УДК 004.8

5.2.2. Математические, статистические и инструментальные методы в экономике (физико-математические науки, экономические науки)

АВТОМАТИЗИРОВАННЫЙ СИСТЕМНО-КОГНИТИВНЫЙ АНАЛИЗ ВЛИЯНИЯ СОСТАВА БЕТОНА НА ЕГО ФИЗИКО-МЕХАНИЧЕСКИЕ СВОЙСТВА И СТОИМОСТЬ

Луценко Евгений Вениаминович
д.э.н., к.т.н., профессор
Web of Science ResearcherID S-8667-2018
Scopus Author ID: 57188763047
РИНЦ SPIN-код: 9523-7101
prof.lutsenko@gmail.com http://lc.kubagro.ru
https://www.researchgate.net/profile/Eugene_Lutsenko
Кубанский Государственный Аграрный университет имени И.Т.Трубилина, Краснодар, Россия

Бетон является одним из самых древних и самых полуполярных строительных материалов, благодаря своим уникальным физическим свойствам, простоте технологии изготовления и низкой стоимости. Бетон известен человечеству уже как минимум около 6000 лет. За это время накоплен огромный опыт изготовления бетонных смесей различного состава. Строители на протяжении веков пытались добиться нужных им свойств бетона путем добавления в растворы и смеси различных компонент в различных пропорциях. Эта работа является весьма актуальной и интенсивно продолжается и сегодня. Основным методом исследования бетонных смесей на протяжении веков являлся эмпирический экспериментальный метод. Проще говоря, исследователи меняли дозировку различных компонент, добавляли и исключали определенные компоненты и просто на практике изучали физико-механические характеристики бетона, получившегося при использовании некоторой данной рецептуры и технологии. В последние столетия и в наше время появляется и бурно развивается теория бетона и бетонных смесей, которая разрабатывает содержательные модели взаимодействия различных компонент бетона и с помощью этих моделей объясняет получение тех или иных физико- механические свойств бетона на макроуровне. Сегодня настало время, когда к этой работе привлекаются и новые технологии искусственного интеллекта, в частности автоматизированный системно-когнитивный анализ (АСК-анализ) и его программный инструментарий – интеллектуальная система «Эйдос». В данной статье приводится полный численный пример применения АСК-анализа для исследования влияния состава бетона на его

UDC 004.8 UDC 004.8

5.2.2. Mathematical, statistical and instrumental methods of economics (physical and mathematical sciences, economic sciences)

AUTOMATED SYSTEM-COGNITIVE ANALYSIS OF THE INFLUENCE OF CONCRETE COMPOSITION ON ITS PHYSICAL AND MECHANICAL PROPERTIES AND COST

Lutsenko Evgeniy Veniaminovich
Doctor of Economics, Cand.Tech.Sci., Professor
Web of Science ResearcherID S-8667-2018
Scopus Author ID: 57188763047
RSCI SPIN code: 9523-7101
prof.lutsenko@gmail.com http://lc.kubagro.ru
https://www.researchgate.net/profile/Eugene_Lutsenko
Kuban State Agrarian University named after I.T. Trubilin, Krasnodar, Russia

Concrete is one of the oldest and most semi-polar building materials, due to its unique physical properties, simplicity of manufacturing technology and low cost. Concrete has been known to mankind for at least about 6000 years. During this time, vast experience has been accumulated in the manufacture of concrete mixtures of various compositions. Builders have been trying for centuries to achieve the properties of concrete they need by adding various components to solutions and mixtures in various proportions. This work is very relevant and continues intensively today. The main method of studying concrete mixtures for centuries has been the empirical experimental method. Simply put, the researchers changed the dosage of various components, added and excluded certain components and simply studied in practice the physical and mechanical characteristics of concrete obtained by using some given formulation and technology. In recent centuries and in our time, the theory of concrete and concrete mixtures has been emerging and rapidly developing, which develops meaningful models of the interaction of various components of concrete and with the help of these models explains the obtaining of certain physical and mechanical properties of concrete at the macro level. Today is the time when new artificial intelligence technologies are involved in this work, in particular automated system-cognitive analysis (ASC-analysis) and its software tools – the intelligent system "Eidos". This article provides a complete numerical example of the use of ASC-analysis to study the effect of the composition of concrete on its physical and mechanical properties and cost. This numerical example is hosted in the Eidos cloud and can be installed and studied, as well as improved or adapted and localized by any user of the Eidos system in the world. This allows us to use this article as a basis for laboratory work in disciplines

физико-механические свойства и стоимость. Этот численный пример размещен в Эйдос-облаке и может быть установлен и изучен, а также усовершенствован или адаптирован и локализован любым пользователем системы «Эйдос» в мире. Это позволяет использовать данную статью в качестве основы для лабораторной работы по дисциплинам, связанным с искусственным интеллектом и бетоноведению

Ключевые слова: АСК-АНАЛИЗ, АВТОМАТИЗИРОВАННЫЙ СИСТЕМНО-КОГНИТИВНЫЙ АНАЛИЗ, ИНТЕЛЛЕКТУАЛЬНАЯ СИСТЕМА «ЭЙДОС», БЕТОН, БЕТОНОВЕДЕНИЕ, ФИЗИКО-МЕХАНИЧЕСКИЕ СВОЙСТВА И СТОИМОСТЬ БЕТОНА

related to artificial intelligence and concrete science

Keywords: ASC-ANALYSIS, AUTOMATED SYSTEM-COGNITIVE ANALYSIS, INTELLIGENT SYSTEM "EIDOS", CONCRETE, CONCRETE SCIENCE, PHYSICAL AND MECHANICAL PROPERTIES AND COST OF CONCRETE

http://dx.doi.org/10.21515/1990-4665-191-009

INTRODUCTION

Description of the researched subject area

This issue is discussed in more detail in [1]. Concrete is one of the oldest and most semi-polar building materials due to its unique physical properties, ease of manufacturing technology and low cost. Concrete has been known to mankind for at least 6000 years [1]. During this time, vast experience has been accumulated in the manufacture of concrete mixtures of various compositions. For centuries, builders have tried to achieve the properties of concrete they need by adding various components to solutions and mixtures in various proportions. This work is very relevant and intensively continues today.

The main method for studying concrete mixtures for centuries has been the empirical experimental method. Simply put, the researchers changed the dosage of various components, added and excluded certain components, and simply in practice studied the physical and mechanical characteristics of concrete obtained using a given recipe and technology.

In recent centuries and in our time, the theory of concrete and concrete mixtures (betonology) appears and is rapidly developing, which develops meaningful models of the interaction of various components of concrete and, with the help of these models, explains the obtaining of certain physical and mechanical properties of concrete at the macro level.

This issue is discussed in more detail in [1].

This article provides a complete numerical example of the application of ASC analysis to study the effect of concrete composition on its physical and mechanical properties and cost. This numerical example is hosted in the Eidos cloud and can be installed and studied, as well as improved or adapted and localized by any user of the Eidos system in the world. This allows us to use this

article as a basis for laboratory work in disciplines related to artificial intelligence and concrete science.

Object and subject of research

Object of study (simulation) - concrete.

Subject of study- revealing the dependences of the physical-mechanical and economic properties of concrete on its composition.

Under the economic properties of concrete is understood its cost.

In more detail, the problem solved in the article, its relevance, as well as the purpose of the work are discussed in [1].

2. METHODS

In more detail, the justification of the requirements for the method of solving the problem, a literary review of the methods of solving problems, their characteristics and assessment of the degree of compliance with reasonable requirements, as well as Automated system-cognitive analysis (ASC-analysis) as a method of solving problems, they are discussed in [1].

The Eidos system is a toolkit for ASC-analysis

Of course, on the Eidos system, as they say, “The light did not converge like a wedge.” There are many very worthy artificial intelligence systems. To personally verify this, it is enough to independently search the Internet, just look at the files: NCKR-1,NCKR-2,NCKR-3,NCKR-4 or follow the links: https://learn.microsoft.com/ru-ru/dotnet/machine-learning/how-does-mldotnet-work, http://chat.openai.com/, https://poe.com/, https://neural-university.ru/, https://dzen.ru/a/ZCKZRKvrlEMBWOk8, https://ora.ai/, https://ora.ai/explore?path=trending, https://ora.ai/eugene-lutsenko/aidos, https://rudalle.ru/, there are still a lot of excellent neural networks: https://problembo.com/en/services (and this might come in handy here - 10 minutes mail: https://10minutemail.net/).

Useful neural networks and applications for various fields:

For designers: SiteKick- a neural network for creating landing pages; AdCreative - makes advertising creatives, posters; Looka - logos by text description; Watermark remover - helps to remove watermarks; Booth ai - creates stock photos according to the description; PatternedAI - patterns by text description; Hama - cut out unnecessary elements from a photo or picture; RoomGPT - “trying on” a new renovation for your apartment, helping you choose a design;

For photographers:; Pallete fm - colorizes black and white images; Relight - changes chiaroscuro in photos; Photoroom - cut elements from photos, change background; LeiaPix - will turn a 2D photo into 3D.; Nostalgia Photo - improves the quality of old photos; pfpmaker - generator of avatars for social networks; Picsart - replaces or removes unwanted elements in the photo;

For those who edit videos:; CapCut is a handy editor, available in the browser. There is color correction, different effects; vidyo ai - cut video into

short fragments; Reface - change the person's face on the video; Run wayml - a variety of editing tools; Colourlab AI - neural network for color correction; Topaz Video AI - greatly improve video quality, remove noise and shaking screen; Luma AI - will make a 3D image from a series of photos; Simplified - picture animation; SpiritMe - your online digital copy;

💻For IT people;; CodePal - writes code from scratch, fixes bugs, evaluates finished code; Codesnippets - creates a code on a text request; Buildt AI - a search engine for VSCode, will find ready-made code on the Internet; Code GPT - code generator plugin for VSCode; Autobackend - automatic backend; Adrenaline - searches for and helps fix bugs in the code; Tabnine - adds code if you fail; ;

📚 For schoolchildren and students;; Consensus - database of scientific articles; ExamCram - turns complex learning materials into flashcards and tests for self-examination; MathGPT - solves problems in mathematics; editGPT - fixes bugs in English; Yip - the same, but on the web and with Wikipedia support; ChatBA - makes presentations for you; YouTube Summary with ChatGPT - converts videos or lectures to text; Explain Me Like I'm Five - explains complex scientific terms in simple language;

For job seekers:; Interview GPT AI - asks tricky questions and helps prepare for an interview; Resume Worded - improves the summary; kickresume - make a cool resume and write a motivation letter; Cover Letter AI - write an accompanying text for a resume; ;

⛏ For those who did not help Google:; Chord - will write an abstract in response to a query in a line; Lexii ai - a bot that can link to sources; Perplexity - a neural network-search engine in the form of a browser extension; Nuclia - cloud or server search; Phind - can search for code, will help IT people;

For recreation and entertainment:; RadioGPT - radio where music is generated by neurons; EndlessVN - endless visual novel; Natural Language Playlist - will pick up a playlist for 7 hours especially for you; Movie Deep Search - will find a movie on demand; FashionAdvisor AI - tips from a neuro-stylist; Hello History - with the help of it you will communicate with a historical character; Cool Gift Ideas - will choose a gift for a person according to his description; Endel - neuro music that helps you fall asleep; PlaylistAI - will collect a playlist in Apple and Spotify by text or picture.; Tattoos AI - makes sketches for tattoos.

The purpose and objectives of the article are considered in [1].

RESULTS

Task-1. Cognitive structuring of the subject area. Two interpretations of the classification and descriptive scales and gradations

This issue is discussed in more detail in [1]. In this paper, concrete acts as an object of modeling, its composition as factors (Table 1), and as the results of

these factors, the physical and mechanical properties of concrete and its cost (Table 2):

Table1– Descriptive scales (factors)

KOD_OPSC	NAME_OPSC
1	BREED OF GROUND STONE
2	COEFF. VOID STONE
3	IST. DENSITY CRUSHED STONE KG/M CUBE
4	BULK DENSITY OF CRUSHED STONE
5	COEFF. G SLIDING GRAINS
6	RASH. CEM. WITHOUT X EXT. KG/M CUBE
7	CONSUMPTION OF CEMENT KG/M CUBE
8	CRUSHED STONE CONSUMPTION KG/M CUBE
9	SAND CONSUMPTION KG/M CUBE
10	WATER CONSUMPTION LITER/M CUBE
11	CHEMICAL. ADDITIVE LITER/MCU
12	WEIGHT BET. MIXTURES KG
13	VOLUME BET. SWEEP M CUBE
14	CHEM. APP. PLASTIF. KG/M CUBE

Source: c:\Aidos-X\AID_DATA\A0000001\System\Opis_Sc.xlsx

Table2– Classification scales (results of factors)

KOD_CLSC	NAME_CLSC
1	STRENGTH CLASS WHEN COMPRESSED
2	STRENGTH GRADE
3	COMFORTABLE BRAND
4	BRAND FOR FROST.
5	BRAND ON VODONEPR
6	GRADE ACTIVITY OF CEMENT
7	W/C WATER CEMENT REL.
8	WATER PERMEABILITY
9	K1 - COEFF. CHEM. ADDITIVES
10	K2 - COEFF. ACCOUNTING H.D. ON STRENGTH
11	MARK BETH. MIXTURES M KG/SM KV
12	STAND. CEMENT RUB
13	STAND. rubble RUB
14	STAND. SAND RUB
15	STAND. PLASTIF. RUB
16	TOTAL COST OF FSG RUB/M CUBE

Source: c:\Aidos-X\AID_DATA\A0000001\System\Class_Sc.xlsx

3.2. Task-2. Formalization of the subject area

This issue is discussed in more detail in [1].

Source: [25]: https://i.ytimg.com/vi/fLZJImHTALQ/maxresdefault.jpg

Using the standard capabilities of MS Excel, we will present the initial data from Table 3 in the form standard for the Eidos system (Table 4 in [1]). *Note:* Completely in MS Excel table 4 can be downloaded from the link: http://lc.kubagro.ru/Source_data_applications/Applications-000391/Inp_data.xlsx.

The 2nd figure 8 indicates that in the descriptive scales the total number of gradations is 95, and in table 6 there are only 75 of them. This is because in some descriptive scales there are “Space” gradations or zeros, which, in

accordance with the In Figure 8, it is considered not as significant, but as missing data.

Data imbalance is understood as uneven distribution of the values of the properties of the modeling object or the factors acting on it over the range of changes in the values of numerical scales and between scales, both numerical and textual. The mathematical model of ASC-analysis makes it possible to correctly overcome the imbalance of data by moving from absolute frequencies to relative and quantitative measures of knowledge in system-cognitive models (we will see this below).

Table3– Classification scales and gradations (in full)

KOD_CLS	NAME_CLS
1	STRENGTH CLASS COMPRESSION-B12.5
2	STRENGTH CLASS COMPRESSION-IN-7.5
3	STRENGTH CLASS COMPRESSION-IN 12.5
4	STRENGTH CLASS COMPRESSION-B12.5
5	STRENGTH CLASS COMPRESSION-B15
6	STRENGTH CLASS COMPRESSION-B20
7	STRENGTH CLASS COMPRESSION-B22.5
8	STRENGTH CLASS COMPRESSION-B25
9	STRENGTH CLASS COMPRESSION-B30
10	STRENGTH CLASS COMPRESSION-B35
11	STRENGTH CLASS COMPRESSION-B40
12	STRENGTH CLASS IN COMPRESSION-M 100
13	STRENGTH CLASS COMPRESSION-M100
14	STRENGTH CLASS COMPRESSION-M150
15	STRENGTH CLASS COMPRESSION-M200
16	STRENGTH GRADE-1/5-{100.0000000, 190.0000000}
17	STRENGTH GRADE-2/5-{190.0000000, 280.0000000}
18	STRENGTH GRADE-3/5-{280.0000000, 370.0000000}
19	STRENGTH GRADE-4/5-{370.0000000, 460.0000000}
20	STRENGTH GRADE-5/5-{460.0000000, 550.0000000}
21	BRAND FOR SURFACE-J1
22	STANDARD BRAND-P2
23	STANDARD BRAND-P3
24	STANDARD BRAND-P4
25	BRAND ON DOBOOKL.-P5 b. us.
26	BRAND ON DOBOOKL.-P5 b.us
27	BRAND ON DOBOOKL.-P5 (b us)
28	BRAND ON DOBOOKL.-SZh-2
29	BRAND ON DOBOOKL.-SZh2
30	FROST GRADE-F100
31	FROST GRADE-F150
32	FROST GRADE-F200
33	FROST GRADE-F25
34	FROST GRADE-F50
35	FROST GRADE-F75
36	GRADE ON VODONEPR-W 4
37	GRADE ON VODONEPR-W10
38	GRADE ON VODONEPR-W12
39	GRADE ON VODONEPR-W2
40	GRADE ON VODONEPR-W4
41	GRADE ON VODONEPR-W6
42	GRADE ON VODONEPR-W8
43	BRAND ACTIVITY OF CEMENT-1/5-{400.0000000, 420.0000000}
44	BRAND ACTIVITY OF CEMENT-2/5-{420.0000000, 440.0000000}
45	BRAND ACTIVITY OF CEMENT-3/5-{440.0000000, 460.0000000}

46	BRAND ACTIVITY OF CEMENT-4/5-{460.0000000, 480.0000000}
47	BRAND ACTIVITY OF CEMENT-5/5-{480.0000000, 500.0000000}
48	W/C WATER-CEMENT RATIO-1/5-{0.4496124, 0.6055473}
49	W/C WATER-CEMENT RATIO-2/5-{0.6055473, 0.7614823}
50	W/C WATER-CEMENT RATIO-3/5-{0.7614823, 0.9174172}
51	W/C WATER-CEMENT RATIO-4/5-{0.9174172, 1.0733522}
52	W/C WATER-CEMENT RATIO-5/5-{1.0733522, 1.2292871}
53	WATER PERMEABILITY-1/5-{140.0000000, 160.0000000}
54	WATER PERMEABILITY-2/5-{160.0000000, 180.0000000}
55	WATER PERMEABILITY-3/5-{180.0000000, 200.0000000}
56	WATER PERMEABILITY-4/5-{200.0000000, 220.0000000}
57	WATER PERMEABILITY-5/5-{220.0000000, 240.0000000}
58	K1 - COEFF. CHEM. ADDITIONS-1/5-{0.8000000, 0.8200000}
59	K1 - COEFF. CHEM. ADDITIONS-2/5-{0.8200000, 0.8400000}
60	K1 - COEFF. CHEM. ADDITIONS-3/5-{0.8400000, 0.8600000}
61	K1 - COEFF. CHEM. ADDITIONS-4/5-{0.8600000, 0.8800000}
62	K1 - COEFF. CHEM. ADDITIONS-5/5-{0.8800000, 0.9000000}
63	K2 - COEFF. ACCOUNTING H.D. STRONG-1/5-{1.0000000, 1.0320000}
64	K2 - COEFF. ACCOUNTING H.D. STRONG-2/5-{1.0320000, 1.0640000}
65	K2 - COEFF. ACCOUNTING H.D. STRONG-3/5-{1.0640000, 1.0960000}
66	K2 - COEFF. ACCOUNTING H.D. STRONG-4/5-{1.0960000, 1.1280000}
67	K2 - COEFF. ACCOUNTING H.D. STRONG-5/5-{1.1280000, 1.1600000}
68	MARK BETH. MIXTURES M KG/SM KV-1/5-{100.0000000, 190.0000000}
69	MARK BETH. MIXTURES M KG/SM KV-2/5-{190.0000000, 280.0000000}
70	MARK BETH. MIXTURES M KG/SM KV-3/5-{280.0000000, 370.0000000}
71	MARK BETH. MIXTURES M KG/SM KV-4/5-{370.0000000, 460.0000000}
72	MARK BETH. MIXTURES M KG/SM KV-5/5-{460.0000000, 550.0000000}
73	STAND. CEMENT RUB-1/5-{320.2631661, 547.2705329}
74	STAND. CEMENT RUB-2/5-{547.2705329, 774.2778997}
75	STAND. CEMENT RUB-3/5-{774.2778997, 1001.2852664}
76	STAND. CEMENT RUB-4/5-{1001.2852664, 1228.2926332}
77	STAND. CEMENT RUB-5/5-{1228.2926332, 1455.3000000}
78	STAND. RUBBER-1/5-{722.2309967, 807.1684162}
79	STAND. RUBBER-2/5-{807.1684162, 892.1058357}
80	STAND. RUBBER-3/5-{892.1058357, 977.0432552}
81	STAND. RUBBER-4/5-{977.0432552, 1061.9806747}
82	STAND. RUBBER-5/5-{1061.9806747, 1146.9180942}
83	STAND. SAND RUB-1/5-{183.6644758, 252.0263806}
84	STAND. SAND RUB-2/5-{252.0263806, 320.3882855}
85	STAND. SAND RUB-3/5-{320.3882855, 388.7501903}
86	STAND. SAND RUB-4/5-{388.7501903, 457.1120952}
87	STAND. SAND RUB-5/5-{457.1120952, 525.4740000}
88	STAND. PLASTIF. RUB-1/5-{35.8744514, 62.9995611}
89	STAND. PLASTIF. RUB-2/5-{62.9995611, 90.1246708}
90	STAND. PLASTIF. RUB-3/5-{90.1246708, 117.2497806}
91	STAND. PLASTIF. RUB-4/5-{117.2497806, 144.3748903}
92	STAND. PLASTIF. RUB-5/5-{144.3748903, 171.5000000}
93	TOTAL COST OF FSG RUB/M CUB-1/5-{1107.5740322, 1418.7886437}
94	TOTAL COST OF FSG RUB/M CUB-2/5-{1418.7886437, 1730.0032553}
95	TOTAL COST OF FSG RUB/M CUB-3/5-{1730.0032553, 2041.2178668}
96	TOTAL COST OF FSG RUB/M CUB-4/5-{2041.2178668, 2352.4324784}
97	TOTAL COST OF FSG RUB/M CUB-5/5-{2352.4324784, 2663.6470899}

Source: c:\Aidos-X\AID_DATA\A0000001\System\Classes.xlsx

Table4– Descriptive scales and gradations (in full)

KOD_ATR	NAME_ATR
1	ROAD OF CRUSHED STONE-granite
2	BREED OF CRUSHED STONE-KNOWN
3	ROCK OF CRUSHED STONE-limestone
4	ROCK OF CRUSHED STONE-Sand
5	ROAD OF CRUSHED STONE-SMS
6	BREED OF GRINDED STONE-tv.p, gran
7	RING
8	ROAD OF CRUSHED STONE-hard rocks
9	ROAD OF CRUSHED STONE - crushed stone.
10	ROAD OF CRUSHED STONE - crushed stone.
11	COEFF. VOID RUBBER-1/5-{0.4669118, 0.4723974}
12	COEFF. VOID Rubble-2/5-{0.4723974, 0.4778829}
13	COEFF. VOID RUBBER-3/5-{0.4778829, 0.4833685}
14	COEFF. VOID RUBBER-4/5-{0.4833685, 0.4888540}
15	COEFF. VOID RUBBER-5/5-{0.4888540, 0.4943396}
16	IST. DENSITY CRUSHED STONE KG/M KUB-1/5-{2650.0000000, 2664.0000000}
17	IST. DENSITY CRUSHED STONE KG/M KUB-2/5-{2664.0000000, 2678.0000000}
18	IST. DENSITY CRUSHED STONE KG/M KUB-3/5-{2678.0000000, 2692.0000000}
19	IST. DENSITY CRUSHED STONE KG/M KUB-4/5-{2692.0000000, 2706.0000000}
20	IST. DENSITY CRUSHED STONE KG/M KUB-5/5-{2706.0000000, 2720.0000000}
21	BULK DENSITY OF CRUSHED STONE-1/5-{1340.0000000, 1362.0000000}
22	BULK DENSITY OF CRUSHED STONE-2/5-{1362.0000000, 1384.0000000}
23	BULK DENSITY OF CRUSHED STONE-3/5-{1384.0000000, 1406.0000000}
24	BULK DENSITY OF CRUSHED STONE-4/5-{1406.0000000, 1428.0000000}
25	BULK DENSITY OF CRUSHED STONE-5/5-{1428.0000000, 1450.0000000}
26	COEFF. G SLIDING ZEREN-1/5-{1.1000000, 1.1920000}
27	COEFF. G SLIDING ZEREN-2/5-{1.1920000, 1.2840000}
28	COEFF. G SLIDING ZEREN-3/5-{1.2840000, 1.3760000}
29	COEFF. G SLIDING ZEREN-4/5-{1.3760000, 1.4680000}
30	COEFF. G SLIDING ZEREN-5/5-{1.4680000, 1.5600000}
31	RASH. CEM. WITHOUT X EXT. KG/M KUB-1/5-{113.8871473, 197.8683385}
32	RASH. CEM. WITHOUT X EXT. KG/M KUB-2/5-{197.8683385, 281.8495297}
33	RASH. CEM. WITHOUT X EXT. KG/M KUB-3/5-{281.8495297, 365.8307210}
34	RASH. CEM. WITHOUT X EXT. KG/M KUB-4/5-{365.8307210, 449.8119122}
35	RASH. CEM. WITHOUT X EXT. KG/M KUB-5/5-{449.8119122, 533.7931034}
36	CONSUMPTION OF CEMENT KG/M CUB-1/5-{102.4984326, 179.9987461}
37	CONSUMPTION OF CEMENT KG/M CUBE-2/5-{179.9987461, 257.4990596}
38	CONSUMPTION OF CEMENT KG/M CUBE-3/5-{257.4990596, 334.9993730}
39	CONSUMPTION OF CEMENT KG/M CUBE-4/5-{334.9993730, 412.4996865}
40	CONSUMPTION OF CEMENT KG/M CUBE-5/5-{412.4996865, 490.0000000}
41	CRUSHED STONE CONSUMPTION KG/M KUB-1/5-{1017.9897151, 1062.1062633}
42	CRUSHED STONE CONSUMPTION KG/M KUB-2/5-{1062.1062633, 1106.2228115}
43	CRUSHED STONE CONSUMPTION KG/M KUB-3/5-{1106.2228115, 1150.3393596}
44	CRUSHED STONE CONSUMPTION KG/M KUB-4/5-{1150.3393596, 1194.4559078}
45	CRUSHED STONE CONSUMPTION KG/M KUB-5/5-{1194.4559078, 1238.5724560}
46	SAND CONSUMPTION KG/M CUB-1/5-{551.5449724, 756.8359779}
47	SAND CONSUMPTION KG/M CUBE-2/5-{756.8359779, 962.1269834}
48	SAND CONSUMPTION KG/M CUBE-3/5-{962.1269834, 1167.4179890}
49	SAND CONSUMPTION KG/M CUBE-4/5-{1167.4179890, 1372.7089945}
50	SAND CONSUMPTION KG/M CUBE-5/5-{1372.7089945, 1578.0000000}
51	WATER CONSUMPTION LITER/M CUBE-1/5-{126.0000000, 154.8000000}
52	WATER CONSUMPTION LITER/M CUBE-2/5-{154.8000000, 183.6000000}

53	WATER CONSUMPTION LITER/M CUBE-3/5-{183.6000000, 212.4000000}
54	WATER CONSUMPTION LITER/M CUBE-4/5-{212.4000000, 241.2000000}
55	WATER CONSUMPTION LITER/M CUBE-5/5-{241.2000000, 270.0000000}
56	CHEMICAL. ADDITIVE LITER/M CUBE-1/5-{0.9318039, 1.7254431}
57	CHEMICAL. ADDITIVE LITER/M CUBE-2/5-{1.7254431, 2.5190823}
58	CHEMICAL. ADDITIVE LITER/M CUBE-3/5-{2.5190823, 3.3127216}
59	CHEMICAL. ADDITIVE LITER/M CUBE-4/5-{3.3127216, 4.1063608}
60	CHEMICAL. ADDITIVE LITER/M CUBE-5/5-{4.1063608, 4.9000000}
61	WEIGHT BET. MIXTURES KG-1/5-{2068.4800000, 2129.4506545}
62	WEIGHT BET. MIXTURES KG-2/5-{2129.4506545, 2190.4213090}
63	WEIGHT BET. MIXTURES KG-3/5-{2190.4213090, 2251.3919636}
64	WEIGHT BET. MIXTURES KG-4/5-{2251.3919636, 2312.3626181}
65	WEIGHT BET. MIXTURES KG-5/5-{2312.3626181, 2373.3332726}
66	VOLUME BET. Sweep M CUBE-1/5-{0.9700000, 0.9760000}
67	VOLUME BET. Sweep M CUBE-2/5-{0.9760000, 0.9820000}
68	VOLUME BET. Sweep M CUBE-3/5-{0.9820000, 0.9880000}
69	VOLUME BET. Sweep M CUBE-4/5-{0.9880000, 0.9940000}
70	VOLUME BET. Sweep M CUBE-5/5-{0.9940000, 1.0000000}
71	CHEM. APP. PLASTIF. KG/M KUB-1/5-{1.0249843, 1.7999874}
72	CHEM. APP. PLASTIF. KG/M KUB-2/5-{1.7999874, 2.5749906}
73	CHEM. APP. PLASTIF. KG/M KUB-3/5-{2.5749906, 3.3499937}
74	CHEM. APP. PLASTIF. KG/M KUB-4/5-{3.3499937, 4.1249969}
75	CHEM. APP. PLASTIF. KG/M KUB-5/5-{4.1249969, 4.9000000}

Source: c:\Aidos-X\AID_DATA\A0000001\System\Attributes.xlsx

Table5– Training set (in full)

NAME	N2	N3	N4	N5	N6	N7	N8	N9	N10	N11	N12	N13	N14	N15	N16	N17	N18	N19	N20	N21	N22	N23	N24	N25	N26	N27	N28	N29	N30	N31	N32	N33	N34	N35
B-7,5	2	16	29	34	39	43	52	53	62	67	68	73	79	84	88	94	3	15	16	21	26			31		36	45	47	51	56		65	66	71
B-7,5	2	16	29	34	39	43	52	53	62	67	68	73	82	84	88	95	6	15	16	21	26			31		36	45	47	51	56		65	66	71
B-7,5	2	16	21	34	39	43	52	54	62	67	68	73	81	84	88	95	6	15	16	21	28			31		36	43	47	51	56		65	66	71
B-7,5	2	16	22	34	39	43	52	56	62	67	68	73	81	84	88	95	3	15	16	21	28			31		36	43	47	53	56		64	66	71
B-7,5	2	16	23	34	39	43	52	56	62	67	68	73	78	84	88	94	3	15	16	21	28			31		36	43	47	53	56		64	66	71
B-7,5	2	16	24	34	39	43	52	57	62	67	68	73	78	83	89	94	3	15	16	21	28			32		37	43	46	53	56		64	66	72
B-7,5	2	16	22	34	39	43	52	56	62	67	68	73	81	84	88	95	6	15	16	21	28			31		36	43	47	53	56		64	66	71
B-7,5	2	16	23	34	39	43	52	56	62	67	68	73	81	84	88	95	6	15	16	21	28			31		36	43	47	53	56		64	66	71
B-7,5	2	16	24	34	39	43	52	57	62	67	68	73	81	83	89	95	6	15	16	21	28			32		37	43	46	53	56		64	66	72
B-7,5	2	16	22	34	39	43	52	56	62	67	68	73	80	84	88	94	9	15	16	21	28			31		36	43	47	53	56		64	66	71
B-7,5	2	16	23	34	39	43	52	56	62	67	68	73	80	84	88	94	9	15	16	21	28			31		36	43	47	53	56		64	66	71
B-7,5	2	16	24	34	39	43	52	57	62	67	68	73	80	83	89	94	9	15	16	21	28			32		37	43	46	53	56		64	66	72
B-7,5	2	16	28	34	39	47	52	53	62	67	68	73	79	84	88	94	3	15	16	21	26			31		36	45	47	51	56		65	66	71
B-7,5	2	16	29	34	39	47	52	53	62	67	68	73	82	84	88	95	6	15	16	21	26			31		36	45	47	51	56		65	66	71
B-7,5	2	16	21	34	39	47	52	54	62	67	68	73	78	84	88	94	3	15	16	21	28			31		36	43	47	51	56		65	66	71
B-7,5	2	16	22	34	39	47	52	56	62	67	68	73	78	84	88	94	3	15	16	21	28			31		36	43	47	53	56		64	66	71
B-7,5	2	16	23	34	39	47	52	56	62	67	68	73	78	84	88	94	3	15	16	21	28			31		36	43	47	53	56		64	66	71
B-7,5	2	16	24	34	39	47	52	56	62	67	68	73	78	83	88	94	3	15	16	21	28			31		36	43	46	53	56		63	66	71
B-7,5	2	16	22	34	39	47	52	56	62	67	68	73	81	84	88	95	6	15	16	21	28			31		36	43	47	53	56		64	66	71
B-7,5	2	16	23	34	39	47	52	56	62	67	68	73	81	84	88	95	6	15	16	21	28			31		36	43	47	53	56		64	66	71
B-7,5	2	16	24	34	39	47	52	57	62	67	68	73	81	83	88	95	6	15	16	21	28			31		36	43	46	53	56		63	66	71
B-7,5	2	16	22	34	39	47	52	56	62	67	68	73	80	84	88	94	9	15	16	21	28			31		36	43	47	53	56		64	66	71
B-7,5	2	16	23	34	39	47	52	56	62	67	68	73	80	84	88	95	9	15	16	21	28			31		36	43	47	53	56		64	66	71
B-7,5	2	16	24	34	39	47	52	57	62	67	68	73	80	83	88	95	9	15	16	21	28			31		36	43	46	53	56		63	66	71
M 100	12	16	23	33	39	43						75		87	90	93	4									38		50	55	58		61	70	73
M100	13	16	23	33	39	47						75		87	89	94	4									37		50	54	57		61	70	72
M150	14	16	23	34	39	43						76		87	91	95	4									39		50	55	59		62	70	74
M150	14	16	23	34	39	47						76		87	91	95	4									39		50	55	59		62	70	74
M200	15	17	23	34	39	43						77		87	92	96	4									40		50	55	60		63	70	75
M200	15	17	23	34	39	47						77		87	92	96	4									40		50	55	60		63	70	75
B12,5	1	16	28	34	39	43	51	53	62	67	68	73	82	84	88	95	7	15	16	21	26			31		36	45	47	51	56		65	66	71
B12,5	4	16	21	34	39	43	51	54	62	67	68	73	82	84	88	95	7	15	16	21	26			31		36	45	47	51	56		65	66	71
B12,5	4	16	22	34	39	43	51	56	62	67	68	74	78	84	89	94	2	15	16	21	28			32		37	43	47	53	57		64	66	72
B12,5	4	16	23	34	39	43	51	56	62	67	68	74	78	83	89	94	2	15	16	21	28			32		37	43	46	53	57		64	66	72
B12,5	4	16	24	34	39	43	51	57	62	67	68	74	78	83	89	94	2	15	16	21	28			32		37	43	46	53	57		64	66	72
B 12,5	3	16	22	34	39	43	51	56	62	67	68	74	81	84	89	95	7	15	16	21	28			32		37	43	47	53	57		64	66	72
B12,5	4	16	23	34	39	43	51	56	62	67	68	74	81	83	89	95	7	15	16	21	28			32		37	43	46	53	57		64	66	72
B12,5	4	16	24	34	39	43	51	57	62	67	68	74	81	83	89	95	7	15	16	21	28			32		37	43	46	53	57		64	66	72
B12,5	4	16	22	34	39	43	51	56	62	67	68	74	79	84	89	95	9	15	16	21	28			32		37	43	47	53	57		64	66	72
B12,5	4	16	23	34	39	43	51	56	62	67	68	74	79	83	89	95	9	15	16	21	28			32		37	43	46	53	57		64	66	72
B12,5	4	16	24	34	39	43	51	57	62	67	68	74	79	83	89	95	9	15	16	21	28			32		37	43	46	53	57		64	66	72
B12,5	1	16	28	34	39	47	51	53	62	67	68	73	79	84	88	94	2	15	16	21	26			31		36	45	47	51	56		65	66	71
B12,5	1	16	21	34	39	47	51	54	62	67	68	73	79	84	88	94	2	15	16	21	26			31		36	45	47	51	56		65	66	71

B12,5	4	16	22	34	39	47	51	56	62	67	68	74	78	84	88	94	2	15	16	21	28			32		36	43	47	53	56		64	66	71
B12,5	4	16	23	34	39	47	51	56	62	67	68	74	78	84	89	94	2	15	16	21	28			32		37	43	47	53	56		64	66	72
B12,5	4	16	24	34	39	47	51	57	62	67	68	74	78	83	89	94	2	15	16	21	28			32		37	43	46	53	57		64	66	72
B12,5	4	16	22	34	39	47	51	56	62	67	68	74	81	84	88	95	7	15	16	21	28			32		36	43	47	53	56		64	66	71
B12,5	4	16	23	34	39	47	51	56	62	67	68	74	81	84	89	95	7	15	16	21	28			32		37	43	47	53	56		64	66	72
B12,5	4	16	24	34	39	47	51	57	62	67	68	74	81	83	89	95	7	15	16	21	28			32		37	43	46	53	57		64	66	72
B12,5	4	16	22	34	39	47	51	56	62	67	68	74	79	84	88	95	9	15	16	21	28			32		36	43	47	53	56		64	66	71
B12,5	4	16	23	34	39	47	51	56	62	67	68	74	79	84	89	95	9	15	16	21	28			32		37	43	47	53	56		64	66	72
B12,5	4	16	24	34	39	47	51	57	62	67	68	74	79	83	89	95	9	15	16	21	28			32		37	43	46	53	57		64	66	72
B15	5	17	29	34	39	43	50	53	62	67	69	73	82	84	88	95	7	15	16	21	27			31		36	44	47	51	56		65	66	71
B15	5	17	21	34	39	43	50	54	62	67	69	74	82	84	89	95	7	15	16	21	27			32		37	44	47	51	57		65	66	72
B15	5	17	21	34	39	43	50	54	62	67	69	74	78	84	89	94	2	15	16	21	27			32		37	44	47	51	57		65	66	72
B15	5	17	22	34	39	43	50	56	62	67	69	74	81	84	89	95	7	15	16	21	29			32		37	42	47	53	57		64	66	72
B15	5	17	23	34	39	43	50	56	62	67	69	74	81	83	89	96	7	15	16	21	29			32		37	42	46	53	57		64	66	72
B15	5	17	24	34	39	43	50	57	62	67	69	74	81	83	90	96	7	15	16	21	29			33		38	42	46	53	57		64	66	73
B15	5	17	22	34	39	43	50	56	62	67	69	74	78	84	89	95	2	15	16	21	29			32		37	42	47	53	57		64	66	72
B15	5	17	23	34	39	43	50	56	62	67	69	74	78	83	89	95	2	15	16	21	29			32		37	42	46	53	57		64	66	72
B15	5	17	24	34	39	43	50	57	62	67	69	74	78	83	90	95	2	15	16	21	29			33		38	42	46	53	57		64	66	73
B15	5	17	22	34	39	43	50	56	62	67	69	74	79	84	89	95	9	15	16	21	29			32		37	42	47	53	57		64	66	72
B15	5	17	23	34	39	43	50	56	62	67	69	74	79	83	89	95	9	15	16	21	29			32		37	42	46	53	57		64	66	72
B15	5	17	24	34	39	43	50	57	62	67	69	74	79	83	90	95	9	15	16	21	29			33		38	42	46	53	57		64	66	73
B15	5	17	29	34	39	47	50	53	62	67	69	73	82	84	88	95	7	15	16	21	27			31		36	44	47	51	56		65	66	71
B15	5	17	21	34	39	47	50	54	62	67	69	74	82	84	88	95	7	15	16	21	27			31		36	44	47	51	56		65	66	71
B15	5	17	21	34	39	47	50	54	62	67	69	74	78	84	88	94	2	15	16	21	27			31		36	44	47	51	56		65	66	71
B15	5	17	22	34	39	47	50	56	62	67	69	74	81	84	89	95	7	15	16	21	29			32		37	42	47	53	57		64	66	72
B15	5	17	23	34	39	47	50	56	62	67	69	74	81	84	89	96	7	15	16	21	29			32		37	42	47	53	57		64	66	72
B15	5	17	24	34	39	47	50	57	62	67	69	74	81	83	89	96	7	15	16	21	29			32		37	42	46	53	57		64	66	72
B15	5	17	22	34	40	47	50	56	62	67	69	74	79	84	89	95	9	15	16	21	29			32		37	42	47	53	57		64	66	72
B15	5	17	23	34	40	47	50	56	62	67	69	74	79	84	89	95	9	15	16	21	29			32		37	42	47	53	57		64	66	72
B15	5	17	24	34	40	47	50	57	62	67	69	74	79	83	89	95	9	15	16	21	29			32		37	42	46	53	57		64	66	72
B15	5	17	22	34	39	47	50	56	62	67	69	74	78	84	89	95	2	15	16	21	29			32		37	42	47	53	57		64	66	72
B15	5	17	23	34	39	47	50	56	62	67	69	74	78	84	89	95	2	15	16	21	29			32		37	42	47	53	57		64	66	72
B15	5	17	24	34	39	47	50	57	62	67	69	74	78	83	89	95	2	15	16	21	29			32		37	42	46	53	57		64	66	72
B20	6	17	22	35	39	43	49	56	62	67	69	75	81	84	90	96	7	15	16	21	29			33		38	41	47	53	57		64	66	73
B20	6	17	23	35	39	43	49	56	62	67	69	75	81	83	90	96	7	15	16	21	29			33		38	41	46	53	58		64	66	73
B20	6	17	24	35	39	43	49	57	62	67	69	75	81	83	90	96	7	15	16	21	29			33		38	41	46	53	58		64	66	73
B20	6	17	22	35	39	43	49	56	62	67	69	75	78	84	90	95	2	15	16	21	29			33		38	41	47	53	57		64	66	73
B20	6	17	23	35	39	43	49	56	62	67	69	75	78	83	90	95	2	15	16	21	29			33		38	41	46	53	58		64	66	73
B20	6	17	24	35	39	43	49	57	62	67	69	75	78	83	90	95	2	15	16	21	29			33		38	41	46	53	58		64	66	73
B20	6	17	22	35	39	43	49	56	62	67	69	75	79	84	90	95	9	15	16	21	29			33		38	41	47	53	57		64	66	73
B20	6	17	23	35	39	43	49	56	62	67	69	75	79	83	90	95	9	15	16	21	29			33		38	41	46	53	58		64	66	73
B20	6	17	24	35	39	43	49	57	62	67	69	75	79	83	90	95	9	15	16	21	29			33		38	41	46	53	58		64	66	73
B20	6	17	21	35	40	47	50	54	62	67	69	74	81	84	89	95	7	15	16	21	29			32		37	41	47	51	57		65	66	72
B20	6	17	22	35	39	47	50	56	62	67	69	75	78	84	89	95	2	15	16	21	29			32		37	41	47	53	57		64	66	72
B20	6	17	23	35	39	47	50	56	62	67	69	75	78	84	89	95	2	15	16	21	29			32		37	41	47	53	57		64	66	72
B20	6	17	24	35	39	47	50	57	62	67	69	75	78	83	90	95	2	15	16	21	29			33		38	41	46	53	57		64	66	73
B20	6	17	22	35	36	47	50	56	62	67	69	75	79	84	89	95	10	15	16	21	29			32		37	41	47	53	57		64	66	72
B20	6	17	23	35	36	47	50	56	62	67	69	75	79	84	89	95	10	15	16	21	29			32		37	41	47	53	57		64	66	72
B20	6	17	24	35	36	47	50	57	62	67	69	75	79	83	90	96	10	15	16	21	29			33		38	41	46	53	57		64	66	73
B20	6	17	22	35	39	47	50	56	62	67	69	75	81	84	89	96	7	15	16	21	29			32		37	41	47	53	57		64	66	72
B20	6	17	23	35	39	47	50	56	62	67	69	75	81	84	89	96	7	15	16	21	29			32		37	41	47	53	57		64	66	72
B20	6	17	24	35	39	47	50	57	62	67	69	75	81	83	90	96	7	15	16	21	29			33		38	41	46	53	57		64	66	73
B20	6	17	22	30	36	47	50	56	62	67	69	75	81	84	89	96	1	15	16	21	29			32		37	41	47	53	57		64	66	72
B20	6	17	23	30	36	47	50	56	62	67	69	75	81	84	89	96	1	15	16	21	29			32		37	41	47	53	57		64	66	72
B20	6	17	24	30	36	47	50	57	62	67	69	75	81	83	90	96	1	15	16	21	29			33		38	41	46	53	57		64	66	73
B20	6	17	27	35	40	47	50	57	62	67	69	75	81	83	90	96	7	15	16	21	29			33		38	41	46	53	57		63	66	73
B20	6	17	27	35	40	47	49	57	58	63	69	74	81	83	90	96	7	11	20	25	29			33		38	44	46	53	58		65	66	73
B20	6	17	22	35	39	47	49	56	58	63	69	74	81	84	89	95	7	11	20	25	29			33		37	44	47	52	57		65	66	72
B20	6	17	23	35	39	47	49	56	58	63	69	74	81	84	89	95	7	11	20	25	29			33		37	44	46	52	57		65	66	72
B20	6	17	24	35	39	47	49	57	58	63	69	74	81	84	89	95	7	11	20	25	29			33		37	44	46	52	58		65	66	72
B22,5	7	18	21	30	40	43	48	54	62	67	70	75	80	84	89	96	7	15	16	21	30			33		37	41	47	51	57		65	66	72
B22,5	7	18	21	30	41	43	48	54	62	67	70	75	79	84	89	95	10	15	16	21	30			33		37	41	47	51	57		65	66	72
B22,5	7	18	22	30	40	43	48	56	62	67	70	75	79	83	90	96	10	15	16	21	30			33		38	41	46	53	58		64	66	73
B22,5	7	18	23	30	40	43	48	56	62	67	70	75	79	83	90	96	10	15	16	21	30			33		38	41	46	53	58		64	66	73
B22,5	7	18	24	30	40	43	48	57	62	67	70	76	79	83	91	96	10	15	16	21	30			34		39	41	46	53	58		64	66	74
B22,5	7	18	22	30	41	43	48	56	62	67	70	75	80	83	90	96	7	15	16	21	30			33		38	41	46	53	58		64	66	73
B22,5	7	18	23	30	41	43	48	56	62	67	70	75	80	83	90	96	7	15	16	21	30			33		38	41	46	53	58		64	66	73
B22,5	7	18	24	30	41	43	48	57	62	67	70	76	80	83	91	96	7	15	16	21	30			34		39	41	46	53	58		64	66	74
B22,5	7	18	26	30	41	43	48	57	62	67	70	76	80	83	91	97	7	15	16	21	30			34		39	41	46	53	58		64	66	74
B22,5	7	18	21	30	41	47	49	54	62	67	70	74	80	84	89	96	7	15	16	21	30			32		37	41	47	51	57		65	66	72
B22,5	7	18	21	30	41	47	49	54	62	67	70	74		84	89	93	5	15	16	21	30			32		37	41	47	51	57		65	66	72
B22,5	7	18	22	30	40	47	49	56	62	67	70	75	79	84	90	96	10	15	16	21	30			33		38	41	47	53	57		64	66	73
B22,5	7	18	23	30	40	47	49	56	62	67	70	75	79	83	90	96	10	15	16	21	30			33		38	41	46	53	58		64	66	73
B22,5	7	18	24	30	40	47	49	57	62	67	70	75	79	83	90	96	10	15	16	21	30			33		38	41	46	53	58		64	66	73
B22,5	7	18	22	30	41	47	49	56	62	67	70	75	80	84	90	96	7	15	16	21	30			33		38	41	47	53	57		64	66	73
B22,5	7	18	23	30	41	47	49	56	62	67	70	75	80	83	90	96	7	15	16	21	30			33		38	41	46	53	58		64	66	73
B22,5	7	18	24	30	41	47	49	57	62	67	70	75	80	83	90	96	7	15	16	21	30			33		38	41	46	53	58		64	66	73
B22,5	7	18	26	30	41	47	49	57	62	67	70	76	80	83	90	96	7	15	16	21	30			33		38	41	46	53	58		64	66	73
B25	8	18	21	31	41	47	49	54	62	67	70	74	80	84	89	96	7	15	16	21	30			32		37	41	47	51	57		65	66	72
B25	8	18	21	31	42	47	49	54	62	67	70	74	79	84	89	95	10	15	16	21	30			32		37	41	47	51	57		65	66	72
B25	8	18	22	31	41	47	49	56	62	67	70	75	80	84	90	96	7	15	16	21	30			33		38	41	47	53	58		64	66	73
B25	8	18	23	31	41	47	49	56	62	67	70	75	80	83	90	96	7	15	16	21	30			33		38	41	46	53	58		64	66	73
B25	8	18	24	31	41	47	49	57	62	67	70	75	80	83	90	96	7	15	16	21	30			33		38	41	46	53	58		64	66	73
B25	8	18	22	31	42	47	49	56	62	67	70	75	79	84	90	96	10	15	16	21	30			33		38	41	47	53	58		64	66	73
B25	8	18	23	31	42	47	49	56	62	67	70	75	79	83	90	96	10	15	16	21	30			33		38	41	46	53	58		64	66	73
B25	8	18	24	31	42	47	49	57	62	67	70	75	79	83	90	96	10	15	16	21	30			33		38	41	46	53	58		64	66	73
B25	8	18	25	31	41	47	49	57	62	67	70	76	80	83	91	96	7	15	16	21	30			34		39	41	46	53	58		64	66	74
B25	8	18	25	31	41	47	49	57	62	67	70	76	79	83	91	96	10	15	16	21	30			34		39	41	46	53	58		64	66	74
B25	8	18	21	31	41	47	49	54	62	67	70	75	80	84	89	96	7	15	16	21	30			32		37	41	47	51	57		65	66	72

B25	8	18	21	31	42	47	49	54	62	67	70	75	79	84	89	95	10	15	16	21	30			32		37	41	47	51	57		65	66	72
B25	8	18	22	31	41	47	49	56	62	67	70	75	80	84	90	96	7	15	16	21	30			33		38	41	47	53	58		64	66	73
B25	8	18	23	31	41	47	49	56	62	67	70	76	80	83	90	96	7	15	16	21	30			33		38	41	46	53	58		64	66	73
B25	8	18	24	31	41	47	49	57	62	67	70	76	80	83	90	97	7	15	16	21	30			33		38	41	46	53	58		64	66	73
B25	8	18	22	31	42	47	49	56	62	67	70	75	79	84	90	96	10	15	16	21	30			33		38	41	47	53	58		64	66	73
B25	8	18	23	31	42	47	49	56	62	67	70	76	79	83	90	96	10	15	16	21	30			33		38	41	46	53	58		64	66	73
B25	8	18	24	31	42	47	49	57	62	67	70	76	79	83	90	96	10	15	16	21	30			33		38	41	46	53	58		64	66	73
B25	8	18	25	31	42	47	49	57	62	67	70	76	80	83	91	97	7	15	16	21	30			34		39	41	46	53	58		64	66	74
B25	8	18	25	31	42	47	49	57	62	67	70	76	79	83	91	96	10	15	16	21	30			34		39	41	46	53	58		64	66	74
B30	9	19	23	32	37	47	48	56	62	67	71	75	80	83	91	96	1	15	16	21	30			34		39	41	46	53	58		64	66	74
B30	9	19	24	32	42	47	48	57	62	67	71	76	80	83	91	96	8	15	16	21	30			34		39	41	46	53	58		64	66	74
B30	9	19	25	32	42	47	48	57	62	67	71	76	80	83	91	97	8	15	16	21	30			34		39	41	46	54	59		64	66	74
B30	9	19	24	32	37	47	48	57	62	67	71	76	80	83	91	96	1	15	16	21	30			34		39	41	46	53	58		64	66	74
B30	9	19	25	32	37	47	48	57	62	67	71	76	80	83	91	97	1	15	16	21	30			34		39	41	46	54	59		64	66	74
B35	10	19	23	32	37	47	48	56	62	67	71	76	80	83	91	97	8	15	16	21	30			34		39	41	46	53	59		64	66	74
B35	10	19	24	32	37	47	48	57	62	67	71	76	80	83	91	97	8	15	16	21	30			34		39	41	46	53	59		64	66	74
B35	10	19	25	32	37	47	48	57	62	67	71	76	80	83	92	97	8	15	16	21	30			35		40	41	46	54	59		64	66	75
B35	10	19	24	32	37	47	48	57	62	67	71	76	80	83	91	97	1	15	16	21	30			34		39	41	46	53	59		64	66	74
B35	10	19	25	32	37	47	48	57	62	67	71	76	80	83	92	97	1	15	16	21	30			35		40	41	46	54	59		64	66	75
B40	11	20	23	32	38	47	48	56	62	67	72	76	80	83	92	97	7	15	16	21	30			35		40	41	46	53	59		64	66	75
B40	11	20	24	32	38	47	48	57	62	67	72	77	80	83	92	97	7	15	16	21	30			35		40	41	46	53	59		64	66	75
B40	11	20	25	32	38	47	48	57	62	67	72	77	80	83	92	97	7	15	16	21	30			35		40	41	46	54	60		64	66	75

Source: c:\Aidos-X\AID_DATA\A0000001\System\EventsKO.xlsx

Note that the Eidos system usually uses databases with the dbf extension. They open in MS Excel or can be converted to xlsx files using online services or in 5.12 mode (this mode of the Eidos system is written in Python).

Task-3. Synthesis of statistical and system-cognitive models. Multiparameter typing and partial knowledge criteria

This issue is discussed in more detail in [1].

Table6– Absolute frequency matrix (ABS statistical model)

		Classes					Sum
		1	*...*	*j*	*...*	*W*	
Factor values	*1*	N_{11}		N_{1j}		N_{1W}	
	...						
	i	N_{i1}		N_{ij}		N_{iW}	$N_{i\Sigma}=\sum_{j=1}^{W}N_{ij}$
	...						
	M	N_{M1}		N_{Mj}		N_{MW}	
Total number of features by class				$N_{\Sigma j}=\sum_{i=1}^{M}N_{ij}$			$N_{\Sigma\Sigma}=\sum_{i=1}^{W}\sum_{j=1}^{M}N_{ij}$
The total number of training sample objects by class				$N_{\Sigma j}$			$N_{\Sigma\Sigma}=\sum_{j=1}^{W}N_{\Sigma j}$

This issue is discussed in more detail in [1].

Table7 – Matrix of conditional and unconditional percentage distributions (statistical models PRC1 and PRC2)

		Classes					Unconditional Feature Probability
		1	...	j	...	W	
Factor values	1	P_{11}		P_{1j}		P_{1W}	
	...						
	i	P_{i1}		$P_{ij}=\frac{N_{ij}}{N_{\Sigma j}}$		P_{iW}	$P_{i\Sigma}=\frac{N_{i\Sigma}}{N_{\Sigma\Sigma}}$
	...						
	M	P_{M1}		P_{Mj}		P_{MW}	
Unconditional class probability				$P_{\Sigma j}$			

This issue is discussed in more detail in [1].

Let us pay special attention to the fact that the comparison of actual and theoretical absolute frequencies by division leads to zero when normalized (which is necessary for the application of additive integral criteria) by taking the logarithm and subtracting 1 to the same models as the comparison of conditional and unconditional relative frequencies by dividing with the same normalization methods. Thus, if, based on the absolute frequency matrix, we calculate the matrices of conditional and unconditional percentage distributions, and then compare the actual absolute frequencies with the theoretical ones by subtracting and dividing, and also compare the conditional and unconditional relative frequencies also by subtracting and dividing, and normalize to 0 by taking logarithm and by subtracting 1, then 3 statistical models are obtained: an absolute frequency matrix and two relative frequency matrices, those. conditional and unconditional percentage distributions, as well as a total of 7 system-cognitive models. There are simply no other system-cognitive models calculated on the basis of the above statistical models. This is the configurator of statistical and cognitive models in the sense of V.A. Lefevre. ***Under the configurator, V.A. Lefevre understood the minimum complete set of conceptual scales or constructs, i.e. concepts sufficient to adequately describe the subject area*** [1][1]. It should be noted that all these models are calculated in the Eidos intellectual system.

This issue is discussed in more detail in [1].

1See 1.2.1.2.1.1. Definition of the concept of a configurator, http://lc.kubagro.ru/aidos/aidos06_lec/index.htm

Table8– Various analytical forms of partial knowledge criteria used in ASC-analysis and the Eidos system

Name of the knowledge model and particular criterion	Expression for a particular criterion	
	Through relative frequencies	Through absolute frequencies
ABS, the matrix of absolute frequencies, Nij - the actual number of occurrences of the i-th attribute in objects of the j-th class; $\overline{N}_{ij}$ - the theoretical number of occurrences of the i-th feature in objects of the j-th class; Ni is the total number of features in the i-th line; Nj is the total number of features or objects of the training sample in the j-th class; N is the total number of features in the entire sample (Table 7)	$N_{ij} - фактическая\ частота;$ $N_i = \sum_{j=1}^{W} N_{ij};\ N_j = \sum_{i=1}^{M} N_{ij};\ N = \sum_{i=1}^{W}\sum_{j=1}^{M} N_{ij};$ $\overline{N}_{ij} = \frac{N_i N_j}{N} - теоретическая\ частота.$	
PRC1, the matrix of conditional Pij and unconditional Pi percentage distributions, Nj is the total number of features by class	---	$P_{ij} = \frac{N_{ij}}{N_j};\ P_i = \frac{N_i}{N}$
PRC2, the matrix of conditional Pij and unconditional Pi percentage distributions, Nj is the total number of training sample objects by class		
INF1, partial criterion: the amount of knowledge according to A. Kharkevich, 1st option for calculating probabilities: Nj - the total number of features for the j-th class. The probability that if an object of the j-th class has a feature, then this is the i-th feature	$I_{ij} = \Psi \times Log_2 \frac{P_{ij}}{P_i}$	$I_{ij} = \Psi \times Log_2 \frac{N_{ij}}{\overline{N}_{ij}} = \Psi \times Log_2 \frac{N_{ij} N}{N_i N_j}$
INF2, partial criterion: the amount of knowledge according to A. Kharkevich, 2nd option for calculating probabilities: Nj - the total number of objects in the j-th class. The probability that if an object of the j-th class is presented, then the i-th attribute will be found in it.		
INF3, partial test: Chi-square: differences between actual and theoretically expected absolute frequencies	---	$I_{ij} = N_{ij} - \overline{N}_{ij} = N_{ij} - \frac{N_i N_j}{N}$
INF4, partial criterion: ROI - Return On Investment, 1st option for calculating probabilities: Nj - the total number of features for the j-th class	$I_{ij} = \frac{P_{ij}}{P_i} - 1 = \frac{P_{ij} - P_i}{P_i}$	$I_{ij} = \frac{N_{ij}}{\overline{N}_{ij}} - 1 = \frac{N_{ij} N}{N_i N_j} - 1$
INF5, partial criterion: ROI - Return On Investment, 2nd option for calculating probabilities: Nj - the total number of objects in the j-th class		
INF6, partial criterion: difference between conditional and unconditional probabilities, 1st option for calculating probabilities: Nj – total number of features in the j-th class	$I_{ij} = P_{ij} - P_i$	$I_{ij} = \frac{N_{ij}}{N_j} - \frac{N_i}{N} = \frac{N_{ij} N - N_i N_j}{N_j N}$
INF7, particular criterion: the difference between the conditional and unconditional probabilities, 2nd option for calculating probabilities: Nj - the total number of objects in the j-th class		

Table designations: This issue is discussed in more detail in [1].

Table9– Matrix of the system-cognitive model

		Classes					Significance of the factor
		1	...	j	...	W	
Factor values	1	I_{11}		I_{1j}		I_{1W}	$\sigma_{1\Sigma}=\sqrt[2]{\frac{1}{W-1}\sum_{j=1}^{W}\left(I_{1j}-\bar{I}_1\right)^2}$
	...						
	i	I_{i1}		I_{ij}		I_{iW}	$\sigma_{i\Sigma}=\sqrt[2]{\frac{1}{W-1}\sum_{j=1}^{W}\left(I_{ij}-\bar{I}_i\right)^2}$
	...						
	M	I_{M1}		I_{Mj}		I_{MW}	$\sigma_{M\Sigma}=\sqrt[2]{\frac{1}{W-1}\sum_{j=1}^{W}\left(I_{Mj}-\bar{I}_M\right)^2}$
Class reduction degree		$\sigma_{\Sigma 1}$		$\sigma_{\Sigma j}$		$\sigma_{\Sigma W}$	$H=\sqrt[2]{\frac{1}{(W\cdot M-1)}\sum_{j=1}^{W}\sum_{i=1}^{M}\left(I_{ij}-\bar{I}\right)^2}$

This issue is discussed in more detail in [1].

Table10– Configurator of system-cognitive models of ASC-analysis and intellectual system "Eidos"

	Comparison method	Normalization is not required	Normalization to 0 by taking the logarithm	Normalization to 0 by subtracting 1
Comparison of actual and theoretical absolute frequencies	By division	---	INF1, INF2, Alexander Kharkevich	INF4, INF5, ROI
	By subtraction	INF3, Karl Pearson's χ-square	---	---
Comparison of conditional and unconditional relative frequencies	By division	---	INF1, INF2, Alexander Kharkevich	INF4, INF5, ROI
	By subtraction	INF6, INF7	---	---

This issue is discussed in more detail in [1].

It is significant that Karl Pearson's χ-squared measure model from statistics turned out to be mathematically closely related to the return on investment (ROI) used in economics in the theory of investment portfolio management and with Alexander Kharkevich's measure of information from semantic information theory and knowledge management theory. All these models are calculated in the Eidos intellectual system.

This issue is discussed in more detail in [1].

The solution of task-4: assessment of the reliability of the model, task-5: selection of the most reliable model, task-6: identification and forecasting, is given in [1]. In the same work, the integral criteria "Volume of knowledge" and "Semantic resonance of knowledge" are considered, as well as some important mathematical properties of integral criteria.

Table11– Clarification of the terminology of ASC analysis

No.	Traditional terms (synonyms)	New term	Formula
1	1. Significance of the value of the factor (attribute). 2. Differentiating power of the value of the factor (attribute). 3. The value of the factor (attribute) value for solving the problem of identification and other problems	The root of the information power of the factor value	$\sigma_{i\Sigma}=\sqrt[2]{\frac{1}{W-1}\sum_{j=1}^{W}\left(I_{ij}-\bar{I}_i\right)^2}$
2	1. The degree of determinism of the class. 2. The degree of conditionality of the class.	Root of class information power	$\sigma_{\Sigma j}=\sqrt[2]{\frac{1}{M-1}\sum_{i=1}^{M}\left(I_{ij}-\bar{I}_j\right)^2}$
3	1. The quality of the model. 2. The value of the model. 3. The degree of formation of the model. 4. Quantitative measure of the degree of severity of regularities in the modeled subject area	The root of the information power of the model	$H=\sqrt[2]{\frac{1}{(W\cdot M-1)}\sum_{j=1}^{W}\sum_{i=1}^{M}\left(I_{ij}-\bar{I}\right)^2}$

Solving the problem of identification and forecasting in the Eidos system

In ASC-analysis, advanced forecasting methods based on the scenario method of ASC-analysis or scenario ASC-analysis have been developed and implemented in the Eidos system. But the tasks of this work do not include their detailed consideration, especially since they are consecrated in detail both at the theoretical level and with detailed numerical examples in [4-7] and in a number of others.

Of these output forms, consider only two: 4.1.3.1 and 4.1.3.2 (Figure 18 in [1]). These output forms, taking into account what has been said above about the integral criteria of the "Eidos" system, are said to be "intuitive" and do not require special comments.

Task-7. Decision Support

The solution of task-7 is given in [1] and includes the following subtasks:

- simplified decision-making as an inverse forecasting problem, positive and negative information portraits of classes, SWOT analysis;
- a developed decision-making algorithm in adaptive intelligent control systems based on ASC-analysis and the Eidos system.

Task-8. Examining the object of modeling by examining its model

The solution of task-8 is given in [1] and includes the following subtasks:

- inverted SWOT Diagrams of Descriptive Scale Values (Semantic Potentials);
- cluster-constructive analysis of classes;
- cluster-constructive analysis of the values of descriptive scales;

- knowledge Model of the Eidos system and Nonlocal Neurons;
- non-local neural network;
- 3D Integral Cognitive Maps;
- 2D Integral Cognitive Maps of Meaningful Class Comparison (Mediated Fuzzy Plausible Reasoning);
- 2D-integrated cognitive maps of meaningful comparison of factor values (mediated fuzzy plausible reasoning);
- cognitive functions;
- significance of descriptive scales and their gradations.

Table12– The strength of the influence of factor values on the behavior of the simulation object in the INF4 SC-model

No.	No.%	Code	Factor value name	Significance, %	Significance cumulatively, %
1	1.333	61	WEIGHT BET. MIXTURES KG-1/5-{2068.4800000, 2129.4506545}	14,590	14,590
2	2.667	62	WEIGHT BET. MIXTURES KG-2/5-{2129.4506545, 2190.4213090}	8.674	23.264
3	4,000	4	ROCK OF CRUSHED STONE-Sand	6.576	29.840
4	5.333	50	SAND CONSUMPTION KG/M CUBE-5/5-{1372.7089945, 1578.0000000}	6.576	36.416
5	6.667	70	VOLUME BET. Sweep M CUBE-5/5-{0.9940000, 1.0000000}	6.576	42.992
6	8,000	55	WATER CONSUMPTION LITER/M CUBE-5/5-{241.2000000, 270.0000000}	6.524	49.516
7	9.333	60	CHEMICAL. ADDITIVE LITER/M CUBE-5/5-{4.1063608, 4.9000000}	5.659	55.175
8	10.667	5	ROAD OF CRUSHED STONE-SMS	4.019	59.194
9	12,000	40	CONSUMPTION OF CEMENT KG/M CUBE-5/5-{412.4996865, 490.0000000}	2.865	62.059
10	13.333	75	CHEM. APP. PLASTIF. KG/M KUB-5/5-{4.1249969, 4.9000000}	2.865	64.924
11	14.667	35	RASH. CEM. WITHOUT X EXT. KG/M KUB-5/5-{449.8119122, 533.7931034}	2.595	67.518
12	16,000	54	WATER CONSUMPTION LITER/M CUBE-4/5-{212.4000000, 241.2000000}	2.332	69.850
13	17.333	63	WEIGHT BET. MIXTURES KG-3/5-{2190.4213090, 2251.3919636}	2.199	72.049
14	18.667	eleven	COEFF. VOID RUBBER-1/5-{0.4669118, 0.4723974}	2.146	74.195
15	20,000	20	IST. DENSITY CRUSHED STONE KG/M KUB-5/5-{2706.0000000, 2720.0000000}	2.146	76.341
16	21.333	25	BULK DENSITY OF CRUSHED STONE-5/5-{1428.0000000, 1450.0000000}	2.146	78.487
17	22.667	52	WATER CONSUMPTION LITER/M CUBE-2/5-{154.8000000, 183.6000000}	2.041	80.528
18	24,000	59	CHEMICAL. ADDITIVE LITER/M CUBE-4/5-{3.3127216, 4.1063608}	1.555	82.084
19	25.333	8	ROAD OF CRUSHED STONE-hard rocks	1.325	83.409
20	26.667	26	COEFF. G SLIDING ZEREN-1/5-{1.1000000, 1.1920000}	1.223	84.632
21	28,000	45	CRUSHED STONE CONSUMPTION KG/M KUB-5/5-{1194.4559078, 1238.5724560}	1.223	85.856
22	29.333	39	CONSUMPTION OF CEMENT KG/M CUBE-4/5-{334.9993730, 412.4996865}	0.955	86.811
23	30.667	74	CHEM. APP. PLASTIF. KG/M KUB-4/5-{3.3499937, 4.1249969}	0.955	87.766
24	32,000	44	CRUSHED STONE CONSUMPTION KG/M KUB-4/5-{1150.3393596, 1194.4559078}	0.894	88.660
25	33.333	1	ROAD OF CRUSHED STONE-granite	0.891	89.550
26	34.667	34	RASH. CEM. WITHOUT X EXT. KG/M KUB-4/5-{365.8307210, 449.8119122}	0.795	90.346
27	36,000	27	COEFF. G SLIDING ZEREN-2/5-{1.1920000, 1.2840000}	0.699	91.045
28	37.333	51	WATER CONSUMPTION LITER/M CUBE-1/5-{126.0000000, 154.8000000}	0.528	91.572
29	38.667	65	WEIGHT BET. MIXTURES KG-5/5-{2312.3626181, 2373.3332726}	0.504	92.077
30	40,000	3	ROCK OF CRUSHED STONE-limestone	0.482	92.559
31	41.333	6	BREED OF GRINDED STONE-tv.p, gran	0.467	93.026
32	42.667	31	RASH. CEM. WITHOUT X EXT. KG/M KUB-1/5-{113.8871473, 197.8683385}	0.464	93.490
33	44,000	36	CONSUMPTION OF CEMENT KG/M CUB-1/5-{102.4984326, 179.9987461}	0.418	93.908
34	45.333	71	CHEM. APP. PLASTIF. KG/M KUB-1/5-{1.0249843, 1.7999874}	0.418	94.326
35	46.667	56	CHEMICAL. ADDITIVE LITER/M CUBE-1/5-{0.9318039, 1.7254431}	0.361	94.687
36	48,000	58	CHEMICAL. ADDITIVE LITER/M CUBE-3/5-{2.5190823, 3.3127216}	0.359	95.046
37	49.333	10	ROAD OF CRUSHED STONE - crushed stone.	0.345	95.391
38	50.667	thirty	COEFF. G SLIDING ZEREN-5/5-{1.4680000, 1.5600000}	0.335	95.726
39	52,000	38	CONSUMPTION OF CEMENT KG/M CUBE-3/5-{257.4990596, 334.9993730}	0.321	96.047
40	53.333	73	CHEM. APP. PLASTIF. KG/M KUB-3/5-{2.5749906, 3.3499937}	0.321	96.368
41	54.667	42	CRUSHED STONE CONSUMPTION KG/M KUB-2/5-{1062.1062633, 1106.2228115}	0.280	96.648
42	56,000	28	COEFF. G SLIDING ZEREN-3/5-{1.2840000, 1.3760000}	0.272	96.921
43	57.333	43	CRUSHED STONE CONSUMPTION KG/M KUB-3/5-{1106.2228115, 1150.3393596}	0.272	97.193
44	58.667	29	COEFF. G SLIDING ZEREN-4/5-{1.3760000, 1.4680000}	0.264	97.457
45	60,000	2	BREED OF CRUSHED STONE-KNOWN	0.263	97.720
46	61.333	33	RASH. CEM. WITHOUT X EXT. KG/M KUB-3/5-{281.8495297, 365.8307210}	0.249	97.969
47	62.667	37	CONSUMPTION OF CEMENT KG/M CUBE-2/5-{179.9987461, 257.4990596}	0.237	98.206

48	64,000	72	CHEM. APP. PLASTIF. KG/M KUB-2/5-{1.7999874, 2.5749906}	0.237	98.443
49	65.333	7	RING	0.234	98.677
50	66.667	57	CHEMICAL. ADDITIVE LITER/M CUBE-2/5-{1.7254431, 2.5190823}	0.207	98.884
51	68,000	41	CRUSHED STONE CONSUMPTION KG/M KUB-1/5-{1017.9897151, 1062.1062633}	0.198	99.081
52	69.333	32	RASH. CEM. WITHOUT X EXT. KG/M KUB-2/5-{197.8683385, 281.8495297}	0.192	99.273
53	70.667	46	SAND CONSUMPTION KG/M CUB-1/5-{551.5449724, 756.8359779}	0.190	99.463
54	72,000	47	SAND CONSUMPTION KG/M CUBE-2/5-{756.8359779, 962.1269834}	0.153	99.616
55	73.333	9	ROAD OF CRUSHED STONE - crushed stone.	0.138	99.754
56	74.667	53	WATER CONSUMPTION LITER/M CUBE-3/5-{183.6000000, 212.4000000}	0.072	99.826
57	76,000	64	WEIGHT BET. MIXTURES KG-4/5-{2251.3919636, 2312.3626181}	0.058	99.884
58	77.333	15	COEFF. VOID RUBBER-5/5-{0.4888540, 0.4943396}	0.031	99.916
59	78.667	16	IST. DENSITY CRUSHED STONE KG/M KUB-1/5-{2650.0000000, 2664.0000000}	0.031	99.947
60	80,000	21	BULK DENSITY OF CRUSHED STONE-1/5-{1340.0000000, 1362.0000000}	0.031	99.978
61	81.333	66	VOLUME BET. Sweep M CUBE-1/5-{0.9700000, 0.9760000}	0.022	100,000
62	82.667	12	COEFF. VOID Rubble-2/5-{0.4723974, 0.4778829}	0.000	100,000
63	84,000	13	COEFF. VOID RUBBER-3/5-{0.4778829, 0.4833685}	0.000	100,000
64	85.333	14	COEFF. VOID RUBBER-4/5-{0.4833685, 0.4888540}	0.000	100,000
65	86.667	17	IST. DENSITY CRUSHED STONE KG/M KUB-2/5-{2664.0000000, 2678.0000000}	0.000	100,000
66	88,000	18	IST. DENSITY CRUSHED STONE KG/M KUB-3/5-{2678.0000000, 2692.0000000}	0.000	100,000
67	89.333	19	IST. DENSITY CRUSHED STONE KG/M KUB-4/5-{2692.0000000, 2706.0000000}	0.000	100,000
68	90.667	22	BULK DENSITY OF CRUSHED STONE-2/5-{1362.0000000, 1384.0000000}	0.000	100,000
69	92,000	23	BULK DENSITY OF CRUSHED STONE-3/5-{1384.0000000, 1406.0000000}	0.000	100,000
70	93.333	24	BULK DENSITY OF CRUSHED STONE-4/5-{1406.0000000, 1428.0000000}	0.000	100,000
71	94.667	48	SAND CONSUMPTION KG/M CUBE-3/5-{962.1269834, 1167.4179890}	0.000	100,000
72	96,000	49	SAND CONSUMPTION KG/M CUBE-4/5-{1167.4179890, 1372.7089945}	0.000	100,000
73	97.333	67	VOLUME BET. Sweep M CUBE-2/5-{0.9760000, 0.9820000}	0.000	100,000
74	98.667	68	VOLUME BET. Sweep M CUBE-3/5-{0.9820000, 0.9880000}	0.000	100,000
75	100,000	69	VOLUME BET. Sweep M CUBE-4/5-{0.9880000, 0.9940000}	0.000	100,000

This issue is discussed in more detail in [1].

Table13– The strength of the influence of factors on the behavior of the object of modeling in the system-cognitive model INF4

No.	No.%	Code	Factor name	Significance factor a, %	Significance factor cumulatively, %
1	7.143	12	WEIGHT BET. MIXTURES KG	28.096	28.096
2	14.286	10	WATER CONSUMPTION LITER/M CUBE	12.411	40.507
3	21.429	eleven	CHEMICAL. ADDITIVE LITER/MCU	8.789	49.296
4	28.571	1	BREED OF GROUND STONE	7.956	57.253
5	35.714	9	SAND CONSUMPTION KG/M CUBE	7.470	64.723
6	42.857	13	VOLUME BET. SWEEP M CUBE	7.123	71.845
7	50,000	7	CONSUMPTION OF CEMENT KG/M CUBE	5.177	77.023
8	57.143	14	CHEM. APP. PLASTIF. KG/M CUBE	5.177	82.200
9	64.286	6	RASH. CEM. WITHOUT X EXT. KG/M CUBE	4.636	86.836
10	71.429	8	CRUSHED STONE CONSUMPTION KG/M CUBE	3.096	89.932
eleven	78.571	5	COEFF. G SLIDING GRAINS	3.016	92.948
12	85.714	2	COEFF. VOID STONE	2.351	95.299
13	92.857	3	IST. DENSITY CRUSHED STONE KG/M CUBE	2.351	97.649
14	100,000	4	BULK DENSITY OF CRUSHED STONE	2.351	100,000

Table 17 shows that approximately 28% of the total influence on the behavior of the modeled object is due to the weight of the concrete mixture, another 12% of the influence is due to water consumption, and chemical additives have a relatively smaller influence: about 9%. Thus, these three factors in total, i.e. 21% of all factors provide approximately 50% of the total influence on the object of modeling, and 50% of the most significant factors give a total of 77% of the influence. The strongest factor: "Weight of the concrete mix", is about 12 times stronger than the weakest one: "True density of crushed stone".

Degree of determinism of classes and classification scales

This issue is discussed in more detail in [1]. Table 18 presents the initial data for constructing the cumulative curve in Figure 40 in [1].

Table 18 shows what proportion of the total degree of determinism of all classes each class has. The degree of conditionality by the values of the factors of different future states of the modeling object, corresponding to the classes, is quite significantly different from each other.

For example, only 16% of the most rigidly deterministic classes have a total of approximately 50% degree of determinism, and 50% of the most deterministic classes provide about 90% of the total determinism of all classes.

Table14– The degree of determinism of classes in the CK-model INF3

No.	No.%	Code	Class name	Significance, %	Significance cumulative, %
1	1.031	62	K1 - COEFF. CHEM. SUPPLEMENTS-5/5-{0.9, 0.9}	5.933	5.933
2	2.062	67	K2 - COEFF. ACCOUNTING H.D. STRONG-5/5-{1.1, 1.2}	5.933	11.867
3	3.093	47	BRAND ACTIVITY OF CEMENT-5/5-{480.0, 500.0}	4.038	15.904
4	4.124	39	GRADE ON VODONEPR-W2	3.749	19.654
5	5.155	84	STAND. SAND RUB-2/5-{252.0, 320.4}	3.090	22.744
6	6.186	34	FROST GRADE-F50	3.049	25.793
7	7.216	83	STAND. SAND RUB-1/5-{183.7, 252.0}	3.008	28.801
8	8.247	56	WATER PERMEABILITY-4/5-{200.0, 220.0}	2.925	31.726
9	9.278	95	TOTAL COST OF FSG RUB/M CUBE-3/5-{1730.0, 2041.2}	2.637	34.363
10	10.309	43	BRAND ACTIVITY OF CEMENT-1/5-{400.0, 420.0}	2.307	36.671
11	11,340	89	STAND. PLASTIF. RUB-2/5-{63.0, 90.1}	2.307	38.978
12	12.371	17	STRENGTH GRADE-2/5-{190.0, 280.0}	2.184	41.162
13	13.402	57	WATER PERMEABILITY-5/5-{220.0, 240.0}	2.143	43.304
14	14.433	96	TOTAL COST OF FSG RUB/M CUB-4/5-{2041.2, 2352.4}	2.143	45.447
15	15.464	69	MARK BETH. MIXTURES M KG/SM KV-2/5-{190.0, 280.0}	2.101	47.548
16	16.495	16	STRENGTH GRADE-1/5-{100.0, 190.0}	2.060	49.609
17	17.526	74	STAND. CEMENT RUB-2/5-{547.3, 774.3}	2.019	51.628
18	18.557	75	STAND. CEMENT RUB-3/5-{774.3, 1001.3}	1.937	53.564
19	19.588	68	MARK BETH. MIXTURES M KG/SM KV-1/5-{100.0, 190.0}	1.895	55.459
20	20.619	23	STANDARD BRAND-P3	1.772	57.231
21	21.649	49	W/C WATER-CEMENT RATIO-2/5-{0.6, 0.8}	1.731	58.962
22	22.680	90	STAND. PLASTIF. RUB-3/5-{90.1, 117.2}	1.731	60.692
23	23.711	24	STANDARD BRAND-P4	1.607	62.299
24	24.742	79	STAND. RUBBER-2/5-{807.2, 892.1}	1.607	63.906
25	25.773	80	STAND. RUBBER-3/5-{892.1, 977.0}	1.607	65.513
26	26.804	18	STRENGTH GRADE-3/5-{280.0, 370.0}	1.566	67.079
27	27.835	50	W/C WATER-CEMENT RATIO-3/5-{0.8, 0.9}	1.566	68.644
28	28.866	70	MARK BETH. MIXTURES M KG/SM KV-3/5-{280.0, 370.0}	1.566	70.210
29	29.897	81	STAND. RUBBER-4/5-{977.0, 1062.0}	1.442	71.652
30	30.928	22	STANDARD BRAND-P2	1.401	73.053
31	31.959	88	STAND. PLASTIF. RUB-1/5-{35.9, 63.0}	1.319	74.372
32	32.990	73	STAND. CEMENT RUB-1/5-{320.3, 547.3}	1.236	75.608
33	34.021	6	STRENGTH CLASS COMPRESSION-B20	1.112	76.720
34	35.052	78	STAND. RUBBER-1/5-{722.2, 807.2}	1.071	77.792
35	36.082	2	STRENGTH CLASS COMPRESSION-IN-7.5	0.989	78.780
36	37.113	5	STRENGTH CLASS COMPRESSION-B15	0.989	79.769
37	38.144	35	FROST GRADE-F75	0.989	80.758
38	39.175	52	W/C WATER-CEMENT RATIO-5/5-{1.1, 1.2}	0.989	81.747
39	40.206	76	STAND. CEMENT RUB-4/5-{1001.3, 1228.3}	0.989	82.736
40	41.237	94	TOTAL COST OF FSG RUB/M CUB-2/5-{1418.8, 1730.0}	0.948	83.684
41	42.268	48	W/C WATER-CEMENT RATIO-1/5-{0.4, 0.6}	0.906	84.590
42	43.299	51	W/C WATER-CEMENT RATIO-4/5-{0.9, 1.1}	0.906	85.496
43	44.330	thirty	FROST GRADE-F100	0.865	86.362
44	45.361	41	GRADE ON VODONEPR-W6	0.865	87.227
45	46.392	8	STRENGTH CLASS COMPRESSION-B25	0.824	88.051
46	47.423	31	FROST GRADE-F150	0.824	88.875
47	48.454	4	STRENGTH CLASS COMPRESSION-B12.5	0.742	89.617
48	49.485	7	STRENGTH CLASS COMPRESSION-B22.5	0.742	90.358

49	50.515	21	BRAND FOR SURFACE-J1	0.700	91.059
50	51.546	54	WATER PERMEABILITY-2/5-{160.0, 180.0}	0.700	91.759
51	52.577	91	STAND. PLASTIF. RUB-4/5-{117.2, 144.4}	0.700	92.460
52	53.608	32	FROST GRADE-F200	0.536	92.995
53	54.639	40	GRADE ON VODONEPR-W4	0.536	93.531
54	55.670	97	TOTAL COST OF FSG RUB/M CUB-5/5-{2352.4, 2663.6}	0.536	94.067
55	56.701	42	GRADE ON VODONEPR-W8	0.494	94.561
56	57.732	19	STRENGTH GRADE-4/5-{370.0, 460.0}	0.412	94.973
57	58.763	71	MARK BETH. MIXTURES M KG/SM KV-4/5-{370.0, 460.0}	0.412	95.385
58	59.794	25	BRAND ON DOBOOKL.-P5 b. us.	0.371	95.756
59	60.825	37	GRADE ON VODONEPR-W10	0.330	96.086
60	61.856	53	WATER PERMEABILITY-1/5-{140.0, 160.0}	0.330	96.415
61	62.887	82	STAND. RUBBER-5/5-{1062.0, 1146.9}	0.330	96.745
62	63.918	92	STAND. PLASTIF. RUB-5/5-{144.4, 171.5}	0.288	97.033
63	64.948	36	GRADE ON VODONEPR-W 4	0.247	97.281
64	65.979	87	STAND. SAND RUB-5/5-{457.1, 525.5}	0.247	97.528
65	67.010	9	STRENGTH CLASS COMPRESSION-B30	0.206	97.734
66	68.041	10	STRENGTH CLASS COMPRESSION-B35	0.206	97.940
67	69.072	29	BRAND ON DOBOOKL.-SZh2	0.206	98.146
68	70.103	58	K1 - COEFF. CHEM. ADDITIVE-1/5-{0.8, 0.8}	0.165	98.311
69	71.134	63	K2 - COEFF. ACCOUNTING H.D. STRONG-1/5-{1.0, 1.0}	0.165	98.475
70	72.165	77	STAND. CEMENT RUB-5/5-{1228.3, 1455.3}	0.165	98.640
71	73.196	1	STRENGTH CLASS COMPRESSION-B12.5	0.124	98.764
72	74.227	eleven	STRENGTH CLASS COMPRESSION-B40	0.124	98.888
73	75.258	20	STRENGTH GRADE-5/5-{460.0, 550.0}	0.124	99.011
74	76.289	28	BRAND ON DOBOOKL.-SZh-2	0.124	99.135
75	77.320	38	GRADE ON VODONEPR-W12	0.124	99.258
76	78.351	72	MARK BETH. MIXTURES M KG/SM KV-5/5-{460.0, 550.0}	0.124	99.382
77	79.381	14	STRENGTH CLASS COMPRESSION-M150	0.082	99.464
78	80.412	15	STRENGTH CLASS COMPRESSION-M200	0.082	99.547
79	81.443	26	BRAND ON DOBOOKL.-P5 b.us	0.082	99.629
80	82.474	27	BRAND ON DOBOOKL.-P5 (b us)	0.082	99.712
81	83.505	33	FROST GRADE-F25	0.082	99.794
82	84.536	93	TOTAL COST OF FSG RUB/M CUB-1/5-{1107.6, 1418.8}	0.082	99.876
83	85.567	3	STRENGTH CLASS COMPRESSION-IN 12.5	0.041	99.918
84	86.598	12	STRENGTH CLASS IN COMPRESSION-M 100	0.041	99.959
85	87.629	13	STRENGTH CLASS COMPRESSION-M100	0.041	100,000
86	88.660	44	BRAND ACTIVITY OF CEMENT-2/5-{420.0, 440.0}	0.000	100,000
87	89.691	45	BRAND ACTIVITY OF CEMENT-3/5-{440.0, 460.0}	0.000	100,000
88	90.722	46	BRAND ACTIVITY OF CEMENT-4/5-{460.0, 480.0}	0.000	100,000
89	91.753	55	WATER PERMEABILITY-3/5-{180.0, 200.0}	0.000	100,000
90	92.784	59	K1 - COEFF. CHEM. SUPPLEMENTS-2/5-{0.8, 0.8}	0.000	100,000
91	93.814	60	K1 - COEFF. CHEM. SUPPLEMENTS-3/5-{0.8, 0.9}	0.000	100,000
92	94.845	61	K1 - COEFF. CHEM. SUPPLEMENTS-4/5-{0.9, 0.9}	0.000	100,000
93	95.876	64	K2 - COEFF. ACCOUNTING H.D. STRONG-2/5-{1.0, 1.1}	0.000	100,000
94	96.907	65	K2 - COEFF. ACCOUNTING H.D. STRONG-3/5-{1.1, 1.1}	0.000	100,000
95	97.938	66	K2 - COEFF. ACCOUNTING H.D. STRONG-4/5-{1.1, 1.1}	0.000	100,000
96	98.969	85	STAND. SAND RUB-3/5-{320.4, 388.8}	0.000	100,000
97	100,000	86	STAND. SAND RUB-4/5-{388.8, 457.1}	0.000	100,000

Table 19 provides information on the degree of determinism of classes by the values of factors in the INF3 system-cognitive model. The degree of determination of classification scales is the average of the degree of determination of their gradations.

Table15– The degree of determinism of classification scales in the system-cognitive model INF3

No.	No.%	Code	Name of the classification scale	Degree determinism, %	Degree determinism cumulative, %
1	6.250	2	STRENGTH GRADE	7.044	7.044
2	12,500	6	GRADE ACTIVITY OF CEMENT	7.044	14.088
3	18,750	12	STAND. CEMENT RUB	7.044	21.132
4	25,000	14	STAND. SAND RUB	7.044	28.176

5	31.250	15	STAND. PLASTIF. RUB	7.044	35.221
6	37,500	16	TOTAL COST OF FSG RUB/M CUBE	7.044	42.265
7	43.750	7	W/C WATER CEMENT REL.	6,770	49.034
8	50,000	8	WATER PERMEABILITY	6,770	55.804
9	56.250	9	K1 - COEFF. CHEM. ADDITIVES	6,770	62.574
10	62,500	10	K2 - COEFF. ACCOUNTING H.D. ON STRENGTH	6,770	69.343
11	68.750	11	MARK BETH. MIXTURES M KG/SM KV	6,770	76.113
12	75,000	13	STAND. rubble RUB	6.724	82.837
13	81.250	4	BRAND FOR FROST.	5,870	88.707
14	87,500	5	BRAND ON VODONEPR	5.032	93.739
15	93.750	3	COMFORTABLE BRAND	3.913	97.652
16	100,000	1	STRENGTH CLASS WHEN COMPRESSED	2.348	100,000

The discussion and conclusions are given in [1] and it is inappropriate to cover them in detail in this article.

В заключение остается добавить, что в работе [1] все желающие могут ознакомиться с полным вариантом данной статьи на русском языке.

REFERENCES

1. Lutsenko E.V. Automated system-cognitive analysis of the influence of concrete composition on its physical and mechanical properties and cost // July 2023, DOI: 10.13140/RG.2.2.14701.56804, License CC BY 4.0, https://www.researchgate.net/publication/372591270