To develop a methodology for finding the competencies of agricultural workers with a positive economic return

Anna Aletdinova[1 2 *], *Zoya* Kapelyuk[3], *Marina* Drozdova[3], and *Svetlana* Gorodkova[3]

[1] Novosibirsk State Technical University, Automated Control System Department, 630073, Novosibirsk, Russia
[2] National University of Oil and Gas «Gubkin University», Automated Control System Department, 119991, Moscow, Russia
[3] Siberian University of the Consumer Cooperation, Department of Theoretical and Applied Economics, 630087, Novosibirsk, Russia

Abstract. The paper describes a study by the example of processing the results of a survey of 200 employees of the agro-industrial complex on psychological tests, work experience and salary level. The authors identified the following groups of competencies: intellectual and educational, communicative, motivational and volitional, management. 15 psychological tests were used to assess their presence in respondents. After correlation and variance analyses, a statistically significant model of the dependence of the wage level on 12 indicators was obtained: ability and readiness for self-development and self-education, tolerance, high motivation for success, self-actualization of personality, strong interest in professional development, focus on interaction, high level of emotional intelligence. At the same time, it can be used in research only for the agricultural complex at the current time, i.e., at the beginning of the sixth technological order.

1 Introduction

An important factor in economic development, digitalization and the introduction of new technologies is the development of digital culture, the creation of a new educational environment, the development of technological infrastructure and the formation of human capital. This is also proved by the results of the Digital IQ study, which examines the impact of investments in digital technologies and systems. Any success of the transformation, the transition to a new technological order will depend on not only the intensification of technologies, the use of special sensors, algorithms, analytical tools and information systems, etc., but also on human capital. Organizations of the agro-industrial complex should attract, retain and train specialists of the "digital generation" who form the information society and possess the competencies that are most in demand in their field of activity.

The change in the functions of workers and the conditions of technological development of the agro-industrial complex will inevitably lead to the expansion of forms of employment, changes in working hours, the erasure of territorial boundaries, increased flexibility of labor, the transfer of economic and social activities to the Internet environment, the urbanization of agriculture.

We believe that in addition to classical factors such as education, seniority, place of residence, influencing the formation of human capital, a person's entrepreneurial abilities, high motivation for success and achievement of goals, free orientation on the Internet and possession of information and communication technologies, access to open knowledge can be significant. This is confirmed by the studies of N. Frederiksen, Tangney, V. Bouchard, S. Zaika, O. Gridin, D. Rusmingsih, E. L. Widarni, S. Bawono [1–5].

Drastic changes in the life of a modern person, increasing the pace of interaction in everyday life and production activities have influenced the paradigm of training specialists, i.e. there was a need to move from a qualification model to a competence model. Modern employees should continuously engage in self-education, expand and improve their competencies [6].

It is difficult for researchers to numerically assess most of the competencies of employees, because it is necessary to take into account the psychophysical state of a person, willpower, hereditary traits, so scientists suggest resorting to the use of psychodiagnostic methods. There are several areas of competence research at the interface with psychology:

- contradictions of professional competencies and intrapersonal conflict [7],
- assessment of cognitive characteristics of a person [8, 9],
- identification of success factors in the professional activity of an employee [10],
- economic and legal aspects of competencies, including assessment of economic impact [11–14].

As our analysis of scientific publications has shown, the least attention is paid to the creation of methods for psychodiagnostics of cognitive characteristics of an

* Corresponding author: aletdinova@corp.nstu.ru

employee that form his competencies. And such methods can be developed both for individual industries and be universal.

The purpose of the study is to select and substantiate a set of competencies/psychodiagnosis techniques to identify the competencies of agricultural workers in terms of informative features that affect the amount of wages.

2 Materials and methods

This section includes the main theoretical approaches and terms used in the study, as well as methodological justification and the main steps of scientific work.

2.1. Materials

Let us highlight the approaches and terms that will be used in the work.

First, let us introduce a restriction. We will consider competencies within the framework of a person's professional activity. Competencies are formally described requirements for personal, professional, etc. qualities of employees necessary for the successful functioning of the activities of entrepreneurs and/or organizations.

Professional competencies in Russia are determined by educational standards for educational institutions of different levels.

Critical competencies imply the competencies that are most in demand for this technological stage and this field of activity (and for our research for the agro-industrial complex) in the labor market. They are constantly changing in the process of economic development.

The set of competencies will be divided into the following groups: intellectual and educational, communicative, motivational and volitional, management.

A positive economic return implies an increase in the level of wages if the employee has the competence in question.

2.2. Research methods

To assess competencies, the authors chose the following methods of psychodiagnostics and labeled the results of them as variables:

- Assessment of the ability to self-development and self-education (SC1),
- Readiness for self-development (SC2),
- Creativity (SC3),
- Tolerance index (SC4),
- Communicative tolerance (SC5),
- Diagnosis of interference in establishing emotional contacts (SC6),
- The need to achieve a goal (SC7),
- Measuring tolerance (SC8),
- Resilience (SC9),
- Degree of risk tolerance (SC10),
- Motivation for success (SC11),
- The level of self-actualization of the individual (SC12),
- Morphological test of life values (SC13),
- Diagnosis of personality orientation (SC14),
- Emotional Intelligence (SC15).

The sample size of respondents is 200 employees of the agro-industrial complex. Correlation and variance analyses of the respondents' test results were used for the study.

The hypothesis in the study was that in the presence of the competencies in question, agricultural workers, with other identical characteristics have a higher salary level.

Let us introduce additional notation. The variable Y is salary, Ex – work experience, Scn – points obtained by psychodiagnostics methods for assessing competencies. Let us conduct a correlation analysis between the variables: SC1, SC2, SC3, SC4, SC5, SC6, SC7, SC8, SC9, SC10, SC11, SC12, SC13, SC14, SC15, Ex, Scn, Y.

3 Results and discussion

Let us construct a correlation matrix for the values: SC1, SC2, SC3, SC4, SC5, SC6, SC7, SC8, SC9, SC10, SC11, SC12, SC13, SC14, SC15, Ex, Scn, Y (Figure 1).

	Correlations (Spreadsheet1.sta)															
Variable	Ex	Sc1	Sc2	Sc3	Sc4	Sc5	Sc6	Sc7	Sc8	Sc9	Sc10	**Sc11**	Sc12	Sc13	Sc14	Sc15
Ex	1,000000	0,047183	0,170304	0,092099	0,074366	0,040908	0,006842	-0,016326	-0,048044	0,154161	-0,186372	0,096990	0,073491	0,188004	0,073661	0,126994
Sc1	0,047183	1,000000	0,139161	0,039356	0,096988	0,138504	0,092927	0,167893	0,119871	0,153907	0,028481	0,271680	0,343711	0,270739	0,163568	0,128322
Sc2	0,170304	0,139161	1,000000	-0,036054	0,033676	-0,096083	0,066945	0,135212	0,134274	0,171415	0,041675	0,224454	0,235648	0,216815	0,077466	0,120585
Sc3	0,092099	0,039356	-0,036054	1,000000	-0,014263	0,163357	-0,131310	0,075111	0,035610	0,059920	0,107189	-0,012923	-0,071226	0,012515	0,023235	0,047760
Sc4	0,074366	0,096988	0,033676	-0,014263	1,000000	0,152372	-0,011966	-0,018140	0,036009	0,190041	0,032635	0,103281	0,081165	0,216422	-0,044824	0,123077
Sc5	0,040908	0,138504	-0,096083	0,163357	0,152372	1,000000	-0,004160	0,162258	0,002959	0,118862	-0,019839	-0,001697	0,003284	0,019819	-0,014694	-0,088902
Sc6	0,006842	0,092927	0,066945	-0,131310	-0,011966	-0,004160	1,000000	0,052630	0,130591	0,042378	0,091283	0,027510	0,101005	-0,032549	0,059373	-0,009743
Sc7	-0,016326	0,167893	0,135212	0,075111	-0,018140	0,162258	0,052630	1,000000	0,090978	0,198081	-0,053921	0,147820	0,003849	0,027335	0,082424	0,072293
Sc8	-0,048044	0,119871	0,134274	0,035610	0,036009	0,002959	0,130591	0,090978	1,000000	0,144597	0,149935	0,088241	0,132236	0,121875	0,160746	0,031603
Sc9	0,154161	0,153907	0,171415	0,059920	0,190041	0,118862	0,042378	0,198081	0,144597	1,000000	0,022682	0,295426	0,292830	0,344737	0,275787	0,171419
Sc10	-0,186372	0,028481	0,041675	0,107189	0,032635	-0,019839	0,091283	-0,053921	0,149935	0,022682	1,000000	-0,021957	0,094371	-0,000425	0,040515	0,127369
Sc11	0,096990	0,271680	0,224454	-0,012923	0,103281	-0,001697	0,027510	0,147820	0,088241	0,295426	-0,021957	1,000000	0,350777	0,431834	0,208548	0,225724
Sc12	0,073491	0,343711	0,235648	-0,071226	0,081165	0,003284	0,101005	0,003849	0,132236	0,292830	0,094371	0,350777	1,000000	0,431536	0,241613	0,150247
Sc13	0,188004	0,270739	0,216815	0,012515	0,216422	0,019819	-0,032549	0,027335	0,121875	0,344737	-0,000425	0,431834	0,431536	1,000000	0,066395	0,329838
Sc14	0,073661	0,163568	0,077466	0,023235	-0,044824	-0,014694	0,059373	0,082424	0,160746	0,275787	0,040515	0,208548	0,241613	0,066395	1,000000	-0,002798
Sc15	0,126994	0,128322	0,120585	0,047760	0,123077	-0,088902	-0,009743	0,072293	0,031603	0,171419	0,127369	0,225724	0,150247	0,329838	-0,002798	1,000000
SL	0,194779	0,425411	0,352219	-0,011122	0,255196	0,069729	0,114075	0,168756	0,248407	0,567190	0,057575	0,625649	0,609094	0,623885	0,321021	0,369564

Fig. 1. Correlation matrix.

As we can see from the table, no factor forms a strong correlation. There is no multicorrelationality.

Let us output a table with the level of significance of the factors.

N=178	Regression Summary for Dependent Variable: SL (Spreadsheet1.sta) R= ,88309730 R?= ,77986085 Adjusted R?= ,75798366 F(16,161)=35,647 p<0,0000 Std.Error of estimate: 8,4008					
	b*	Std.Err. of b*	b	Std.Err. of b	t(161)	p-value
Intercept			-117,763	12,85009	-9,16440	0,000000
Ex	0,033216	0,039768	0,046	0,05475	0,83525	0,404814
Sc1	0,107864	0,041403	0,804	0,30845	2,60520	0,010042
Sc2	0,093989	0,040039	0,739	0,31471	2,34744	0,020119
Sc3	-0,021472	0,038826	-0,024	0,04386	-0,55304	0,581004
Sc4	0,087572	0,039038	0,078	0,03497	2,24323	0,026246
Sc5	0,031128	0,039591	0,014	0,01774	0,78623	0,432886
Sc6	0,045149	0,038271	0,081	0,06831	1,17972	0,239851
Sc7	0,018139	0,039765	0,159	0,34860	0,45616	0,648887
Sc8	0,083923	0,038881	1,402	0,64945	2,15847	0,032373
Sc9	0,229786	0,043214	0,324	0,06090	5,31743	0,000000
Sc10	-0,000818	0,039477	-0,001	0,02727	-0,02072	0,983494
Sc11	0,268531	0,043710	0,913	0,14864	6,14344	0,000000
Sc12	0,236365	0,045167	0,334	0,06379	5,23311	0,000001
Sc13	0,193070	0,047453	0,201	0,04934	4,06866	0,000074
Sc14	0,091964	0,040434	1,317	0,57902	2,27443	0,024261
Sc15	0,130825	0,040593	0,074	0,02308	3,22282	0,001537

Fig. 2. Significance levels of the model.

It is necessary to remove those factors whose significance level is $p \geq 0,05$. In our case, this refers to the variable "Work experience" and to competencies 3, 5, 6, 7, 10. It is necessary to consistently remove these factors from the regression equation, starting with the factor whose significance level is higher than the others are, each time rebuilding the model anew (Figure 3, 4, 5, 6. 7, 8).

N=178	Regression Summary for Dependent Variable: SL (Spreadsheet1.sta) R= ,88309697 R?= ,77986026 Adjusted R?= ,75947695 F(15,162)=38,260 p<0,0000 Std.Error of estimate: 8,3748					
	b*	Std.Err. of b*	b	Std.Err. of b	t(162)	p-value
Intercept			-117,735	12,73534	-9,24472	0,000000
Ex	0,033397	0,038672	0,046	0,05325	0,86360	0,389084
Sc1	0,107873	0,041273	0,804	0,30748	2,61364	0,009802
Sc2	0,093943	0,039852	0,738	0,31324	2,35729	0,019604
Sc3	-0,021590	0,038288	-0,024	0,04325	-0,56389	0,573610
Sc4	0,087541	0,038889	0,078	0,03484	2,25104	0,025728
Sc5	0,031131	0,039469	0,014	0,01769	0,78875	0,431414
Sc6	0,045077	0,037992	0,080	0,06781	1,18648	0,237170
Sc7	0,018215	0,039475	0,160	0,34606	0,46142	0,645116
Sc8	0,083831	0,038508	1,400	0,64322	2,17698	0,030929
Sc9	0,229781	0,043079	0,324	0,06071	5,33388	0,000000
Sc11	0,268584	0,043500	0,913	0,14793	6,17430	0,000000
Sc12	0,236283	0,044856	0,334	0,06335	5,26760	0,000000
Sc13	0,193118	0,047251	0,201	0,04913	4,08707	0,000069
Sc14	0,091940	0,040293	1,317	0,57700	2,28179	0,023803
Sc15	0,130694	0,039975	0,074	0,02273	3,26943	0,001316

Fig. 3. Significance levels of the model when excluding Sc10.

N=178	Regression Summary for Dependent Variable: SL (Spreadsheet1.sta) R= ,88293315 R?= ,77957094 Adjusted R?= ,76063838 F(14,163)=41,176 p<0,0000 Std.Error of estimate: 8,3546					
	b*	Std.Err. of b*	b	Std.Err. of b	t(163)	p-value
Intercept			-116,908	12,57827	-9,29446	0,000000
Ex	0,032183	0,038489	0,044	0,05299	0,83616	0,404289
Sc1	0,110289	0,040841	0,822	0,30426	2,70047	0,007655
Sc2	0,096231	0,039447	0,756	0,31005	2,43952	0,015779
Sc3	-0,020920	0,038168	-0,024	0,04311	-0,54811	0,584365
Sc4	0,086151	0,038679	0,077	0,03465	2,22735	0,027293
Sc5	0,033890	0,038919	0,015	0,01744	0,87080	0,385146
Sc6	0,045650	0,037880	0,081	0,06761	1,20512	0,229905
Sc8	0,084576	0,038381	1,413	0,64110	2,20359	0,028955
Sc9	0,232978	0,042416	0,328	0,05977	5,49270	0,000000
Sc11	0,270574	0,043181	0,920	0,14685	6,26597	0,000000
Sc12	0,233891	0,044448	0,330	0,06277	5,26217	0,000000
Sc13	0,191542	0,047013	0,199	0,04888	4,07420	0,000072
Sc14	0,092157	0,040193	1,320	0,57557	2,29286	0,023134
Sc15	0,131828	0,039802	0,075	0,02263	3,31206	0,001141

Fig. 4. Significance levels of the model when excluding Sc10, Sc7.

N=178	Regression Summary for Dependent Variable: SL (Spreadsheet1.sta) R= ,88270304 R?= ,77916467 Adjusted R?= ,76165943 F(13,164)=44,510 p<0,0000 Std.Error of estimate: 8,3367					
	b*	Std.Err. of b*	b	Std.Err. of b	t(164)	p-value
Intercept			-117,901	12,42068	-9,49228	0,000000
Ex	0,030338	0,038260	0,042	0,05268	0,79294	0,428960
Sc1	0,109263	0,040711	0,814	0,30329	2,68389	0,008024
Sc2	0,096843	0,039347	0,761	0,30927	2,46127	0,014880
Sc4	0,087375	0,038532	0,078	0,03452	2,26761	0,024659
Sc5	0,030576	0,038364	0,014	0,01719	0,79699	0,426608
Sc6	0,048465	0,037450	0,087	0,06685	1,29412	0,197444
Sc8	0,083341	0,038233	1,392	0,63863	2,17982	0,030696
Sc9	0,231891	0,042279	0,327	0,05958	5,48478	0,000000
Sc11	0,271051	0,043080	0,922	0,14650	6,29174	0,000000
Sc12	0,235983	0,044189	0,333	0,06241	5,34032	0,000000
Sc13	0,191551	0,046913	0,199	0,04878	4,08312	0,000069
Sc14	0,091655	0,040097	1,313	0,57419	2,28585	0,023543
Sc15	0,130502	0,039644	0,074	0,02254	3,29185	0,001219

Fig. 5. Significance levels of the model when excluding Sc10, Sc7, Sc3.

N=178	Regression Summary for Dependent Variable: SL (Spreadsheet1.sta) R= ,88222334 R?= ,77831802 Adjusted R?= ,76219569 F(12,165)=48,276 p<0,0000 Std.Error of estimate: 8,3273					
	b*	Std.Err. of b*	b	Std.Err. of b	t(165)	p-value
Intercept			-117,526	12,39771	-9,47963	0,000000
Sc1	0,108652	0,040658	0,809	0,30289	2,67236	0,008288
Sc2	0,101337	0,038892	0,797	0,30570	2,60559	0,010010
Sc4	0,088059	0,038479	0,079	0,03447	2,28851	0,023377
Sc5	0,032098	0,038273	0,014	0,01715	0,83868	0,402865
Sc6	0,048959	0,037403	0,087	0,06676	1,30897	0,192365
Sc8	0,080243	0,037990	1,340	0,63457	2,11221	0,036174
Sc9	0,234185	0,042133	0,330	0,05937	5,55829	0,000000
Sc11	0,270367	0,043023	0,919	0,14631	6,28420	0,000000
Sc12	0,234503	0,044100	0,331	0,06228	5,31755	0,000000
Sc13	0,195983	0,046526	0,204	0,04837	4,21229	0,000041
Sc14	0,093742	0,039965	1,342	0,57231	2,34560	0,020186
Sc15	0,132573	0,039513	0,075	0,02247	3,35514	0,000984

Fig. 6. Significance levels of the model when excluding Sc10, Sc7, Sc3 and work experience Ex.

N=178	Regression Summary for Dependent Variable: SL (Spreadsheet1.sta) R= ,88168759 R?= ,77737301 Adjusted R?= ,76262062 F(11,166)=52,695 p<0,0000 Std.Error of estimate: 8,3199					
	b*	Std.Err. of b*	b	Std.Err. of b	t(166)	p-value
Intercept			-118,995	12,26239	-9,70404	0,000000
Sc1	0,113975	0,040123	0,849	0,29891	2,84064	0,005066
Sc2	0,097724	0,038618	0,768	0,30354	2,53050	0,012320
Sc4	0,092325	0,038107	0,083	0,03414	2,42279	0,016477
Sc6	0,048637	0,037367	0,087	0,06670	1,30159	0,194861
Sc8	0,080047	0,037955	1,337	0,63399	2,10899	0,036446
Sc9	0,238822	0,041731	0,337	0,05881	5,72290	0,000000
Sc11	0,269678	0,042977	0,917	0,14615	6,27492	0,000000
Sc12	0,233366	0,044040	0,330	0,06220	5,29900	0,000000
Sc13	0,195670	0,046483	0,203	0,04833	4,20946	0,000042
Sc14	0,092071	0,039880	1,318	0,57109	2,30872	0,022192
Sc15	0,128580	0,039191	0,073	0,02228	3,28090	0,001261

Fig. 7. Significance levels of the model when excluding Sc10, Sc7, Sc3, Ex, Sc5.

N=178	Regression Summary for Dependent Variable: SL (Spreadsheet1.sta) R= ,88039819 R?= ,77510098 Adjusted R?= ,76163397 F(10,167)=57,556 p<0,0000 Std.Error of estimate: 8,3372					
	b*	Std.Err. of b*	b	Std.Err. of b	t(167)	p-value
Intercept			-117,242	12,21354	-9,59936	0,000000
Sc1	0,117361	0,040122	0,874	0,29890	2,92511	0,003922
Sc2	0,099740	0,038667	0,784	0,30393	2,57945	0,010757
Sc4	0,091862	0,038184	0,082	0,03421	2,40575	0,017231
Sc8	0,085644	0,037789	1,431	0,63122	2,26636	0,024713
Sc9	0,239903	0,041809	0,338	0,05892	5,73804	0,000000
Sc11	0,269782	0,043066	0,917	0,14645	6,26434	0,000000
Sc12	0,238134	0,043978	0,336	0,06211	5,41485	0,000000
Sc13	0,189743	0,046356	0,197	0,04820	4,09318	0,000066
Sc14	0,092249	0,039962	1,321	0,57227	2,30841	0,022203
Sc15	0,128339	0,039271	0,073	0,02233	3,26800	0,001315

Fig. 8. Significance levels of the model when excluding Sc10, Sc7, Sc3, Ex, Sc5, Sc6.

Let us construct a frequency histogram of the residuals (Figure 9).

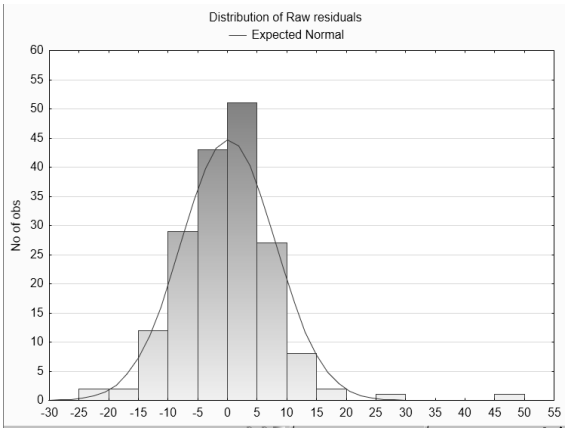

Fig. 9. Frequency histogram of residuals.

The histogram is distributed symmetrically, despite the outlier in the center, so the hypothesis of normality is not rejected.

Next, let us look at the normal probability graph (Figure 10).

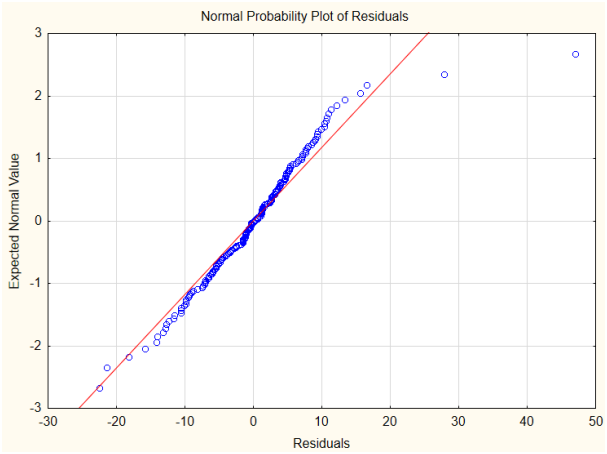

Fig. 10. Normally probabilistic remainder graph.

There are no systematic deviations from the theoretical normal curve, the residuals are distributed normally.

Let us look at the dependence of the predicted values and residuals (Figure 11).

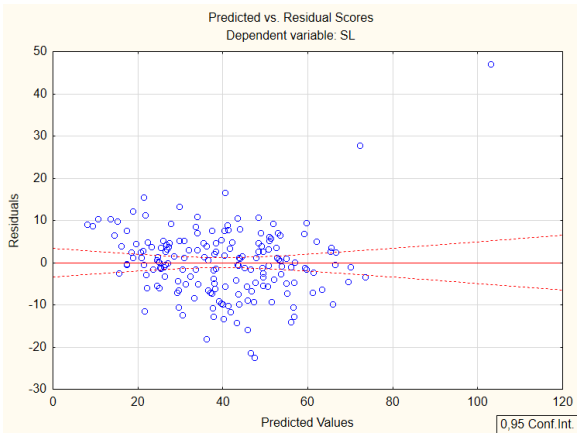

Fig. 11. Dependence of predicted values on residuals.

In the scattering diagram, we see the ratio of the residuals from the predicted values.

In the direction of the movement of points, there is a systematic pattern, expressed by the accumulation of points in the interval of residuals (-10;10) and predicted values in the interval (20;60). Based on this, we say that the residuals depend on the predicted values.

Let us evaluate the acceptability of the model as a whole by the analysis of variance. In the STATISTICA statistical package, it is designated as ANOVA. The analysis of variance is shown in Figure 12.

	Analysis of Variance; DV: SL (Spreadsheet1.sta)				
Effect	**Sums of Squares**	df	Mean Squares	F	p-value
Regress.	40005,89	10	4000,589	57,55555	0,00
Residual	11607,89	167	69,508		
Total	51613,78				

Fig. 12. Variance analysis of the model.

By the level of significance, we can say that the model is acceptable and will work better than the forecast for average values.

The determination index is quite high, it indicates a good quality of the model (Figure 13).

Regression Summary for Dependent Variable: SL (Spreadsheet1.sta)
R= ,88039819 R?= ,77510098 Adjusted R?= ,76163397
F(10,167)=57,556 p<0,0000 Std.Error of estimate: 8,3372

Fig. 13. Assessment of the quality of the regression model.

Its value was 0.775, which means that approximately 77.5% of factors affect the response and are taken into account in our model.

Thus, when analyzing the impact of competencies on the salary level in the model, the following turned out to be informative: Sc1, Sc2, Sc4, Sc8, Sc9, Sc11, Sc12, Sc13, Sc14, Sc15. Consequently, abilities and readiness for self-development and self-education, tolerance, high motivation for success, self-actualization of personality, strong interest in professional development (based on the morphological test of life values), focus on interaction, a high level of emotional intelligence are not interrelated and affect the level of wages of employees of the agro-industrial complex. These competencies can be called critical, because employers are willing to pay employees more money for their availability. The set of critical competencies at different stages of economic development and for different fields of activity will be different. Therefore, research should be carried out separately for different industries, at different time periods.

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