In paper the methodical approach to description of stochastic ensure efficiency of agricultural machinery.

Efficiency, machine, Stochastics.

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AVAILABILITY FACTOR OF FOREST MEW

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The paper presents results on the methodological regulations describing mathematical model to ensure availability factor of forest MEW.

Means, availability factor, forest MEW.

Problem. Since forest equipment is characterized by low reliability, and foreign counterparts are not available because of the high cost for forestry producers, farmers have worn operate machinery. Level spratsovanosti reached 65-80%.

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Analysis of recent research. About 80 percent of the available forest Ukraine MEW worked depreciation period [1] and be written off [2], but continue to be used [3]. The gradual drop in the reliability of this technique has a negative impact on the effluent of logging operations and leads to higher costs [4].

The purpose of research. For the purpose of further use, studies of failures and malfunctions forest MEW as those that worked depreciation period, in a real operation. As a result, it was found in nature and main causes of failures, the main reliability. But it is necessary to perform an assessment of the reliability indices laws establishing their distribution.

Results. In this paper, has been tasked to perform a safety assessment of forest MEW that worked amortization period for the composite index (coefficient of readiness) in two ways: analytically and by cultivation statistics.

Consider readiness assessment factor using tabulated distribution functions through a simple ratio, defined as:

$$K_П = 1 - K_Г = \frac{T_в}{T_о + T_в}, \qquad (1)$$

Somewhere, TV - respectively the average uptime and the average length of rehabilitation.

Suppose Tv < That (is common in practice), then as a simple approximate coefficient can be taken:

KP ≈ TV / So.

As an evaluation factor adopt simple value:

$$\hat{K}_{П} = \frac{\hat{T}_{в}}{\hat{T}_{o}} = \varphi \frac{T_{в}}{T_{o}} = \frac{\nu/(2n)}{\tau/(2r)} \cdot \frac{T_{в}}{T_{o}}, \qquad (2)$$

where $\hat{T}_{o}$ and $\hat{T}_{в}$ - Maximum likelihood estimation in assumptions intervals uptime and recovery have exponential distribution with parameters λ= 1 / thenμ= 1 / Te, respectively.

ν and τ - Dimensionless random variables, which are subject to standard χ^2-The distribution of 2r and 2n degrees of freedom, respectively:

$$\nu = 2n\hat{T}_{в} / T_{в}, \qquad \tau = 2r\hat{T}_{o} / T_{o}.$$

In this case (v independent and τ) Random variable φ in expression (2) is subject to the Fisher F-distribution with 2n, 2r degrees of freedom. Properties of the table and its distribution percentage points given in [4]. In particular, average:

$$M(\varphi) = 2r/(2r-2) = 1/(1-1/r),$$

and variance as n >> 1, r >> 1 $D(\varphi) \approx 1/n + 1/r$ Because $M(\hat{K}_{П}) = K_{П}/(1-1/r)$ Ie grade (2) biased, but the bias decreases as 1 / r. Dispersion of the evaluation at n>> 1, r >> 1 $D(\hat{K}_{П}) \approx K_{П}^2 (1/n + 1/r)$.

Using the table φ_α(M1, m2) percentage points of the F-distribution can be determined confidence intervals (unilateral and bilateral) for simple factor, and hence the coefficient of readiness. When confidence factor α we have:

$$\varphi \ge \varphi_{\alpha}(2n;2r), \qquad \text{or} \qquad \varphi_{\frac{1-\alpha}{2}}(2n;2r) \le \varphi \le \varphi_{\frac{1+\alpha}{2}}(2n;2r),$$

whence we obtain unilateral and bilateral confidence intervals simple factor:

$$K_{П} \ge \frac{\hat{K}_{П}}{\varphi_{\alpha}(2n;2r)}, \qquad \frac{\hat{K}_{П}}{\varphi_{\frac{1+\alpha}{2}}(2n;2r)} \le K_{П} \le \frac{\hat{K}_{П}}{\varphi_{\frac{1-\alpha}{2}}(2n;2r)}.$$

Then bilateral confidence limits for the availability factor KG:

$$\frac{\hat{K}_{П}}{\varphi_{\frac{1-\alpha}{2}}(2n;2r)} \ge K_{Г} \ge \frac{\hat{K}_{П}}{\varphi_{\frac{1+\alpha}{2}}(2n;2r)}. \qquad (3)$$

Availability index of forest MEW on the results of the experimental data can be described as follows:

$$K_{Г} = \frac{t_p}{t_p + t_в}. \tag{4}$$

where tp, TV - total time under forest of MEW and restore all of its components;

Due to the fact that the failure of any unit or system of forest MEW (engine, chassis, fuel system, etc.) Leads to failure of all oil plant, then consider it as a system of series-connected cells. When connected in series are:

$$t_p = \sum_{j=1}^{m} t_{p_j}, \qquad t_в = \sum_{j=1}^{m} t_{в_j}, \tag{5}$$

where m - Total number of units and systems that make up the MEW.

But, in turn, each part of MEW also characterized by the coefficient of readiness:

$$K_{Г_j} = \frac{t_{p_j}}{t_{p_j} + t_{в_j}}. \tag{6}$$

From the expression (6) with (5) define:

$$t_в = \sum_{j=1}^{m} \frac{t_{p_j}\left(1 - K_{Г_j}\right)}{K_{Г_j}} = t_p \sum_{j=1}^{m} \frac{1 - K_{Г_j}}{K_{Г_j}}. \tag{7}$$

Substituting the obtained expression (7) in the expression (4) and making some transformations, we obtain the dependence of the readiness factors of forest MEW its readiness units and systems connected in series elements:

$$K_{Г} = \left[\sum_{j=1}^{m} \frac{1}{K_{Г_j}} - (m-1)\right]^{-1}. \tag{8}$$

As a result of experimental studies have provided a number (n = 48) values of readiness forest MEW. Cultivation statistics perform using a personal computer environment "Excel". Results leveling the empirical distribution of values for normal law given in Table. 1 and Fig. 1. Statistical evaluation of the distribution: the mean value of the coefficient of readiness $\overline{K}_{Г} = \frac{1}{n}\sum_{1}^{n} K_{Г_i} = 0{,}57$; standard deviation $\sigma_{K_Г} = \sqrt{\frac{1}{n-1}\sum_{1}^{n}\left(K_{Г_i} - \overline{K}_{Г}\right)^2} = 0{,}16$. Then the density distribution function will be as follows:

$$f(K_{\Gamma_i}) = \frac{1}{\sigma_{K_\Gamma}\sqrt{2\pi}} \exp\left(-\frac{\left(K_{\Gamma_i} - \overline{K}_\Gamma\right)^2}{2\sigma_{K_\Gamma}{}^2} \right) = 2{,}49 \exp\left[-19{,}53\left(K_{\Gamma_i} - 0{,}57\right)^2 \right].$$

Determine the probability of each interval, assuming that all values of the interval centered in the middle, and the theoretical value of the frequency curve aligned normal law by the formulas:

$$P(K_{\Gamma_i}) = \Delta K_\Gamma \cdot f(K_{\Gamma_i}), \qquad n_i' = n \cdot P(K_{\Gamma_i}),$$

where ΔKG - The width of the interval.

Check the consent of empirical and theoretical distribution laws for Pearson criterion χ^2 showed that the probability of at least 60% of the normal distribution can be used as a mathematical model of the distribution coefficient of technical readiness forest MEW that worked depreciation period.

1. Evaluation kind of f (KHi) forest MEW.

The boundaries of the intervals	Middle OIG	Empirical frequency pi	The density distribution f (OIG)	Probability interval P (KHi)	Theoretical frequency n_i'	$\frac{(n_i - n_i')^2}{n_i'}$
0.30 ... 0.42	0.36	6	1,052	0,126	2.0	0
0.42 ... 0.54	0.48	18	2.126	0.255	4.1	0.88
0.54 ... 0.66	0.60	12	2.447	.294	4.7	0.10
0.66 ... 0.78	0.72	6	1.605	.193	3.1	0.39
0.78 ... 0.90	0.84	6	0,600	0.072	1.2	0.53

Point estimates can be used with reasonable certainty only when large volumes of observations. The smaller the sample size, the easier it is to make a mistake. Therefore, it is important not only to get the average value, but also determine how much this estimate is close to the true value, ie to estimate the error by using the range of values.

For the normal distribution to calculate confidence limits of the mean value of the coefficient of readiness just following expressions: the lower limit of confidential $K_\Gamma^{н} = \overline{K}_\Gamma - t_\alpha \frac{\sigma}{\sqrt{n}}$; the upper limit of confidential $K_\Gamma^{в} = \overline{K}_\Gamma + t_\alpha \frac{\sigma}{\sqrt{n}}$ Where t_α - Student distribution parameter.

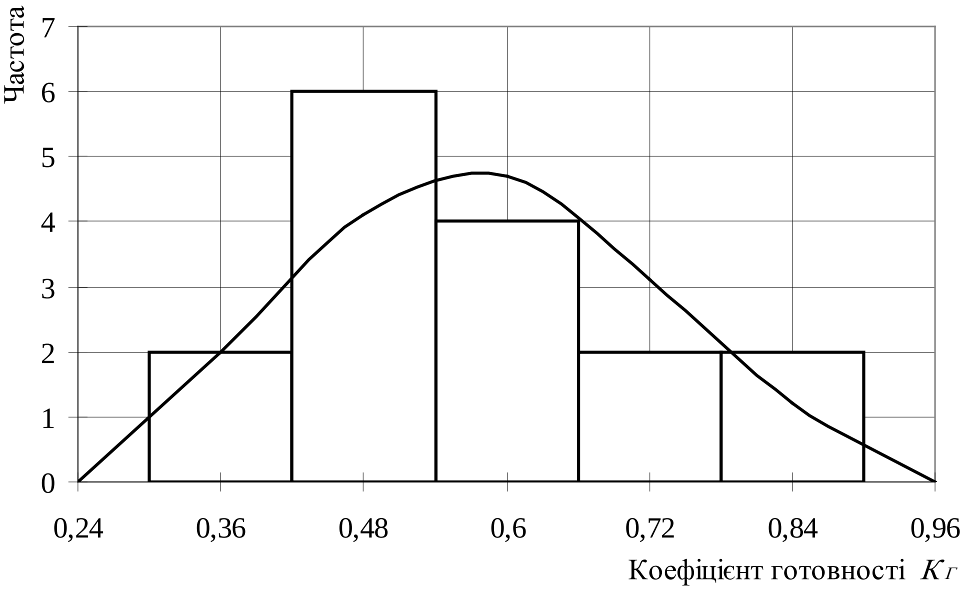

Fig. 1. Histogram and theoretical distribution curve of the coefficient of readiness CG forest MEW.

The effectiveness of proposed steps to assess readiness coefficient and its confidence limits of forest MEW illustrate the data table. 2. The table value estimation and bilateral interval MEW readiness factor that worked amortization period by two parallel ways - through the cultivation of a number of statistical distribution OIG and indirectly by The analytical expressions.

2. Summary evaluation factor preparedness forest MEW.

Parameter	Method of calculation	
	statistical	analytical
The size of the sample n	16	16
Evaluation coefficient KG	0.57	0.54
Standard deviation σ	0.16	-
Confidence probability α	0.90	0.90
Confidence limits availability factor $K_Г^н ... K_Г^в$	0.50 ... 0.64	0.24 ... 0.78

Assessment of chance differences between theoretical and experimental parameters distribution fulfill the criterion by Student t:

$$t = \frac{\left|M(\hat{K}_Г) - \overline{K}_Г\right|\sqrt{n}}{\sigma} = \frac{|0{,}54 - {,}57|\sqrt{16}}{0{,}16} = 0{,}75\,.$$

For t = 0,75 and k = n-1 = 15 for a table we find S (t) = 0,767. The probability that a random divergence is equal to 1-S (t) = 0,233>0.05.

Conclusions

The discrepancy between the theoretical and experimental parameters distribution is negligible, that is random and therefore the theoretical value of the coefficient of readiness assessment is confirmed by experiment.

As a mathematical model of the distribution coefficient of readiness forest MEW that worked depreciation period, with probability P (χ 2) = 0.60, you can use normal distribution with parameters $\overline{K}_{\Gamma} = 0{,}57$ and $\sigma_{K_{\Gamma}} = 0{,}16$. Mean coefficient of readiness of these machines with probability 90% is within 0.50 ... 0.64.

The possibility of analytical estimation of confidence limits availability factor (simple) MEW forest-based F-distribution.

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In this article predstavlenы Results for methodical descriptions provisions Mathematical models Provision Factor readiness lesnыh МЭС.

Funds, Factor readiness lesnoe МЭС.

The paper presents results on methodological regulations describing mathematical models of availability of forest MEM.

Means, Availability, forest MEM.

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TECHNICAL AND ECONOMIC INDICATORS OF improved Actuators Sowing device sown MACHINES

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