

Ministry of Education and Science of Ukraine  
National Aviation University

TRANSPORT VEHICLES OPERATION  
PART V: THE SIMPLEST PROBLEM OF  
THE PROBABILITY OF A CHOICE

SELF-STUDY METHOD GUIDE

Part V

For the Students of the  
Field of Study 27 “Transport”  
Specialty 275 “Transport Technologies”

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Містять декілька рекомендацій для самостійної роботи щодо застосування знань отриманих при проходженні дисципліни «Експлуатація транспортних засобів», що є необхідним для виконання робіт індивідуального завдання, підготовки до складання заключних видів контролю.

Для студентів 2-го курсу галузі знань 27 «Транспорт», спеціальності 275 «Транспортні технології (на авіаційному транспорті)».

**Transport Vehicles Operation. Part V : The Simplest Problem of the Probability of a Choice** : Self-Study Method Guide . Part V / compiler: A. V. Goncharenko. – К. : NAU, 2023. – 54 p.

The **METHOD GUIDE** contains a few recommendations on the Self-Study in regards with the application of the knowledge acquired at the study of the Academic Subject “Transport Vehicles Operation” carrying out, which is indispensable to complete the works of the individual task, get ready for passing the final kinds of the check.

Designed for the 2<sup>nd</sup> year students of the Field of Study 27 “Transport”, Specialty 275 “Transport Technologies (by Air Transport)”.

## CONTENTS

|   |    |
|---|----|
| INTRODUCTION.....                             | 4  |
| GENERAL PROVISIONS.....                       | 8  |
| 1. Planned hours .....                        | 8  |
| 2. Subject content .....                      | 10 |
| A CHOICE PROBABILITY PROBLEM.....             | 12 |
| 1. Basic theoretical provisions.....          | 12 |
| 2. A numerical example .....                  | 15 |
| 3. Expectation.....                           | 18 |
| 4. Variation of a significant parameter ..... | 20 |
| REPORT PREPARATION.....                       | 22 |
| DEFENSE.....                                  | 23 |
| PUBLICATIONS .....                            | 24 |
| REFERENCES.....                               | 25 |

## INTRODUCTION

This **METHOD GUIDE ON THE SELF-STUDY (SS)** is contemplated as an ideological continuation of **PART I-IV**:

[263]: “[Transport Vehicles Operation. Part I : Number of Transport Vehicles](https://er.nau.edu.ua/handle/NAU/56234) : Self-Study Method Guide . Part I . Number of Transport Vehicles . Optimal Choice Dilemma / compiler: A. V. Goncharenko. – K. : NAU, Electronic Repository. – 2022. – 48 p. [https://er.nau.edu.ua/handle/NAU/56234, Method\\_Guide.pdf.](https://er.nau.edu.ua/handle/NAU/56234)”

[275]: “[Transport Vehicles Operation. Part II: Elementary Supply Chain Optimization](https://er.nau.edu.ua/handle/NAU/62062) : Self-Study Method Guide . Part II / compiler: A. V. Goncharenko. – K. : NAU, Electronic Repository. – 2023. – 53 p. [https://er.nau.edu.ua/handle/NAU/62062, II TVO SSG.pdf.](https://er.nau.edu.ua/handle/NAU/62062)”

[276]: “[Transport Vehicles Operation. Part III : Elementary Optimal Supply Speed](https://er.nau.edu.ua/handle/NAU/62139) : Self-Study Method Guide . Part III / compiler: A. V. Goncharenko. – K. : NAU, Electronic Repository. – 2023. – 53 p. [https://er.nau.edu.ua/handle/NAU/62139, III TVO SSG.pdf.](https://er.nau.edu.ua/handle/NAU/62139)”

[277]: “[Transport Vehicles Operation. Part IV : Optimal Number of Transport Vehicles](https://er.nau.edu.ua/handle/NAU/62141) : Self-Study Method Guide . Part IV / compiler: A. V. Goncharenko. – K. : NAU, Electronic Repository. – 2023. – 57 p. [https://er.nau.edu.ua/handle/NAU/62141, IV TVO SSG.pdf.](https://er.nau.edu.ua/handle/NAU/62141)”

in response to the needs of our students in more detailed elaborations concerning the **TRANSPORT VEHICLES OPERATION (TVO)** tasks stated, set, or given for the students’ independent work on this **ACADEMIC SUBJECT** for the specified **CALCULATION AND GRAPHIC PAPER (CGP)**, possibly used in their further educational works, such as their **TERM PAPERING (TP)**, **COURSE PROJECTING (CP)**, further **GRADUATION PAPERS** or even **PH.D. STUDIES**. The whole material is split into portions. Each portion is intended to cover a fraction of the probable applications aimed at the **TRANSPORT TECHNOLOGIES (TT)** (by **AIR TRANSPORT (AT)**), particularly dealing with the **TRANSPORTATION ORGANIZATION AND MANAGEMENT ON TRANSPORT (TOMT)** for AT. It means AT management in operation possibly including some **AIRCRAFT (A/C)** technical operation issues in regards with the **AERONAUTICAL ENGINEERING (AE) MAINTENANCE (M/T)**, as for example, in aviation business.

The presented in the fifth part, **PART V**, of the **METHOD GUIDE ON THE SS** assignments are dedicated, and a special attention is drawn here, to the general aspects of the SS work for the TVO practical works, individual task, final kinds of the check, future students’ prospective

research and scientific publications as well as conference reports and presentations.

The scientific component of the SS work is very important. That is why, specifically, the objectives of the **PART V** material are to help students cope with the challenging problems relating to the studied **ACADEMIC SUBJECT** of TVO on the AT management in operation, for instance, A/C technical operation in regards with the aeronautical engineering M/T as well as the **AIRCRAFT AIRWORTHINESS** support measures.

The set of the considered issues is based upon the **RECOMMENDED LITERATURE SOURCES** (the list is presented, but not limited to it). The **LIST OF LITERATURE** at the end of the **METHOD GUIDE** is basic (major) and compiled partially not only in the alphabetic order, but mainly with respect to the matter of supposed (assumed) importance.

The **REFERENCES LIST** is selected, set in the order [1-277], does not pretend for completeness, but instead it is aimed at developing the students' abilities of thinking and to analyze, contemplate in the specified directory rather than their abilities to know and memorize. However, these are very significant too. Actually, in the contemporary informative boom world, the needed or required data can be easily retrieved from the internet, found in multiple references, guidance materials [1-23], studies, dictionaries, comprehensive books, publications and scientific papers like [24-277] amongst those monographs [9, 90, 108, 121, 198, 201, 206] etc. The **METHOD GUIDE** is designed for the 2nd year students (**BACHELOR'S DEGREE** contenders) in the Field of Study: 27 "Transport", Specialty: 275 "Transport technologies (by air transport)", Specialization: 05 "Air Transportation Management". The considered studied academic subject of TVO finalizes the previous education in the Field of Study: 27 "Transport", Specialty: 275 "Transport technologies (by air transport)", (**BACHELOR'S DEGREE** contenders); plus of the 1st year students (**BACHELOR'S DEGREE** contenders) in the Field of Study: 27 "Transport", Specialty: 275 "Transport technologies (by air transport)", Specialization: 05 "Air Transportation Management". There are a lot of the planned academic subjects in the **BACHELOR'S** and **MASTER'S DEGREE CURRICULA (CURRICULUMS)** related to the considered studied academic subject of TVO.

This very special fifth part, **PART V**, of the studied academic subject of TVO is aimed at the **MATHEMATICAL SETTING OF THE PROBLEMS** considered in the CGP on TVO, with the possibilities of the further development to education work, such as, course projects, even up to the graduation papers, **BACHELOR'S** and **MASTER'S DEGREE GRADUATION WORK**, or even Ph.D. studies. Therefore it is strongly suggested for the students to agree their own envisaged course projects, BACHELOR'S and MASTER'S DEGREE GRADUATION WORK THEMES and prospective research areas with their SUPERVISORS.

The scientific portion of the students' SS work might prolong the initiated at the preceding stages of the **BACHELOR'S DEGREE** contending study. It includes the **students' SS research results publication in scientific journals and scientific conferences proceedings**. In the prospect such kinds of the students' activity may lead to a successful defense of the **GRADUATION WORK** or a successful passing the **FINAL STATE EXAMINATION**; as well that may lead to a successful passing of the **UNIVERSITY PH.D.'S DEGREE PROGRAM ENTRANCE EXAMINATION**. The other benefit of the research results publication may be, for example, in the detailed solutions for obtaining the optimal distributions of transportation means: [263, 277], their combinations, optimization of the supply chain links: [275], and supply speeds: [276], reliability objective measures allowing assessing the improvements of the A/C functional system M/T process considered in references [138-140].

Herewith it is proposed to continue the search for the detailed solutions for the examples considered in the references of:

[194]: “**Goncharenko A. V.** Multi-optional hybridization for UAV maintenance purposes / A. V. Goncharenko // 2019 IEEE 5<sup>th</sup> International Conference “Actual Problems of Unmanned Aerial Vehicles Developments (APUAVD)” Proceedings. – October, 22-24, 2019, Kyiv, Ukraine. – 2019. – pp. 48-51.”

[182]: “**Goncharenko A. V.** Relative Pseudo-Entropy Functions and Variation Model Theoretically Adjusted to an Activity Splitting / A. V. Goncharenko // 2019 9<sup>th</sup> International Conference on Advanced Computer Information Technologies (ACIT'2019). – June 5-7, 2019. – Ceske Budejovice, Czech Republic, 2019. – pp. 52-55.”

[71]: “**Goncharenko A. V.** Measures for estimating transport vessels operators' subjective preferences uncertainty / A. V. Goncharenko // Scientific Bulletin of Kherson State Maritime Academy. – 2012. – № 1(6). – pp. 59-69.”

Completion of CGP is an independent / individual student's work of a creativeness.

The essential sections of the student's report of the CGP completion are:

Introduction;

Literature survey;

Theoretical background;

Major dependencies;

Statistical data;

**Student's own contribution:**

Derivations;

Findings;

Calculations;

Plotting diagrams;

Analysis;

Discussion;

Conclusion;

References;

Other necessary parts (significant results).

The time required for CGP completion is about 10 academic hours.

The length of the report for the about 10 academic hours completion work is up to 5 pages.

For the **PANDEMIC QUARANTINE PERIOD**, especially **MARTIAL LAW**, it possibly might have the corrections in the **ORDER** of the SS on TVO carrying out.

The general control for the SS on TVO performance is realized (amongst others) through the corresponding **GOOGLE CLASS ROOM**.

Thus, dear students, get down to this challenge to demonstrate your own creativity!

## GENERAL PROVISIONS

*The principal theoretical provisions can be found out in references [1-23].*

### 1. Planned hours

According to the **TRAINING PROGRAM** on the **ACADEMIC SUBJECT** of the considered TVO and depending upon the particular academic hours specified for the training and study, the entire **SUBJECT** may contain up to many hours.

According with the **TIME TABLE, PROGRAM, and CURRICULUM**, regularly approved by the **UNIVERSITY RECTOR'S ORDER**, it figures out like following:

17-19 (optionally 18) weeks of the **SEMESTER WORK**, including some days for the **MODULE TESTS** or the **CGP DEFENSE**, final **GRADED TEST CHECK**.

Thus, it all usually makes a **SEMESTER** weeks **PERIOD**.

Regularly, there might be **2 SHIFTS** that are planned for the **STUDENTS**.

Namely:

The **1ST SHIFT** starts at 8:00;

The **2ND SHIFT** starts at 15:20.

For the **SOPHOMORIC STUDENTS** it is usually the **1ST SHIFT**; and for the not large groups it is just **COMMON LABORATORY CLASSES**, without dividing the groups into **HALVES (SUBGROUPS)**.

Therefore, duration is 2 (4) academic hours a week for each **STUDENT** of a group on the day of the **LECTURE DELIVERY** and **LABORATORY CLASS CONDUCTION**. Totally it makes up to 30-40 academic hours of **AUDITORIUM WORK** for the entire considered studied academic subject of TVO. Then, it is plus about up to two thirds



of SS (up to 100 academic hours) including up to 30 academic hours for CGP. As whole it may have variations.

As a rule, the information on the **TIME TABLE, PROGRAM, and CURRICULUM**, and **TOPICS** are provided at the **AIR TRANSPORTATION MANAGEMENT DEPARTMENT** on the **INFORMATION BOARD (DESK)**; as well as, it can be displaced at the corresponding **GOOGLE CLASS ROOM** and/or the **DEPARTMENT WEBSITE (PAGE), UNIVERSITY REPOSITORY PAGE** etc.

For the **PANDEMIC QUARANTINE PERIOD**, especially **MARTIAL LAW**, the general control for the CGP performance is possible (amongst others) through the corresponding **GOOGLE CLASS ROOM**.

## 2. Subject content

This step is very important too.

The mentioned above 18 (16) weeks of the Semester study **STUDENTS' WORK** (accordingly with the **TIME TABLE**) are, or might be, subdivided into **COMMON AND INDIVIDUAL TOPICS**:

1.1. Organizational meeting. Instruction on labour protection and fire safety.

1.2. Common aspects of the General Approaches.

1.3. Individual Tasks relations to the chosen research areas.

1.4. Correspondence with the Final Work theme.

1.5. Appropriate methods of the research.

1.6. Mathematical Apparatus for the objectives.

1.7. Mathematical formulation of the conceptual provisions.

1.8. Experimentations.

1.9. Statistical Data processing.

1.10. Analysis of the obtained preliminary results.

1.11. Choice of the corrective methods and ideas.

1.12. Analysis of the use of the corrected methods research results.

1.13. Implementation into the Final Work.

1.14. Prospects of the research results application.

**1.15. Publication of the research results.**

These **TOPICS** might also be provided at the **AIR TRANSPORTATION MANAGEMENT DEPARTMENT** on the **INFORMATION BOARD (DESK)**; as well as, they can be displaced at the corresponding **GOOGLE CLASS ROOM** and/or **UNIVERSITY REPOSITORY PAGE**.

There is one major document that the student must prepare: **CGP REPORT**. The **REPORT** of the **CGP** is discussed at the corresponding following **SECTIONS** of this **SS METHOD GUIDE**.

After this **PROGRAM** on CGP completion, and having done and submitted the own **REPORT**, every **STUDENT (AUTHOR)** is supposed attempting to pass the

### ***DEFENSE AND GRADED TEST***

The **DEFENSE** is going to be discussed further on in this **SS METHOD GUIDE**.

And the best way of the CGP completion is the **SCIENTIFIC PUBLICATION**, which also will be instructed down here in the presented **SS METHOD GUIDE**.

Theoretical material for the CGP tasks is based upon references [1-277]. The idea is traced from the comparatively newest (latest) books [4, 5, 9, 13-17], **NATIONAL PROVISIONS** for aviation business in compliance with the **IATA, EASA**, continental, normative documents, and **ICAO** requirements like in [14]. Some convenient aspects of the subject learning are in the TOMT for AT, TT (by AT), **DIRECTIVES ON TECHNICAL OPERATION**, A/C and AE M/T, referred to in [14].

For the **PANDEMIC QUARANTINE PERIOD**, especially **MARTIAL LAW**, the general control for the CGP performance is possible (amongst others) through the corresponding **GOOGLE CLASS ROOM**.

## A CHOICE PROBABILITY PROBLEM

*The principal theoretical provisions can be found out in the references [1-23] and other literature sources and informational resources. Especially [23].*

The directions of the CGP work and their completion are reflected in the series of problems offered to be considered, set, and solved.

### 1. Basic theoretical provisions

Suppose amongst the aircraft fleet, there are  $g$  aircraft in “good” condition and  $b$  “bad” aircraft out of  $n$  aircraft “fleet” altogether. Choosing randomly  $m$  aircraft of  $n$ , what is the probability that  $k$  of  $m$  would be in “good” condition?

One method is finding that probability through the ratio of the number of the “favorable” events to the “total” number of possible events.

Generally, it may be written down as

$$P(A) = \frac{N(A)}{N}, \quad (4.1)$$

where  $P(A)$  is the probability of event “ $A$ ”;  $N(A)$  is the number of the events “favorable” to the event of “ $A$ ” (the number of occurrences when the event of “ $A$ ” happened, was realized);  $N$  is the total number of the possible events.

In the considered case (4.1) is interpreted as

$$P_{m(n)}^k(A_g) = \frac{N_{m(n)}^k(A_g)}{N_n^m}, \quad (4.2)$$

where  $P_{m(n)}^k(A_g)$  is the probability that  $k$  of  $m$  randomly chosen aircraft out of  $n$  would be in “good” condition of “ $A_g$ ”;  $N_{m(n)}^k(A_g)$  is the number of the “favorable” events;  $N_n^m$  is the total number of the possible events.

The number of the “favorable” events

$$N_{m(n)}^k(A_g) = C_g^k C_b^s = \frac{g!}{(g-k)!k!} \cdot \frac{b!}{(b-s)!s!} = C_g^k C_{n-g}^{m-k}, \quad (4.3)$$

where  $C_q^j$  is the number of the combinations of  $j$  elements out of  $q$ ;  $s$  is the number of “bad” aircraft amongst  $m$  randomly chosen aircraft out of  $n$ .

Or (4.3) in other notation

$$C_g^k C_{n-g}^{m-k} = \frac{g!}{(g-k)!k!} \cdot \frac{(n-g)!}{[n-g-(m-k)]!(m-k)!}, \quad (4.4)$$

It is obvious that

$$k + s = m \quad (4.5)$$

and

$$g + b = n. \quad (4.6)$$

The total number of all possible events

$$N_n^m = C_n^m = \frac{n!}{(n-m)!m!} = \frac{A_n^m}{P_m} = \frac{P_n}{P_{n-m}P_m}, \quad (4.7)$$

where  $C_n^m$  is the number of the combinations of  $m$  elements out of  $n$ ;  $A_n^m$  is the number of the arrangements of  $m$  elements out of  $n$ ;  $P_i$  is the number of the permutations of  $i$  elements.

The other way of solving the stated problem differs from (4.1)-(4.7) and it implies an application of conditional probabilities.

Generally it is

$$P(AB) = P(A)P(B|A), \quad (4.8)$$

where  $P(AB)$  is the probability of the conjoint occurrence of both events "A" and "B" (probability of the events product);  $P(A)$  is the probability of the event of "A" happening;  $P(B|A)$  is the conditional probability of the event of "B" occurrence on condition that the event of "A" happened.

Considering the conjoint occurrence of three events, let us say "A", "B", and "C", equation (4.8) gets the view of

$$P(ABC) = P(A)P(B|A)P(C|BA), \quad (4.9)$$

where  $P(ABC)$  is the probability of the conjoint occurrence of the mentioned three events "A", "B", and (here it is the probability of the three events product);  $P(C|BA)$  is the conditional probability of the event of "C" happening on condition that both "A", "B" have turned out, either the event of "B" occurred on condition that the event of "A" happened or vice versa.

The concept of (4.8) and (4.9) can be prolonged to more events product probabilities.

## 2. A numerical example

It is proposed to consider such example.

What is the probability that two of three randomly chosen out nine aircraft would be in “good” condition if supposedly amongst those nine aircraft there are four aircraft in “good” condition and five in “bad”?

Approach of (4.1)-(4.7) yields

$$P_{3(9)}^2(A_g) = \frac{N_{3(9)}^2(A_g)}{N_9^3} = \frac{C_4^2 C_{9-4}^{3-2}}{C_9^3}. \quad (4.10)$$

Then developing from (4.10)

$$P_{3(9)}^2(A_g) = \frac{C_4^2 C_{9-4}^{3-2}}{C_9^3} = \frac{4!}{(4-2)!2!} \cdot \frac{(9-4)!}{\frac{9!}{(9-3)!} [(9-4-(3-2))!(3-2)!]}. \quad (4.11)$$

It gives

$$P_{3(9)}^2(A_g) = \frac{5}{14} = \frac{15}{42} = \frac{180}{504} = \frac{45}{126}. \quad (4.12)$$

On the other hand from the ideas of (4.8) and (4.9) it will be like following. The possible outcomes:

$$1. P(GGG) = \frac{4}{9} \cdot \frac{3}{8} \cdot \frac{2}{7} = \frac{24}{504} = \frac{1}{21} = \frac{6}{126}. \quad (4.13)$$

$$2. P(GG\bar{G}) = \frac{4}{9} \cdot \frac{3}{8} \cdot \frac{5}{7} = \frac{60}{504} = \frac{15}{126}. \quad (4.14)$$

$$3. P(G\bar{G}G) = \frac{4}{9} \cdot \frac{5}{8} \cdot \frac{3}{7} = \frac{60}{504} = \frac{15}{126}. \quad (4.15)$$

$$4. P(\overline{G}GG) = \frac{5}{9} \cdot \frac{4}{8} \cdot \frac{3}{7} = \frac{60}{504} = \frac{15}{126}. \quad (4.16)$$

$$5. P(\overline{G}\overline{G}G) = \frac{5}{9} \cdot \frac{4}{8} \cdot \frac{4}{7} = \frac{80}{504} = \frac{20}{126}. \quad (4.17)$$

$$6. P(\overline{G}G\overline{G}) = \frac{5}{9} \cdot \frac{4}{8} \cdot \frac{4}{7} = \frac{80}{504} = \frac{20}{126}. \quad (4.18)$$

$$7. P(G\overline{G}\overline{G}) = \frac{4}{9} \cdot \frac{5}{8} \cdot \frac{4}{7} = \frac{80}{504} = \frac{20}{126}. \quad (4.19)$$

$$8. P(\overline{G}\overline{G}\overline{G}) = \frac{5}{9} \cdot \frac{4}{8} \cdot \frac{3}{7} = \frac{60}{504} = \frac{15}{126}. \quad (4.20)$$

In the notations of (4.13)-(4.20)  $G$  and  $\overline{G}$  designate: “good” and “not good” condition. It might be depicted as  $\overline{G} = B$  or in some other way.

The total number of possible occurrences is

$$2^m = 2^3 = 8. \quad (4.21)$$

Since the probabilities of (4.13)-(4.20) are the probabilities of the complete group of the non-conjoint events,

$$\sum_{i=1}^8 P_i = 1. \quad (4.22)$$

The sought probability that two of three randomly chosen out nine aircraft would be in “good” condition if supposedly amongst those nine aircraft there are four aircraft in “good” condition and five in “bad” is determined as

$$P(GG\overline{G}) + P(G\overline{G}G) + P(\overline{G}GG) = \frac{180}{504} = \frac{45}{126} = \frac{5}{14}. \quad (4.23)$$



The result of (4.23) is obtained as the sum of the probabilities of the outcomes of the variants of 2-4, (4.14)-(4.16).

So, the approach of (4.13)-(4.23) gives the same result as the concept of (4.1)-(4.12). The results of calculations are illustrated in Fig. 4.1.

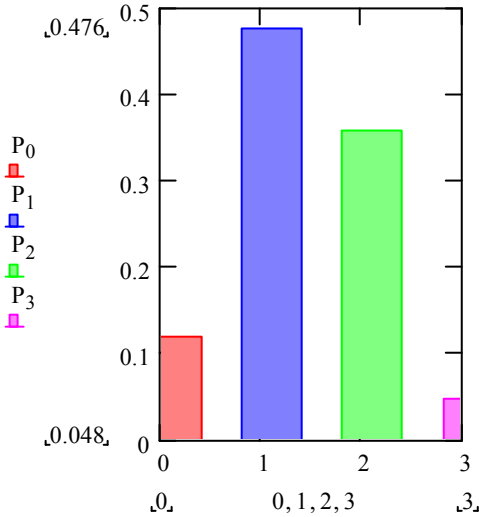


Fig. 4.1 – Bar diagram of probabilities

From (4.1)-(4.23) one can analyze the optimal solution. It depends upon some parameters. Their values are up to the students.

The illustration to the graphical representation is based upon the Mathcad calculation platform.

The magnitudes of the values have a certain conventional (some conditional) measurement units (dimensions).

The students are supposed to set the correspondence.

### 3. Expectation

Having determined the probabilities of the elementary events, (4.13)-(4.20), shown in Fig. 4.1, it is possible to find the expectation.

$$Exp[X] = \sum_{i=0}^3 x_i p_i, \quad (4.24)$$

where  $Exp[X]$  is the expectation of the random value of  $X$ : transported amount;  $x_i$  is the transported amount in a corresponding specified outcome:  $i$  (specific value of the random value);  $p_i$  is the probability of the specific outcome respectfully.

As to the specific values:  $x_i$ , of the random value:  $X$ , they are determined as follows:

$$x_i = ai, \quad (4.25)$$

where  $a$  is a determined unit value of the transported amount;  $i$  is the random value of the number of “good” aircraft.

At the determined unit value of the transported amount of

$$a = 5, \quad (4.26)$$

the expectation of the random value of the transported amount will compile up to

$$Exp[X]_{g=4}^{a=5} = \frac{20}{3}. \quad (4.27)$$

The increased number of “good” aircraft:

$$g = 5, \quad (4.28)$$

on condition of other unchanged parameters, will bring the results presented in Fig. 4.2

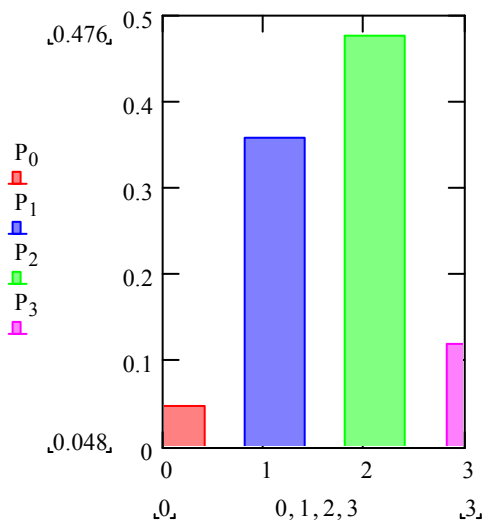


Fig. 4.2 – Bar diagram of probabilities

And the expectation becomes

$$Exp[X]_{g=5}^{a=5} = \frac{25}{3}. \quad (4.29)$$

#### 4. Variation of a significant parameter

The polygons of probabilities are shown in Fig. 4.3.

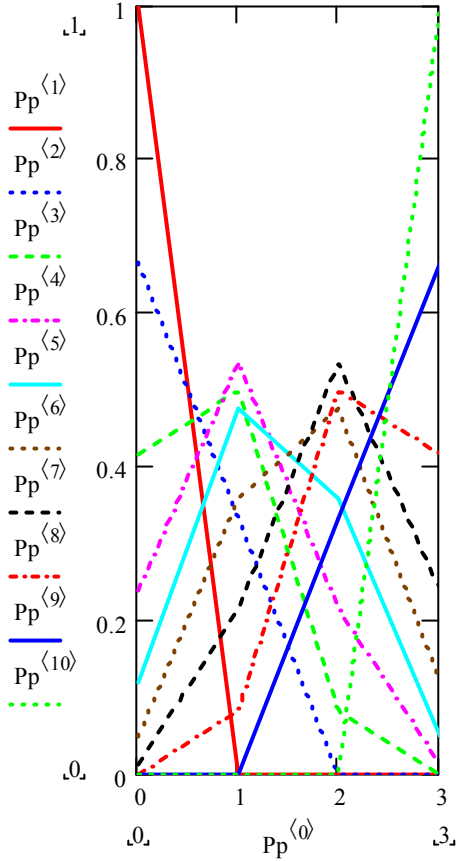


Fig. 4.3 – Polygons of probabilities

In Fig. 4.3 the polygons are plotted for

$$g = [0 \dots 9]. \quad (4.30)$$

The probability polygons start from  $Pp^{(1)}$  which is for the case of  $g = 0$  ; then  $Pp^{(2)}$  for  $g = 1$  ;  $Pp^{(3)}$  for  $g = 2$  ;  $Pp^{(4)}$  for  $g = 3$  ;  $Pp^{(5)}$  for  $g = 4$  ; and so on. Analyze and compare the polygons in Fig. 4.3 with the bar diagrams in Fig. 4.1 and Fig. 4.2.

The expectations also change:

$$Exp[X]_{g=0}^{a=5} = 0, \quad Exp[X]_{g=1}^{a=5} = \frac{5}{3}, \quad Exp[X]_{g=2}^{a=5} = \frac{10}{3}, \dots \quad (4.31)$$

Expectations of (4.31) are shown in Fig. 4.4. The value of (4.29) is also presented there (see Fig. 4.4).

The approach (4.1)-(4.31) allows researching the influence of other parameters.

There are some developments of the problem; in the number of the “good” and “bad” aircraft, different aircraft fleets varying in the aircraft numbers, aircraft types, trajectories, distances, speeds, other random (stochastic, probability) values, cost and other economical issues, dynamics, optimization, subject to additional conditions or constraints and so on.

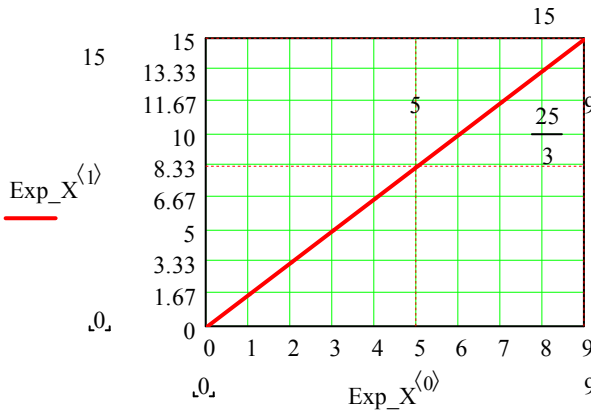


Fig. 4.4 – Expectations of the transported amount

It is possible to plot three-dimensional surfaces and graphically find solutions upon them.

## REPORT PREPARATION

The CGP stages are aimed at the effective CGP time management and results estimation control in the field of TOMT for AT, TT (by AT), A/C and AE M/T.

The best way is when it leads to the **SCIENTIFIC FORMALIZATION** of the **RESEARCHED MATTER**. For this purpose the **SCIENTIFIC PUBLICATIONS** suit the best.

The **CGP REPORT** is usually prepared in accordance with the **REPORT TEMPLATE**. As a rule it is provided at the corresponding **GOOGLE CLASS ROOM** and/or **UNIVERSITY REPOSITORY PAGE**.

The **REPORT** must contain the materials connected with CGP, especially with the **REPORT SECTIONS** characteristic, **INTRODUCTION, IMPORTANCE, TOPICS** etc.

The CGP work completion **REPORT** reflects the student's own achievements in acquiring the practical knowledge and skills of work in the **SCIENTIFIC FORMALIZATION** of the **RESEARCHED ISSUES**. For this purpose the **SCIENTIFIC PUBLICATIONS** suit the best.

The **REPORT** must contain the materials connected with CGP, especially with the researched object characteristic, student's own achievements etc.

The **REPORT** must be **SIGNED** (amongst the others) by the **AUTHOR (STUDENT)**, with pointing the **NAMES** and **POSITIONS**; also **DATED**.

The **AUTHOR (STUDENT)**; should characterize generally the topic; and He/She should emphasize the strong and weak points of the CGP work.

Finally, the **AUTHOR (STUDENT)** should evaluate the CGP work with the own reasonable and own rational **GENERAL ESTIMATION**.

After the CGP work completion (all is **SIGNED, DATED, AND SO ON**) it (**CGP REPORT**) must be, along with the CGP author's own **SCIENTIFIC PUBLICATIONS** (if there are any **RELEVANT**), submitted to the **DEPARTMENT COMMISSION** for the **DEFENSE**.

## **DEFENSE**

*The principal theoretical provisions can be found out in the references [1-23].*

The **DEFENSE** of the **CGP REPORT**, along with the **CGP RELEVANT SCIENTIFIC PUBLICATIONS** (if there are any) on the CGP works completion takes place in the **AIR TRANSPORTATION MANAGEMENT DEPARTMENT COMMISSION** on the corresponding CGP.

The process of the **DEFENSE** is held at the specified period of time.

The **AIR TRANSPORTATION MANAGEMENT DEPARTMENT COMMISSION** on the corresponding CGP is to put the contending **STUDENT** the **FINAL ESTIMATION MARK**.

## PUBLICATIONS

*The principal theoretical provisions can be found out in the lecture notes of the students who have been attended the lectures, completed practical and laboratory works, finished course projects and homework etc., have some scientific inclinations and in the references [1-277].*

For nowadays, it is incredibly important for the students to take part in some scientific activity. Results of such deeds as scientific research must be duly presented to the scientific community. The most popular forms of such presentation are the publications in:

1. Scientific Journals
2. Proceedings of the Scientific Conferences

In any case it is up to the students what and how to do, but relevant **PUBLICATIONS** will definitely help enter the **NEXT STAGE OF EDUCATION** and defend **EDUCATIONAL GRADUATION** and **SCIENTIFIC QUALIFICATION WORKS**, theses, dissertations etc.

Generally speaking the move toward the **PUBLICATIONS** actions may be reduced to a few indispensable steps. Perhaps, the first and apparently the most important is the choice of the scientific supervisor. It has to relate with the general theme of the research and the contender preferences. After finding such field of the creative potential application, it is reasonable to distinguish the specific direction, formulate the problem, propose the solution, and demonstrate verification of the approach and scientific findings.

All the students' findings, including made at the CGP, may be implemented into further students' achievements.

For nowadays the most valuable **PUBLICATIONS** are those indexed in the **SCOPUS** and **WEB OF SCIENCE** **SCIENTIFIC DATABASES**.



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*Навчальне видання*

## ЕКСПЛУАТАЦІЯ ТРАНСПОРТНИХ ЗАСОБІВ

Частина V

### НАЙПРОСТІША ЗАДАЧА ЙМОВІРНОСТІ ВИБОРУ

Методичні рекомендації  
до виконання самостійної роботи  
для студентів 2-го курсу галузі знань 27 «Транспорт»,  
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(Англійською мовою)

Укладач ГОНЧАРЕНКО Андрій Вікторович

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Технічний редактор *А. І. Лавринович*  
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