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ASSESSMENT OF THE INFLUENCE OF GENETIC AND NON-GENETIC FACTORS ON THE GESTATION LENGTH IN DAIRY COWS (USING THE TTE ANALYSIS)

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TTE analysis is an abbreviation of the English term "Time-to-Event," which can be translated as "*analysis of time to a certain event*" (Harman et al., 1996a). It is a broader concept than "*Survival Analysis*", a branch of statistics that examines the probability of an object surviving to a certain age (Machin et al., 2006). Initially, these methods were proposed to address purely medical tasks, but recently the approaches used in "*Survival Analysis*" have been increasingly applied in engineering, economics, sociology, and other fields. All of them deal with the same type of data – that is, data representing the time interval between two events.

In dairy farming, these methods also began to be widely used starting from the 1980s (Thysen, 1988). However, the first attempts to construct and analyze survival tables for dairy cows, and thus to analyze the duration of their productive longevity, were made as early as the 1930s (Cannon & Hansen, 1939).

For example, *the age at first effective insemination* (AFI) is essentially the difference between the date when the heifer's insemination resulted in conception and the date of her birth. *The age at first calving* (AFC) is, accordingly, the difference between the date of her first calving and her date of birth. Sometimes, the terms "duration" or "length"is used to characterize such traits. For instance, *gestation length* (GL) is the time difference between the calving date and the conception date (either of a heifer or a cow). *The calving interval* (CI) is the time difference between the dates of two consecutive calvings (Harman et al., 1996b).

There are several common features of such data. First, they always have values ranging from 0 to infinity (theoretically), meaning they are always positive. Second, their empirical distribution often deviates from the normal (Gaussian-Laplace) distribution, which does not always allow for statistical analysis by classical (parametric) methods. This issue can be addressed by using non-parametric (rank-based) methods of analysis. Additionally, the empirical distribution of such data is characterized by pronounced skewness with a long right "tail". Sometimes, the data may exhibit platykurtic (flat-peaked) or leptokurtic (sharp-peaked) forms. Again, this issue can be resolved by applying methods that transform asymmetric distributions to normality. Finally, the data obtained during a study (or experiment) may sometimes have an unusual form. For example, a record stating that "*a certain cow did not conceive for at least 150 days after calving*" indicates that the days open for this cow was at least 150 days, but the exact date of conception (and thus the exact days open estimate) is unknown (e.g., if the cow was culled from the herd for some reason). From the standpoint of classical statistical methods, such data would typically be deleted during data verification and not included when estimating parameters such as the mean or the standard deviation. However, from the perspective of "*Survival Analysis*"-methodology, this approach is incorrect and would result in biased (primarily underestimated) estimates. After all, the cow still has a recorded days open, which can be represented as "150+" days. The use of such data (known as "*censored*" data) is another feature of "*Survival Analysis*" methods (Kaplan & Meier, 1958).

One of the key indicators used in TTE analysis is the estimation of the Median and its 95% Confidence Interval (95% CI). For example, for gestation length, this estimate represents the duration at which 50% of cows have calved, and the other 50% are still pregnant. Similarly, for the days open, it represents the duration at which 50% of cows have conceived, and the other 50% have not yet conceived (Vargas et al., 1998).

Moreover, TTE analysis can assess the influence of various factors (both qualitative and quantitative) on the dependent variable. The theoretical basis for this analysis is the *Cox proportional hazards model*. One of the key metrics of this methodology is the estimation of the "*Hazard Ratio:*

(HR) and its 95% confidence interval. If the value of one falls within this interval, it indicates that there is no statistically significant difference between the two compared groups. This is further illustrated by the corresponding P-value estimation (Cox, 1972).

The primary objective of this study was to evaluate the impact of both genetic and non-genetic factors on the gestation length in dairy cows, employing the TTE analysis methodologies.

The study utilised the data set on 237 primiparous Holstein cows maintained at PJSC 'Stepnoy', situated in Kamiansko-Dniprovskyi district, Zaporizhzhia region, during the period 2014-2016. The dependent variable, 'the gestation length', was calculated as the difference between the date of calving and the date of conception (in days) for each primiparous cow. The Time-to-Event analysis was employed to estimate median (and 95 % CI) for the gestation length for each subgroup of primiparous cows based on the levels of genetic and non-genetic factors. In addition, the null hypothesis of no effect of certain factor was tested based on the Hazard Ratio estimate and its 95% confidence interval for the reference subgroup and each of the remaining subgroups.

The results showed that for a total of 237 primiparous Holstein cows the gestation length ranged from 260 to 296 days with a mean of 277.8 ± 0.3 days. The survival curves for the gestation length and the median of this trait were characterised by some features for primiparous cows of different sire-bull origins (Likelihood Ratio test: $\chi^2 = 23.545$; $df = 13$; $P = 0.036$). The Hazard Ratio analysis revealed that the subgroup of primiparous cows sired by Vaillant's line bulls exhibited a significantly different pattern compared to animals sired by Elevation's and Chief's line bulls. The influence of the calving year on the gestation length in primiparous cows of the experimental group was not significant. However, the Hazard Ratio analysis demonstrated a significant difference between the subgroups calving in winter versus summer with regard to the calving season. Finally, increasing age at calving resulted in an increased to gestation length in dairy cows.

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COMBINED USE OF A MIXTURE OF LIQUID MANURE AND PLANT WASTE TO PRODUCE BIOFERTILIZERS

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Intensive livestock farming often leads to undesirable environmental consequences due to air, soil and water pollution by animal waste products. A special place in this process is occupied by manure management, which now mostly acts both as a pollutant and as a source of organic fertilizers for agricultural plants (Shablia & Tkachova, 2020).

Despite the availability of modern, sufficiently environmentally friendly manure processing technologies, they are still little used due to their significant cost. Instead, most livestock farms continue to use traditional, outdated, but cheap methods of manure processing. The latter are