;
- build models to solve problems and parametric programming;
- build models and do not solve problems of linear programming;
- build a model and solve problems of discrete programming;
- build models and dynamic programming to solve problems;
- build models and stochastic programming problems to solve;
- build a model of multi-objective optimization.

After studying the discipline "Mathematical Methods of Operations Research" students take the test. Also provided intersession control work, which consists of answering theoretical questions and the implementation of practical work. Options for control of the (theoretical part (T), the practical part (P)) student defines for the last digit of the item record book: number 1, 6 – T1, P1,6; number 2, 7 – T2, P2,7; number 3, 8 – T3, P3,8; number 4, 9 – T4, P4,9; number 5, 0 – T5, P5,10

Organization of SWS:

Should be familiar with the literature, which is disclosed in teaching of, and to perform criteria consisting of:

- Implementation of theoretical problems;
- Practical tasks;
- Filing intersession control work.

A student is considered to be admitted to the final control, if it met all kinds of work current control (intersessional and sessional) and scored on a cumulative points system worth at least 50% of the maximum possible for discipline and timely performed intersessional quiz.

A student who does not start test-exams debt discipline, culminating offset writes a valid test. The student receives a quality assessment ("Accepted" or "not passed") based on the accumulated final grade.

The student who received the results of scoring overall quantitative estimate of less than 60% is rated "not enrolled" and is written tests (commission) for a test, developed at the Department of Higher and Applied Mathematics.

Current control is carried out in the following forms:

- check control work;
- examination of the student during the laboratory work.

Final control is based on integrated total points obtained by the student on the basis of the current control and final semester control (test).

Cumulative final grade (PO) mastering the discipline has:

- a reference work (OM - assessment of intersession, a maximum of 20 points)
- the protection of laboratory work (OZE - assessment of the assembly, a maximum of 30 points)
- assessment of final control measure (ZKR - Around maximum 50 points)

Final score mastering discipline is calculated as follows:

$$PO=0,75\times[0,5\times(OZE+OM)]+0,25\times OZKR$$

Basic literature

1. Konyukhovskii P.V., "Mathematical methods of operations research in the economy." -St. Petersburg, Peter. 2000. - 208C.
2. Glushkov O.V., Khetselius O.Yu., Ambrosov S.V., Swinarenko A.A., Ignatenko G.V., "Probability theory and mathematical statistics." -Odessa: Ecology. 2011.
3. Glushkov O.V., Serbov M.G., Khetselius O.Yu., Dubrovskaya Yu.V., Florko T.O., "Applied mathematics." -Odessa: Ecology. 2007.
4. Glushkov O.V., Kruglyak Yu.O., Chernyakova Yu. G., "Lecture notes linear algebra." -Odessa, TES, 2004.- 117C
5. Glushkov O.V., Ambrosov S.V., Vitavetska L.A., Loboda A.V., "Lecture notes mathematical programming." -Odessa, TES. 2003- 95C.
6. Velikodniy S.S., "Mathematical Methods of Operations Research." - Odessa: E-print. 2015.

Additional literature

1. GPSS World reference manual. Fourth Edition 2001. Copyright Minuteman Software. Holly Springs, NC, U.S.A. 2001.
2. Lapin L. Quantitative methods for business decisions with cases. Fourth edition. HBJ, 1988.
3. Little I.D.C., Murty K.G., Sweeney D.W., Karel C. An algorithm for traveling for the traveling salesman problem. — Operation Research, 1963, vol.11, No. 6, p. 972-989
4. Taha H. Introduction to Operations Research / Ed. from English. Moscow, 1985.

THEORETICAL (Questions for the inspection work)

Variant 1

1. What is used in the statement START operand NP?
2. Using commands you can stop and continue the process under simulation system GPSSWorld?
3. Which statement is to highlight the block model during the modeling process stops. Describe the process principle stop the simulation system.
4. With the use of which team becomes possible to create a tracing process?
5. What information is displayed to the user after using tracing operation?

Variant 2

1. How can I remove all stop conditions that were imposed on the model?
2. Using a team that can create a report of all the modeling process?
3. What additional purpose dialog SHOW.
4. Enumerate full hierarchy of arithmetic and logical operations in GPSS.
5. Which view you can see the result of transactions that are recorded in the dialog SHOW?

Variant 3

1. Specify in what format the user gets value calculation logic operations?
2. With which team can make the transition to a string containing the error code program?
3. Give usually use logical operations?
4. In the dialog box which displays the device model.
5. Describe step by step process of creating a random number generator.

Variant 4

1. What are function keys whose values can change as necessary.
2. Move the purpose of application and blocks QUEUE DEPART.
3. What are the most important attributes of a queue.
4. Enter the advantage of using queuing models.
5. Name two types of execution queues.

Variant 5

1. What command is used to display a histogram? Specify and describe its parameters.
2. Use the function key which can stop the simulation?
3. Which team is responsible for restarting process modeling?
4. Name the viewport histograms.
5. Give the team recording format used for assignment matrix in the language GPSS.

PRACTICAL Task 1

Working with graphical

From the beginning you must choose from a folder examples Sample1.gps. Then perform a broadcast model Command/Create Simulation. In the journal, which will appear after launch the model will display information about successful broadcast model. Need to configure the graphics window. For the correct design of graphical information necessary to connect the value, which is dependent on what physical state we are interested in is your ID. To prepare operational data modeling should call the configuration dialog schedule. You need to use the command Window/Plot Window. In the window that appears, type the current information for modeling.

Plot (1) – needed to build the current expression.

Memorize – used to save the given expression for subsequent removal and restoration process modeling.

Plot (2) – needed to build the new saved expression.

Field Expression – syntax information processed.

When you click OK axis is the construction schedule:

Launch of graphic data. After the command Start, an interactive window will appear in which you must change the default number on your variant. Open schedule. After starting the model in the graphics window displayed current relationship. After the simulation of in the journal will appear – Simulation nod added. After this message appears on your report: Report is complete. After the modeling process should examine the results. For this designed dialog Show.

In the interactive window, type a value C1.

This command displays a log window and status bar relative time range.

In the interactive window Show, write: SHOW Qm\$BARBER

Command shows the maximum length of the queue for the device service Barber, which will also be entered into the log and status bar.

Variants values for the command Start:

1. 10	5. 50	9. 90
2. 20	6. 60	10. 100
3. 30	7. 70	11. 125
4. 40	8. 80	12. 150

Task 2

****Research dynamic modeling windows***

The working model will be created in the previous laboratory work model – Sample1.gps. Need to open and broadcast model. Open the Expression Window (Window/Simulation Window/Expression Window). In the window that appears, in the box Label must add value Time and field Expression - AC1. Then you need to browse and memorizing the set values through View and Memorize (view the actual on the first run model). Then click OK.

In case of need, re-editing expressions made the active window Expression Window by menu item Edit. Need to edit an expression for the research of new active Transact. In Expression Window box must be written: Label - active Transact; Expression - XS1. Then click OK.

To the research instrument windows Facilities Window. Do restart process simulation with the task in the statement Start operand in the following format: START 10000, NP. You can watch the changes necessary statistics without stopping to report the withdrawal process modeling. Stop the process (using the command Halt), collapse the window Expression Window and Facilities Window. Open the Block Window (study of the conditions and delays stop). To continue the simulation using the command F2. Make sure a dynamic graphical simulation. Stop and mark the required operational unit. To select the backlight unit and it is necessary to press Place. After that, the simulation will stop every time when Transact any attempt to enter the selected block (everything necessary to track in the journal modeling).

Back to trace. Menu Command/Custom. In the dialog box that appears, enter the command TRACE. As a result, the active window will be displayed with information indexing trace. So, performed manual mode simulation (debugging), which is a mandatory part of complex models.

For further normal operation of the model to remove all stop following conditions: Window / Simulation Snapshot / User Stops / Remove All. Then perform a restart model (F2). Once the simulation is stopped or came to an end must withdraw a report using command Command/Custom/Report.

*****Expression research***

An additional purpose SHOW command are using this dialog as a sophisticated calculator.

Show dialog box, you can compose complex expressions using specialized functions GPSS. The result of the calculated expression will be given in the Journal format double-precision (float).

Test calculation result of simple arithmetic. For this create model and open window Show, select Command/SHOW and enter value of your variant.

In the Journal window appeared answer format float. Simulation on Stop error. For this dialog Show deliberately enter an expression that expresses the result of errors: SHOW 3/0. After running this command in the log window will appear a statement of an error condition.

You must create a model that consists of only two lines and contains obvious errors. Manually enter in the code window of the program model two lines of error, such as:

HENERATE 10

TERMINATE 1

Then run the model created Command/Create Simulation. Perform editing error that was detected. For do this, click Search/Go To Line. Then you must change H to G and retransmit model Command/Retranslate, and check the log.

Run the following operations:

- 1) Open the sample file Sample1.gps
- 2) Run the simulation.
- 3) Open the device.

In the box, there are no devices to appeal to him first using the command START, enter value of your variant. Click OK. Then in the devices appear certain blocks.

Calculate complex expression, such as: $\log(\text{model time}) + (\text{maximum length of the queue})$. For this in window settings expression on field *Label* should write: complex expression, *Expression* – $\text{LOG}(C1) + (Q\$BARBER)^2$

After filling the fields you must click View. Further, in view of devices will appear important. When using logical operators be sure to put quotes and avoid gaps between the operator and operands.

Run simulation logical expressions. To do this, Expression Window box in the Label field must be written: *Label* – less than 6 pending, *Expression* – $1 + 99 \#((Q\$BARBER)'GE'6)$

This expression will give as a result one in case the queue is less than 6 customers, or in any other case 100. Run simulation stream of random numbers. To do this, choose Command/SHOW and Show dialog box make the following values: SHOW RN1000. RN is returns a random number between 0 and 999 in the status bar and log modeling.

Run the previous query again, and in the Journal with overwhelming probability will receive a different result.

Then perform a functional configuration of the random number. For do this, click Edit/Settings must go to the bookmark Function Keys and along with record label F9 set SHOW RN1000.

Go to Journal and about 5 times fulfill pressing F9. Thus, we can ensure that in several successive queries is issuing a stream of random numbers results.

On the Function Keys is the ability to consolidate any function key (except F1) separate command that will contain logical expression.

Variants values for the command Start:*

1 – 1000	5 – 5000	9 – 9000
2 – 2000	6 – 6000	10 – 10000
3 – 3000	7 – 7000	11 – 11000
4 – 4000	8 – 8000	12 – 12000

Variants values for the command Start:**

1. 67000	5. 42925	9. 30260
2. 84667	6. 62376	10. 72740
3. 52544	7. 47480	11. 22922
4. 30305	8. 95017	12. 28945

Variants values for the command Show:**

1. $5000-2000/20\#(120-110)^2$	7. $100@20\#90/3+543$
2. $2000\#2/2+(50\#10)-100$	8. $120+10^2/15\#50+150$
3. $1500+100-(60\#20)-200\#20/22$	9. $8000@40/20\#3+1200$
4. $500+1005-320/20\#5+1000$	10. $9000\backslash 10/11\#90+3578-125$
5. $(870-120)\#120\backslash 5$	11. $800\#9/2+8520-1120$
6. $1250\backslash 12\#50+867/2$	12. $1000\#4@20+980\#2$

Task 3

**Queues and Q-table*

Blocks QUEVE and DEPART required for static data collection. Especially important static information about the structure of the queue. First, blocks QUEVE and DEPART not delay the promotion transact, but only designed for dynamic tagging of entry and exit transact. Turn the device creates a necessary service and needs no description explicitly. One of the important attributes of the queue parameter is called content queue. In addition, no less important parameter - the length of the queue.

When transact is a unit QUEVE content turn increases the magnitude transact when transact is a block DEPART - meaning reduced. The advantage of using queues is that GPSS generates statistics and numerical characteristics queue statistics published in this standard report

Graphically turn can be framed in a Q-table and in a chart. Also available QUEVES dialog to dynamically view the current state of the simulation.

Open File Sampque.gps. In this model blocks QUEVE and DEPART concludes between a block seize. For transact that can immediately take care unit waiting time will be registered, in addition, the average length and average time will be displayed in the standard report.

Statistics stage during simulation. Run creation process modeling.

Open the queue. For this Window/Simulation Window/Queues Window. In this state in the box to appoint a single stage, but in the case where the model will appear be one transact provides information about queues and their parameters. To do this, choose Command/START and enter the value (your variant). For example, value - 10000.

Stop the simulation by using the F4 and begin to create a histogram service. Histograms graphically display dynamic data that change. When you create histograms used to display the statistics based on the units QUEVE and DEPART. For a histogram must go model editor and add the last line in this format:

Waittime QTABLE Barber,2,3,20; Histogram.

where BARBER - a device based on statistics which are based histogram; 2 - initial value histogram; 3 - increment to operand B; 20 - number incremental to operand B.

Block QTABLE makes image formation Q-table, the construction of which may occur during the simulation. Run retransmission model Summand/Retranslate. Restart simulation and instead START 1 on the six-digit number (your variant), click OK, and immediately the same F4. Open the view diagrams. For use this command, select Simulation Window/Table Window in the box and select the desired mark WAIT TIME.

At the histogram represented on the vertical axis transact deposited on the horizontal column depicted in a number of them for each time interval mode.

To observe the dynamics of constructing histograms must press F2, then the column histogram come in a statistical movement. Open the window units Window / Simulation Window / Block Window. In this window will be vertical movement transact. Open the Device Facilities Window and to analyze the workload of both units of service.

*****Formation process of redefining the matrix means GPSS.***

In GPSS matrix supported formation dimension to 6.

Open File Sample9.gps. To set the matrix in GPSS use the following command format:

```
<name> MATRIX ,B,C,D,E,F,G
```

After block MATRIX operand A is skipped. The operands from B to G determine the dimension of the matrix. In GPSS there is no concept of row or column. For each dimension matrices is used index dimension, which is set in the appropriate window configuration. For example, to specify the matrix dimension of 5*10 should be written:

```
<name> MATRIX ,5,10
```

To access the dimension of the matrix, use the command MSAVEVALUE. However, this treatment only applies to the first two dimensions. The rest of the dimensions should seek the help of a specially formed PLUS - procedures. Matrix is never removed from the scope of GPSS, but you can override the block re-using MATRIX. At the time of its creation all the matrix elements assigned zero values. However, in case you need to change the type of data element must use the command INITIAL, after which all elements assigned unspecified type USP. After changing the type of element can form a matrix that interests us. To access the elements of the matrix using standard numerical attribute MX:

```
MX MATRIX (1,2) then the name of the matrix code dimension.  
SHOW MX$MATR1 (1,2)
```

Run the model creation process. To view the matrix there is some dialog that displays any two selected dimension matrix. Open the matrix Window/Simulation Window/Matrix Window.

As the first file Sample9 given only one matrix, its name will be immediately entered into the field. After the setting will be marking matrix To change the display planes should be in the configuration matrix binding to reorient dimension. Run the simulation by using the START value of 100. Go to the window display matrix Matrix Window, which appear calculated value.

MATRIX1 MATRIX
 MSAVEVALUE MATRIX1,2,2,QA\$PROCESS
 A B C D

Command MSAVEVALUE recorded in the following format:

A operand – the name of the matrix;

B operand – conventional line;

C operand – conditional column;

D operand – value for the newly formed cell.

You must select the optimal placement of elements in the matrix using INDEX field in the settings window.

Apply to manual modeling followed by overrides 25 matrix elements (your variant). To do this, click Command/Custom and all subsequent tasks perform the following:

MSAVEVALUE MATRIX1,1,1,1000

After the command Custom is necessary in the journal modeling sure to assign values, and then open the matrix and check the corresponding item. Thus, the form and fill in the data set, which consists of 25 elements. Define a matrix of higher dimension (for options). To do this in the Custom command must be set in the following format:

MATRIX2 MATRIX 2,3,4,2,5,7

Be sure to create an array, and then must go to the configuration dialog matrix, in which the upper field need to choose a new name matrix. Since six bit matrix, active all fields in window Cross Section. To change the visible section of the matrix, you must decide which of the dimensions will act as a line, and that as columns. For other measurements must select index for optimal task corresponding measurement.

Variants values for the command Start:*

1. 15000	5. 35000	9. 55000
2. 20000	6. 40000	10. 60000
3. 25000	7. 45000	11. 65000
4. 30000	8. 50000	12. 70000

Variants values for the command Start:*

1. 100000	7. 700000
2. 200000	8. 800000
3. 300000	9. 900000
4. 400000	10. 800000
5. 500000	11. 700000
6. 600000	12. 600000

Variants values for the matrix:**

1)

800	100	555	800	5000
350	A	600	333	215
200	2000	700	0	750
500	450	0,5	3050	600
-200	300	900	D	950

2)

333	121	676	932	100
F	0	586	821	756
222	343	One	654	565
444	454	346	545	465
Lab	565	768	0	354

3)

For	700	1500	7000	M
500	300	1,9	320	9000
900	180	300	0	1005
200	4000	R	4009	2000
150	400	750	800	500

4)

100	710	680	840	900
500	320	-99	400	250
0,85	150	550	9050	300
800	640	770	810	555
200	600	0	340	880

5)

800	100	555	800	5000
350	A	600	333	215
200	2000	700	0	750
500	450	0,5	3050	600
-200	300	900	D	950

6)

Hi	510	700	100	-20
600	290	200	660	955
0,01	300	0	490	380
800	750	810	260	765
430	900	500	170	U

7)

500	200	1000	430	Are
770	630	380	400	690
0	470	-999	850	910
999	407	305	405	300
555	800	And	400	700

8)

910	390	420	500	0
740	930	840	330	440
Five	370	730	955	700
500	800	6,06	900	310
1000	200	745	890	-11

9)

D	320	126	439	790
3000	500	810	950	260
250	-33	710	L	800
499	555	300	888	200
Zero	800	420	950	500

10)

One	710	680	750	810
900	840	330	900	500
6000	730	40,5	232	300
800	640	222	343	0
Null	444	750	340	-9

11)

0	165	3400	1000	Boom
900	SM	250	888	215
999	2,05	700	650	810
4000	450	100	500	111
0	300	77,7	555	-666

12)

A	650	300	0	1000
350	400	777	560	610
700	-1,5	7500	410	333
111	450	900	Null	850
5555	280	490	790	Z

Overriding matrix:**

- | | |
|----------------|-----------------|
| 1) 1,2,4,5,6,3 | 7) 1,2,4,3,6,7 |
| 2) 3,5,7,2,1,4 | 8) 3,7,2,4,1,6 |
| 3) 2,6,1,2,7,3 | 9) 4,6,5,7,1,3 |
| 4) 4,3,1,7,5,2 | 10) 7,1,3,4,5,2 |
| 5) 1,5,4,3,2,6 | 11) 3,5,6,1,2,4 |
| 6) 3,5,4,2,7,1 | 12) 2,4,7,1,5,6 |

Task 4

Logic cell frames modeling process.

Open File Sample9.gps. Run the simulation, setting this value to the command START: 1000NP. Stop the simulation by pressing F4. Open the Window/Simulation Window/Logic switches Window. Open the cell Window/Simulation Window/Save values Window. Choose how to display that does not overlap windows (mosaic). Run the simulation step by step (F5) and to observe the behavior of logical keys. Next, press F2, and then stop the simulation. Disconnect detailed review View/Entity Detail for each window. Continue the simulation and make the current screenshot.

Images modeling process reflect a static picture of the model. Images of the modeling process are not updated during the simulation, however, may be called as many times as defined by the user.

It should be relayed model, after closing the windows key and cells. Set parameter START 1000NP and stop after running the simulation. Select the window frame list of current events. To do this, select the command Window/Simulation Snapshot/CEC Snapshot and a window. This window displays transact grouped by priority. Detail gives priorities transact options that are presented in the form of appropriate notes. After further detail a list of parameters, which consists of flags transact. Choose got transact and enter it in the appropriate frame transact Window/Simulation Snapshot/Transaction Snapshot. In the dialog box, enter the number transact. Window appears transact. In this frame contains information about transact including the current value of time priority, block number, the next block number, line number, family number transact. In the drop-down list displays the parameters transact. Run start and stop the process of modeling at least 3 times and after each stop to watch the content windows. Run simulations list of upcoming events. To do this, use the command Window/Simulation Snapshot/FEC Snapshot and perform a similar action, but with one transact. Run framing of transact Window/Simulation Snapshot/XN Groups Snapshot. Then a window frame headers Transaction Group Snapshot. Run framing numerical groups Window/Simulation Snapshot/User chains Snapshot. Run framing numerical groups Window/Simulation Snapshot/Numeric Groups Snapshot. In the current window will appear modeled on Inland numerical hierarchy. In the latter group there are two numerical values added to the simulation. By numerical values attached groups transact, and when you start modeling process attached output values, which are then used in the interim control checking system. Thus, this model, each transact adds value to the group.

Reading and writing data to external files.

Open the model Tstrd.gps. Create the simulation Command/Create Simulation. Open the dialog Matrix Window. In the drop-down list displays the label TOTAL, as the only matrix in this model. Set parameter START 1NP. During the simulation matrix filled with values from 1 to 7, found in the file Tstrd.txt. Block OPEN placed in a separate segment model, as the file is opened once. transact with the highest priority above all when starting the modeling process opens the file for reading. Each of the read parameter value is placed in transact Numero. The next three blocks renews counter (cell), which is then recorded in the parameter and is used as a line number in the matrix. Then the value of the block MSAVEVALUE, read off in P\$Numero, placed in the appropriate row matrix TOTAL. When the end of file, TRANSACT sent to the block CLOSE labeled Finis, closing the data file. Close the window of model and the window Matrix Window. Open model file Ttskrd.gps. Create the simulation. Open the matrices Window/Simulation Window/Matrix Window. Set the setting for START 1NP then a dialog box appears matrices. After the modeling process in the cell array (lines 4 and 6) were made to value 4 and 6 (your variants), which were set in the code model. OPEN Block is located in a separate segment model, as the file is opened once. Then transact, which will make reading part of the SEEK unit, moving the current line position in line 4. The value is read with a block READ, then entered into a matrix and then be scanned to determine the need to perform the next reading. Such actions are carried out and the second value. If an error occurs in a block OPEN or CLOSE transact enters into blocks labeled Flag and Flag1.

In the examples folder models to create a new text file that will contain 10 rows with the following values: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10. After creating the file must register its opening in the file of the model.

```
; GPSS World Sample File - TTSKRD.GPS
*****
; Read a file in two specific locations
; using SEEK and puts the stores the values
; in a matrix. Closes file after second value
; is read and stored.
*****
Total  MATRIX      ,10,1
      GENERATE     ,,,1
      OPEN         ("TSTRD_NEW.TXT"),,Flag
      SEEK         4
      TRANSFER     ,Dord
Again  SEEK        6
Dord   READ        Numero,,Finis
      MSAVEVALUE   Total,P$Numero,1,P$Numero
      TEST E      P$Numero,4,Finis
      TRANSFER     ,Again
Finis  CLOSE       Prob,,Flag1
      TERMINATE    1
Flag   TERMINATE   1
Flag1  TERMINATE   1
```

To work with the model TSTSKRD.gps. Change the values for blocks SEEK.

```
; GPSS World Sample File - TSTSKRD.GPS
*****
; Read a file in two specific locations
; using SEEK and puts the stores the values
; in a matrix. Closes file after second value
; is read and stored.
*****
Total  MATRIX      ,10,1
      GENERATE     ,,,1
      OPEN         ("TSTRD_NEW.TXT"),,Flag
      SEEK         4
      TRANSFER     ,Dord
Again  SEEK         6
Dord   READ        Numero,,Finis
      MSAVEVALUE   Total,P$numero,1,P$numero
      TEST E      P$Numero,4,Finis
      TRANSFER     ,Again
Finis  CLOSE       Prob,,Flag1
      TERMINATE    1
Flag   TERMINATE   1
Flag1  TERMINATE   1
```

Variants values:

- | | |
|----------|-----------|
| 1) 3; 6. | 7) 1; 3. |
| 2) 2; 5. | 8) 6; 8. |
| 3) 5; 7. | 9) 1; 4. |
| 4) 2; 4. | 10) 4; 7. |
| 5) 3; 5. | 11) 6; 9. |
| 6) 5; 8. | 12) 7; 9. |

Task 5

The entry in the selected line of the file by using random access.

Open model file Tstskinw.gps. Create the simulation. Set your command START 1NP. Open the modified file data. To do this, choose File/Open. In the dialog box, you must select the type of file with the extension * .txt, then choose from a list of file Tstskinw.txt (variants on tasks), and click Open.

Before the third line of the file were inserted values that were specified in the code of the model (in this case - 123456). In case if the unit is not used SEEK data would be inserted before the first line of the file. SEEK unit is used to move the fluid line to position the text string three, where the block WRITE to record information. In blocks of OPEN, WRITE and CLOSE in case of input/output error are alternative outlets. On error CLOSE block produces the error code and output code mistakes and puts it in the parameter transact. Close all windows that belong to the task.

Addition of data to the end of the file.

Open model file Tstappw.gps. Run the simulation. Choose Command/START 1NP. Open the modified file data Tstappw.txt (your variants). In this case, the use of block WRITE possible to add value 123456 at the end of the file. WRITE block operates in insert mode (indicated value of one of the operands «ON»). Close all windows that belong to the task.

Daily replacement block write.

Open model file Tstskrw.gps. Create the simulation. Set your command START 1NP. Open the modified file data Tstskrw.txt (your variants). In line 2 was recorded new value 123456. In this case, the unit worked WRITE mode replacement. For this latter operand must specify the parameter label «OFF». Close all windows that belong to the task.

Daily replacement without specifying the position of line.

Open model file Tstsqrw.gps. Create the simulation. Set your command START 1NP. Open the modified file data Tstsqrw.txt (your variants). In this case, since the line item does not indicate the first row is replaced by another. Close all windows that belong to the task.

Daily replacement with multiple consecutive records.

Open model file Tstsqr2w.gps. Create the simulation. Set parameter value for the command START 1NP. Open the modified file data Tstsqr2w.txt (for variants). In this case, after each entrance transact a block WRITE current line item increases by 1 line thus replaced lines 1 and 2. Close all windows that belong to the task.

Working with strings.

Open model file hairdresser Tstcatw.gps. Create the simulation. Set options for the command START 1NP. Open the modified file data Tstcatw.txt. In block WRITE for combining text data with real data was used procedure Catenate, which need when formatting the report or output the selected information in the simulation performed at predetermined intervals. Close all windows that belong to the model.

Processing of the data that are read from the file.

Open model file Tststrdw.gps. Run the simulation. Select Team Command/START and enter the value: 1NP. Open the modified file data Tststrdw.txt (variants on tasks). In this case, the data from the file Tststsw.txt were scanned and processed, thanks to their section into smaller parts and then was chosen piece of information that was read off from a given place in the file.

Variants tasks:

To perform the first five tasks (topics) in the folder examples of models, create text files with changed names models (example first model – Tstskinw_NEW.txt). As the information contained in a text file to write, for example:

Name on line 1

Surname on line 2

Date of birth on line 3

Number of group on line 4

After that, you must register the opening created text file in the code model (block OPEN). Change the setting that is registered in the block WRITE, on the date of the laboratory work, without separators, for example: 01092016.

When performing tasks 6 and 7, use described in the example files intact.

Control questions

1. What is used in the statement START operand NP?
2. Using commands you can stop and continue the process under modeling system GPSS World?
3. What is the operator for block allocation model during the modeling process stops. Describe the process principle stop the simulation system.
4. With the use of which team becomes possible to create a tracing process?
5. What information is displayed to the user after application transaction tracing?
6. How can I remove all stop conditions that were imposed on the model?
7. Using a team that can create a report of all the modeling process?
8. What additional purpose dialog SHOW.
9. List the full hierarchy of arithmetic and logical operations in GPSS.
10. Which view you can see the result of transactions that are recorded in the dialog SHOW?
11. Select the format in which the user gets value calculation logic operations?
12. With which team can make the transition to a string containing the error code program?
13. Give usually use logical operations?
14. In the dialog box which displays the device model.
15. Incrementally describe the process of creating a random number generator.
16. What are function keys whose values can change as necessary.
17. Move the purpose of application and blocks QUEUE DEPART.
18. What are the most important attributes of a queue.
19. Add a preference to use queuing models.
20. Name the two types of processing queues.
21. What command is used to display histograms? Specify and describe its parameters.
22. With which function key you can stop the simulation?
23. Which team is responsible for restarting process modeling?
24. Name the viewing window histograms.
25. Give recording format command is used to set the matrix in the language GPSS.

Methodical instructions
for self-sufficient work of students
and laboratory work on discipline

Mathematical Methods of Operations Research
for the 3rd year students of the extramural studies and distance learning

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