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FORECASTING ELECTRICITY CONSUMPTION OF INDUSTRIAL ENTERPRISES USING EXCEL PROGRAM

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ABSTRACT:

Predicting the electricity consumption of industrial enterprises is a complex and very important task. Approximate forecasting of electricity consumption by enterprises allows taking appropriate measures for its generation for several seasons ahead. Usually predictability in practice is implemented by expert opinion without any in-depth calculation of all kinds of indicators. Automated calculation allows for more accurate forecasting. The paper proposes a forecasting method using the Excel program.

KEYWORDS: forecast, electricity consumption, function, seasonality coefficient

INTRODUCTION:

There are many different models for forecasting today. But if we need to get a result with a little bit of data for a limited amount of time, is it real? Of course it's real! When you need to quickly and easily evaluate the value you want, we can use our favorite Excel functionality, which automatically generates values on the database of existing data. In Excel, we will mainly use tools to evaluate the

expected data of "TRENDATER," "ROST," "WARNING," "LINEIN" and the setting of "PACKAGE ANALYSIS /REGRESSION. It should be noted that this kind of forecast does not take into account the influence of internal and external factors, but this method is perfectly suitable for that would get an approximate result in an inertial scenario, so let's say haste. Consider this for examples of the annual electricity generation of the Eurosnar plant in the Bukhara region of kwh (Figure 1).

months	2015	2016	2017	2018	2019	2020
	fact	fact	fact	fact	fact	fact
january	178056	218800	298000	294919	412925	428000
February	263456	240000	280000	410011	417465	426000
mart	223456	230000	294000	360130	379547	455260
april	160056	260000	284000	380600	329600	426420
May	4041	14800	84000	281771	276040	331660
June	4041	15200	10000	238000	319300	346080
jul	2441	4800	6000	16000	398000	4120
August	5241	6000	6000	14000	52000	16480
september	66841	46527	148634	8000	230000	8240
october	145841	260000	326397	160000	325280	105407
november	144200	324000	265928	362856	346000	360500
December	216000	292000	311958	348202	464000	360500
press:	1413670	1912127	2314917	2874489	3950157	3268667

Figure1. The company's electricity consumption (kWh) Eurosnar for the period 2015-2020.

The first will use the functions of ROST and TREND. These features are designed to extrapolate future values.

Since the ROST function is based on exponential dependencies, values grow more rapidly than with the TREND function used, which returns values with linear exposure by the method of the smallest squares. Although the formulas look the same they use different algorithms. In this regard, it allows you to use different versions of the forecast. A more realistic and accurate forecast in this case gives the function of TREND.

It would therefore be useful to use it in further work. And in general, the ROST function is rather an exception for those who perform the forecast, as exponential growth is quite rare. But in addition to these two functions, there is another one - WARNING. It is similar to the TREND function except that it returns one point on the regression line, rather than the array that defines its line (Figure 2).

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
ELECTRICITY CONSUMPTION kWh	1 413 670	1 912 127	2 314 917	2 874 489	3 950 157	3 274 023								
TREND							4 216 773	4 674 705	5 130 798	5 586 810	6 042 822	6 498 834	6 954 846	7 410 859
GROWTH							4 791 550	5 783 874	6 984 706	8 427 667	10 172 952	12 279 756	14 822 877	17 892 673
FORECAST							4 216 773	4 674 705	5 130 798	5 586 810	6 042 822	6 498 834	6 954 846	7 410 859

Figure:2. Forecast using ROST, FORECAST and FORECAST functions

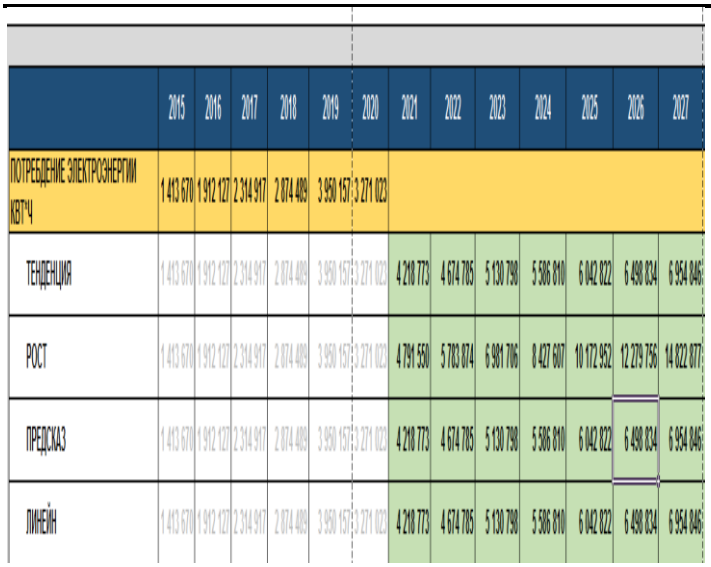
As you can see from Figure 2. Results will be the same as when used, the function of TREND. For a small set of data, probably a better way to do the RIGHT function. At the same time, the TREND feature array works faster when you're going to have to work with large datasets.

Another useful feature is LINEIN. It returns linear promotion parameters to the smallest squares method.

M-tilt and b-segment, these two numbers need to put the equation formula for a straight line

$$y = mx + b \quad (1)$$

For reference, I would like to note that the LINEIN function has separate functions. It's a tilt and a segment function. Thus, LINEIN speeds up the calculation process significantly (Figure 3).

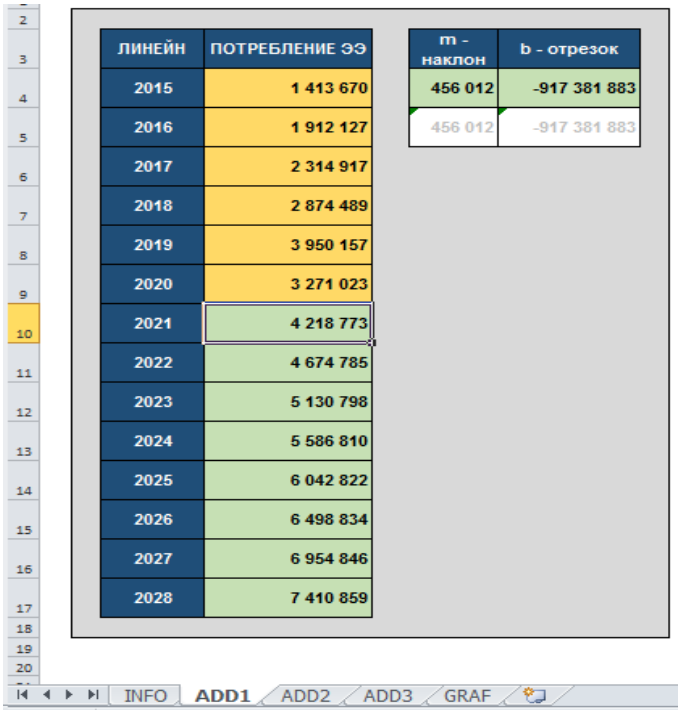


	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
ПОТРЕБЛЕНИЕ ЭЛЕКТРОЭНЕРГИИ КВТЧ	1 413 670	1 912 127	2 314 917	2 874 489	3 950 157	3 271 023							
ТЕНДЕНЦИЯ	1 413 670	1 912 127	2 314 917	2 874 489	3 950 157	3 271 023	4 218 773	4 674 785	5 130 798	5 586 810	6 042 822	6 498 834	6 954 846
РОСТ	1 413 670	1 912 127	2 314 917	2 874 489	3 950 157	3 271 023	4 791 550	5 783 874	6 981 706	8 427 607	10 172 952	12 279 756	14 822 877
ПРЕДСКАЗ	1 413 670	1 912 127	2 314 917	2 874 489	3 950 157	3 271 023	4 218 773	4 674 785	5 130 798	5 586 810	6 042 822	6 498 834	6 954 846
ЛИНЕЙН	1 413 670	1 912 127	2 314 917	2 874 489	3 950 157	3 271 023	4 218 773	4 674 785	5 130 798	5 586 810	6 042 822	6 498 834	6 954 846

Figure:3. Forecast using THE functions of ROST, TREND AND FORECAST and LINEIN

We see that we have got the same result as with the use of functions, TREND and WARNING. If we know how to change the values m and b then it is convenient to do it through the LINKANE function, if not, it is easier to use the functions of TREND or PRODSD.

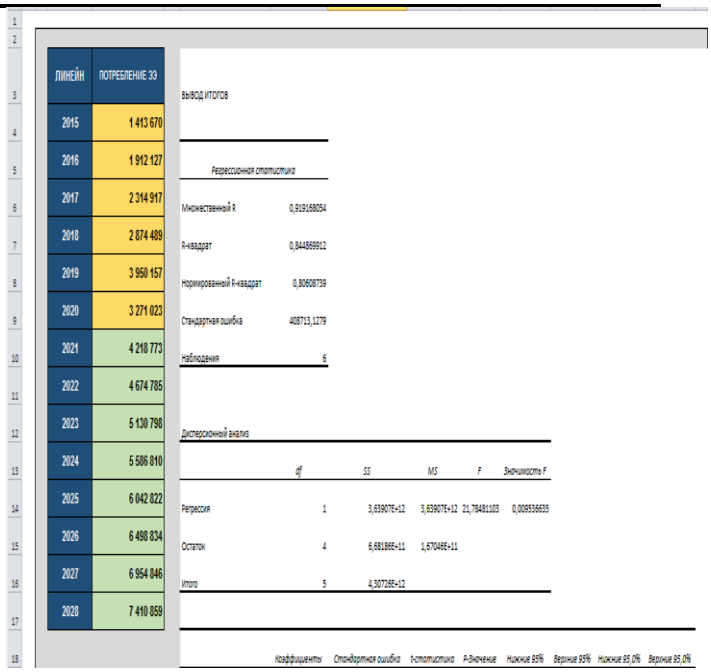
If necessary, you can make a complex calculation with the help of the add-on PACKAGE ANALYSIS/ REGRESSION. For convenience, we will calculate on another sheet (Figure 4).



ЛИНЕЙН	ПОТРЕБЛЕНИЕ ЭЭ
2015	1 413 670
2016	1 912 127
2017	2 314 917
2018	2 874 489
2019	3 950 157
2020	3 271 023
2021	4 218 773
2022	4 674 785
2023	5 130 798
2024	5 586 810
2025	6 042 822
2026	6 498 834
2027	6 954 846
2028	7 410 859

m - наклон	b - отрезок
456 012	-917 381 883
456 012	-917 381 883

INFO | ADD1 | ADD2 | ADD3 | GRAF



ЛИНЕЙН	ПОТРЕБЛЕНИЕ ЭЭ
2015	1 413 670
2016	1 912 127
2017	2 314 917
2018	2 874 489
2019	3 950 157
2020	3 271 023
2021	4 218 773
2022	4 674 785
2023	5 130 798
2024	5 586 810
2025	6 042 822
2026	6 498 834
2027	6 954 846
2028	7 410 859

ВЫВОД ИТОГОВ

Регрессионная статистика

Множественный R	0,919168024
R-квадрат	0,844869912
Нормированный R-квадрат	0,80608739
Стандартная ошибка	408713,1279
Наблюдения	6

Дисперсионный анализ

	df	SS	MS	F	Значимость F
Регрессия	1	3,63907E+12	3,63907E+12	21,78481103	0,009536635
Остаток	4	6,68186E+11	1,67046E+11		
Итого	5	4,30726E+12			

	Коэффициенты	Стандартная ошибка	t-статистика	P-значение	Нижние 95%	Верхние 95%	Нижние 95,0%	Верхние 95,0%

Figure forecast using LINEIN features

We are looking for a data analysis button on the panel-regression-input interval - consumed energy, x-year. We will get more information on the regressive analysis. Similarly, the function of LINEINE (1) multiply the last year by the value of the variable x, and add the intersection u. What are we looking for in the end? The functions of TREND, WARNING and PACKAGE ANALYSIS/REGRESSION in the conditions of such a task gives the same result. The ROST function as seen shows the biggest change in value. To work, we can choose any of these methods, and you can take the average between the data. If you do not want to delve much into the mathematical essence of this issue, then we would advise to use the function of TREND OR WARNING. This is just an inertial forecast does not take into account the result of the factors affecting except the last volume of electricity consumption. Let's show you a small example of how you can complicate the task and get a more accurate result. To do this, we will use data by month, not annual.

The problem: use us known data by month, and calculate seasonal unevenness, take it into account in the calculation. As well as modeling a somewhat scenario of the forecast of

electricity consumption of the Company "Eurosnar."

First of all, we need to calculate the seasonal unevenness. To do this, we need to add up the ranges in cells according to the periods known to us and divide us by the amount and multiply by 12 months. Now with the help of the PRESD formula we do what we have previously but now we have to multiply the prediction result on the seasonality ratio that we calculated previously. To do this, we need to use the INDEX feature.

Now we have forecasts for future periods, and we have to add to the forecast itself to calculate the allowable upper and lower limits, which will allow us to assess the optimistic and pessimistic forecast. We need to calculate the acceptable deviations of forecast values. To do this, you can do the function of DOVERT, that is, the confidence interval. Now the principle is simple: that we count the urinal forecast that it is necessary from our first result of the forecast to calculate the deviation factor, if optimistic, then add to our result this deviation (Figure 5).

	КОЭФФИЦИЕНТ СЕЗОННОСТИ
ЯНВАРЬ	1,40
ФЕВРАЛЬ	1,55
МАРТ	1,48
АПРЕЛЬ	1,40
МАЙ	0,76
ИЮНЬ	0,71
ИЮЛЬ	0,33
АВГУСТ	0,08
СЕНТЯБРЬ	0,39
ОКТЯБРЬ	1,01
НОЯБРЬ	1,38
ДЕКАБРЬ	1,52

Отклонение
49 627

ИТОГО	ПРЕДСКАЗ	ПРЕДСКАЗ (оптимистический)	ПРЕДСКАЗ (пессимистический)
2015	1 413 670	1 413 670	1 413 670
2016	1 912 127	1 912 127	1 912 127
2017	2 314 917	2 314 917	2 314 917
2018	2 874 489	2 874 489	2 874 489
2019	3 950 157	3 950 157	3 950 157
2020	3 271 023	3 271 023	3 271 023
2021	4 042 592	4 638 114	3 447 071
2022	4 452 379	5 047 900	3 856 857
2023	4 862 165	5 457 687	4 266 644
2024	5 272 798	5 868 320	4 677 277
2025	5 682 861	6 278 382	5 087 340
2026	6 092 647	6 688 169	5 497 126
2027	6 502 434	7 097 955	5 906 913
2028	6 913 067	7 508 589	6 317 546

Figure 5. Forecast using seasonality factor

Thus, we calculated the forecasts for the months to 2028, taking into account the seasonal unevenness and three scenarios. It remains to add up the numbers and get the annual data and make to the table.

Here are 8 prediction options (Figure 6).

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
ПОТРЕБЛЕНИЕ ЭЛЕКТРОЭНЕРГИИ КВТЧ	1 413 670	1 912 127	2 314 917	2 874 489	3 950 157	3 271 023								
ТЕНДЕНЦИЯ	1 413 670	1 912 127	2 314 917	2 874 489	3 950 157	3 271 023	4 210 773	4 674 705	5 130 798	5 586 810	6 042 822	6 498 834	6 954 846	7 410 859
РОСТ	1 413 670	1 912 127	2 314 917	2 874 489	3 950 157	3 271 023	4 791 550	5 703 074	6 901 706	8 427 607	10 172 952	12 279 756	14 822 077	17 892 673
ПРЕДСКАЗ	1 413 670	1 912 127	2 314 917	2 874 489	3 950 157	3 271 023	4 210 773	4 674 705	5 130 798	5 586 810	6 042 822	6 498 834	6 954 846	7 410 859
ЛИНЕЙН	1 413 670	1 912 127	2 314 917	2 874 489	3 950 157	3 271 023	4 210 773	4 674 705	5 130 798	5 586 810	6 042 822	6 498 834	6 954 846	7 410 859
ПАКЕТ АНАЛИЗА	1 413 670	1 912 127	2 314 917	2 874 489	3 950 157	3 271 023	4 210 773	4 674 705	5 130 798	5 586 810	6 042 822	6 498 834	6 954 846	7 410 859
ПРЕДСКАЗ (по месяцам)	1 413 670	1 912 127	2 314 917	2 874 489	3 950 157	3 271 023	4 042 592	4 452 379	4 862 165	5 272 798	5 682 861	6 092 647	6 502 434	6 913 067
ПРЕДСКАЗ (по месяцам - оптим)	1 413 670	1 912 127	2 314 917	2 874 489	3 950 157	3 271 023	4 638 114	5 047 900	5 457 687	5 868 320	6 278 382	6 688 169	7 097 955	7 508 589
ПРЕДСКАЗ (по месяцам - пессим)	1 413 670	1 912 127	2 314 917	2 874 489	3 950 157	3 271 023	3 447 071	3 856 857	4 266 644	4 677 277	5 087 340	5 497 126	5 906 913	6 317 546

Figure 6. Forecast using 8 features

Now you can see it all on the same graph.

The maximum result on consumption will show the function of ROST, then the optimistic scenario of the forecast by month, then the function of TRENDANESS, FORECAST, LINEIN, PACKAGE ANALYSIS/REGRESSION, then the function of predictive by month and the last line on the chart is a urinsiistic scenario of forecast by month (Figure7).

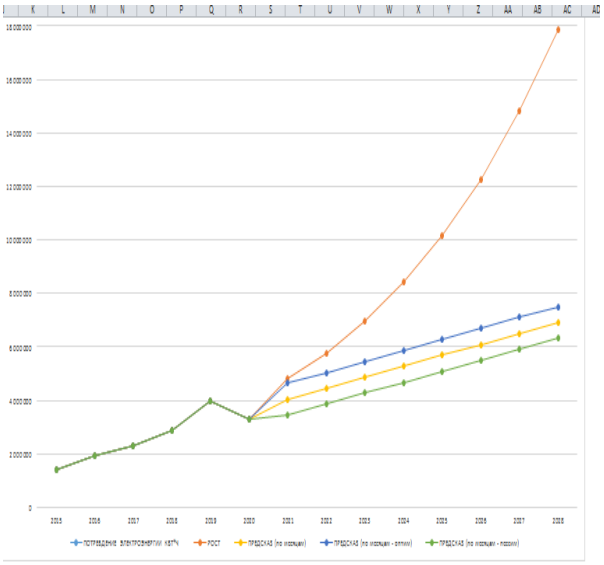


Figure 7. Graph/chart for 8-functions.

CONCLUSIONS:

A simple prediction with Excel functionality is possible.

1. If you need to connect any factors, you can always come up with ways to include them in the calculation, as we, for example, made a monthly calculation of seasonality in three scenarios.

2. What scenario of the forecast can be considered true decides a particular specialist when solving a particular problem.

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