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Using Statistical Tests for Examination of Reproductive System Disease Losses in Dairy Farms.

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THIS study aimed to apply some parametric and non-parametric statistical methods to analyze productive and economic loss due to diseases in dairy farms, From the summer of 2017 to the winter of 2020, a field survey was carried out in different areas of Egypt, covering (Menofia, Kaliobia, El Behira, and El Giza) province, on random sampling of dairy producing sectors. Farmers, the private sector, and the governmental were amongst these sectors. This study investigated several dairy breeds: Balady (a native breed), Holstein-Friesian (an alien breed), and Cross-bred (Balady X Friesian)**.** The results concluded that, the statistical tests (Analysis of variance test, t-test, and Chi^2-test were effective tools to evaluate the diseases losses in dairy animals especially cattle and buffaloes . The higher incidence of productive and reproductive disorders in buffaloes was reported in anestrous (33.5%), inactive ovaries (31.2%), silent heat (22.6%), endometritis (13.2%) and clinical mastitis (11.7%). Where, the lower incidence was repeated breeder (8.8%), retained placenta (7.5%), lameness (4.3%), and abortion (1.8%) respectively. While, in cattle, the incidence of productive and reproductive disorders reported was from highest to lowest as follows clinical mastitis (29%), endometritis (25.5%), lameness (17.4%), repeat breeder (14.2%), retained placenta (13.3%), anestrous (7%), inactive ovaries (5.7%), silent heat (5.1%) and abortion (1.2%) respectively.

Keywords: Statistical tests , Reproductive System Disease Losses , Dairy farms.

Introduction

Biostatistics is the branch of statistics involved with the design and analysis of biomedical research data. It's a set of ideas and methods for producing and applying quantitative evidence to scientific problems, estimating unknown quantities, and evaluating the uncertainty in our estimations [1].

Biostatistics is a disciplinary field committed to the creation and utilization of statistical theories and methodologies, targeting the research study of occurrences that emerge within the realm of life sciences. Biostatisticians draw problems not only from health and medicine, but also from such fields as agriculture, biology, genetics, biochemistry, biophysics, demography, epidemiology, and many others. Any probabilistic or statistical development in these areas may be classified as biostatistics. for example, demography. The field plays a central role in population research, but some of the basic theories underlying the analysis of migration, mortality, fertility, family life cycle, and population growth were developed by some researchers[2].

Inferential statistical approaches are classified into two types: parametric and nonparametric. The term "parametric" refers to all statistical procedures used to compare means, whereas the phrase "nonparametric" refers to metrics other than means, such as median, mean ranks, and proportions. The variable is assumed to be continuous and relatively regularly distributed in parametric testing. When the continuous data has a non-normal distribution or when there are other types of data besides continuous variables, nonparametric techniques are used. There are, thankfully, nonparametric alternatives to the most common parametric techniques. This is useful

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because the nonparametric alternative can be used as a fallback analysis when the assumptions of a parametric test are violated[3].

The application of biological statistics, and biostatistics, contributes significantly to thriving and advancing research issues, improving data analysis using properly design of the experiment to accommodate the research questions, measurements refining, data processing, and the interpretation of output of the results. resulting in a more powerful conclusion[4].

People are very concerned about safety and health issues in areas like industry, farming, communities, etc. as they enjoy the accomplishments of modern society. Research on safety and health has thus grown in significance. A growing number of statistical analysis techniques are being employed in a variety of study fields for increasing the effectiveness of safety and health data analysis we must select prober statistical methods. As there are many statistical methods being used in diverse research areas, and many statistical models have been developed to describe research objectives and results. The American Statistical Association (ASA) noted in 1999 that statistical analysis is a crucial tool for examining practically all facets of society, and that recent advancements in the fields of safety, health, and medicine have greatly benefited from this instrument [5].

The current study was used to acquire reliable results, use some parametric and not parametric statistical approaches to analyze biomedical information.

Material and methods

Source of data:

From the summer of 2017 to the winter of 2020, a field survey was carried out in different areas of Egypt, covering (Menofia, Kaliobia, El Behira, and El Giza) province, on random sampling of dairy-producing sectors. Farmers, the private sector, and the government were amongst these sectors. This study investigated several dairy breeds: Balady (a native breed), Holstein-Friesian (an alien breed), and Cross-bred (Balady X Friesian).

Data collecting techniques:

The information acquired came from both cross-sectional and longitudinal field studies. Throughout the data collection procedure, the researcher interacted extensively with dairy owners and managers. A minimum of two trips to the dairy farms were made, each during a distinct season - summer and winter **.**

According to some authors [6,7] Data were accrued by the researcher via two distinct strategies:

• By utilizing precise archives found within the dairy farms under scrutiny.

• During interview sessions, this questionnaire was given to dairy operators and administrators.

The data obtained, also known as raw data, included milk production records and reproductive [6] . These data were categorized into different factors in order to evaluate the economic viability, output, and fertility capabilities of dairy cattle.

This data classification comprised:

Production and Management Data:

- The size of the herd.
- Breeds being reared, such as Balady, Cross, and Holstein-Friesian.
- Lactation number (notated as parity), which can range from 1, 2, 3, 4, 5, 6, 7, and so forth.
- Production sectors are categorized into Farmer, Private, or Government.
- Summer and winter are the calving seasons .
- Lactation period in days, annual milk yield in tons, and daily milk yield in kg.
- Feed types consumed, including berseem, grain silage, concentrates, tipn, bran, derris, dry matter intake, and annual feed consumption.

Reproductive Data: Various parameters relevant to dairy reproductive performance were gathered, including calving season, calving interval, open days, dry period, calving date, insemination date, dry-off date, and the manner of insemination, whether artificial or natural.

(Financial) data.

Dairy production costs.

Fixed costs. This entails the depreciation of assets such as buildings, livestock, equipment, and the milking area. The depreciation rate for the building was computed by dividing the total cost of the establishment over a 25-year lifespan. For the machinery, the cost was spread out over 5 years, and for the milking area, a period of 15 years was used. When it comes to livestock depreciation, the straight-line method was applied. This involved subtracting the animal's meat value from its original purchase price, then dividing this by the expected useful life in years - generally a 20-year period. This is written in the context of academic discourse[8] .

The variable costs, are composed of several elements. These include the expenditure on medicines, vaccines, disinfectants, and veterinary oversight, all measured in the local currency (LE). Alongside these, feed expenses are impactful; they encompass the cost of berseem – both fresh and as hay – per dairy animal, hell per dairy animal, silage per dairy animal, concentrates per dairy animal, and other additional feeding costs. Furthermore, operational expenses such as labor, electricity, and various miscellaneous outlays also form a significant part of the variable costs[7].

Dairy production returns : It includes the "LE" profits from (milk marketing, calves added to the herd values or sales, animal profits, and manure revenue). The earnings from milk sales are determined by multiplying the total milk produced in the year by the price of the milk[7] (according to the prices during the years of the study.

Statistical analysis :(different statistical methods used according to the type of data.

The data was collected, organized, summarized, and statistically analyzed using the computer applications SPSS/PC+ "version 25" (SPSS, 2018). The researcher entered the acquired data onto the computer using the SPSS/PC+ application. For each animal, all productive and reproductive parameters impacting dairy products, as well as expenses and returns, were computed, and statistically assessed based on fixed factors (breed, calving interval, dry period, and days open). Then, for sketching figures, images, and curves, curve exper or STATGRAPHICS® Centurion XVI11. The nested design was used to assess the effect of the following interactions on the variables affecting dairy economic, productive, and reproductive efficiency.

Parametric tests: Analysis of variance test: used for comparison between the different breeds among different production and economic variables of dairy farms. The test was used to test the significance of the variables in the production and cost function.

Multivariate analysis of variance using the General linear model (GLM): The goal of this statistical model was to look into the effects of calving interval, days open, and days dry (dry season) on several breeds of dairy cows, as well as how they interact on productive and reproductive factors, costs, and benefits.

Duncan's multiple range test (DMRT) The procedure was carried out to determine if there were statistically significant dissimilarities in the mean values of the scrutinized parameters. These parameters were associated with various facets of dairy production, including productivity, reproduction, the expenditure involved, and the subsequent returns from production[9].

T-tests were performed to determine the significance of each link between production and the variables affecting it during the derivation of the production and cost functions[10] .

Methods that are not parametric Distributed parametric tests may yield inaccurate results if the normality assumptions are not met and the sample means are not normal. Non-parametric tests (distribution-free tests) are used in such instances since they do not require the normality assumption[11].

To assess categorical or nominal variables, the chi-square test, Fischer's exact test, and McNemar's test are utilized.

If no differences exist across groups (i.e., null hypothesis is accepted), the Chi-square test compares frequencies and assesses if the observed data differs significantly from the expected data. It's calculated using the following formula: the squared difference between observed (O) and expected (E) data (or deviation, d) divided by expected data used to study the significance of the incidences of different diseases affecting dairy herds.

$$\chi_c^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

Statistical programs:

The data was gathered, arranged, summed up and statistically assessed with the SPSS/PC+ "version 25" software program (SPSS, 2018).

Microsoft® Excel® for Microsoft 365 MSO (Version 2310 Build 16.0.16924.20054) 64-bit.

Microsoft Office PowerPoint (Microsoft® PowerPoint® 2019 MSO (Version 2110 Build 16.0.14527.20234) 64-bit,

STATGRAPHICS® Centurion XVI11 was used for drawing figures, graphics, and curves.

Results and discussion

Cost and incidences of productive and reproductive disorders affecting dairy cattle and buffaloes.

Cost of common productive and reproductive disorders

According to the table, the following results were obtained:

Clinical mastitis cost/cow/year:

The average total cost of clinical mastitis was (870.23 LE/cow/year), which is divided as (136.34, 100.12, and 633.77 LE/cow) for the amount of discarded milk due to drug residues and poor quality, treatment of mastitis animal and milk production lost due to infection, respectively. Milk yield decreased by (10 %) due to mastitis. The cost associated with each component probably varies between herds; partly because of differences in performance parameters (yield level, fertility, etc.) and partly because of different preferences of farmers influencing, for instance, their inclination to contact a veterinarian when mastitis is detected. The results agreed with [12,13]who reported that mastitis costs include veterinary costs, increased labor requirements, discarded milk (during treatment), and reduced milk yield and quality. Also, the health costs represent only 3 to 6% of the value of milk production.

Cost of retained fetal membranes/cow/year: The average total cost of retained placenta was (235.31 LE/cow/year), which is divided as (19.65, 80.66, and 145 LE/cow) by the amount of discarded milk due to drug residues and poor quality, treatment of affected animal and milk production lost as a result of retention of placenta, respectively. Retained placenta caused a decrease in milk yield by (2.2%). The results might be due to the cost of therapy and period of treatment and the value of decreased milk production. [14]revealed that costs of treatment of retained placentas in Georgia herds were $0.03 per cow inventory in beef operations and $0.40 per cow inventory in dairy farms. Also, estimated a loss of 239 kg milk in lactations of first lactation cows following parturitions was with the retained placenta [15] .

Cost of endometritis/cow/year: The average total cost of endometritis was (240.02 LE/cow/year), which is divided as (29.10, 78.21, and 132.71 LE/cow) by the amount of discarded milk due to drug residues and poor quality, treatment of affected animal and milk production lost as a result of endometritis, respectively. Milk yield decreased by (2 %) due to endometritis.

Cost of silent heat/cow/year:

The average total cost of silent heat treatment was (105.71 LE/cow/year.

Cost of inactive ovaries/cow/year:

The average total cost of silent heat treatment was (148.22 LE/cow/year.

Cost of anestrous/cow/year:

The average total cost of silent heat treatment was (157.33 LE/cow/year.

Cost of repeat breeder syndrome/cow/year:

The average total cost of repeat breeder was (210.6 LE/cow/year), which was divided as (135.87and 93.63 LE/cow) for treatment of affected animal and milk production lost because of repeat breeder syndrome, respectively. Milk yield decreased by (1.4 %) due to repeat breeder syndrome and hormonal disturbances.

Cost of abortion/cow/year:

The average total cost of abortion when occurring in the late stage of gestation was (6028 LE/cow/year), which is divided as (128 and 5900 LE/cow) for treatment of aborted animals and milk production lost as a result of abortion, in addition, to the value of avoided return from missed calf (1200 LE). While, when the animal was aborted in the early (mid-stage) of gestation, its total cost was (653.24 LE/cow/year), in the form of (55.44, 128, and 470.20 LE) for discarded milk, treatment, and decreased milk production, respectively, in addition to the value of avoided return from missed calf (780.33 LE). The milk loss ranged from (4.7 to 97 %) according to the time of the abortion.[16]show that the loss resulting from each abortion was estimated at approximately $2,333. Also, [17] reported that the cost of a pregnancy loss typically increased with gestation length and accounts for $555.

Cost of lameness/cow/year:

The average total cost of lameness was (645.57 LE/cow/year), which is divided as (60.20, 113.65, and 470.80 LE/cow) for the amount of discarded milk due to drug residues and poor quality, treatment of lame animals, and decrease in milk production as a result of lameness, respectively. Milk yield decreased by (7 %) due to lameness. The higher cost of lameness might be due to the long course of treatments and anti-inflammatory drug.

Costs which affect milk yield; also, a lame animal cannot feed or drink well and become emaciated causing a decrease in milk yield. The variation in the cost of different above-mentioned disorders is probably due to the variation in a treatment plan, period of treatment, amount of milk discarded due to drug residues, the severity of diseases, and the degree of decrease in milk production. According to [18]annual losses owing to reproductive diseases and poor breeding in Egyptian cattle and buffaloes' amount to more than 100 million Egyptian pounds (77 million $). In addition, [19]showed that ovarian inactivity, silent heat, endometritis, and recurrent breeding are the most common reproductive diseases in Egyptian buffaloes.

Incidences of common productive and reproductive disorders among dairy cattle and buffaloes

The table explained that the higher incidence of productive and reproductive disorders in buffaloes was anestrous (33.5%), inactive ovaries (31.2%), silent heat (22.6%), and endometritis (13.2%) and clinical mastitis (11.7%). Where, the lower incidence was repeated breeder (8.8%), retained placenta (7.5%), lameness (4.3%), and abortion (1.8%) respectively. While, in cattle, the incidence of productive and reproductive disorders is arranged from highest to lowest as follows clinical mastitis (29%), endometritis (25.5%), lameness (17.4%), repeat breeder (14.2%), retained placenta (13.3%), anestrous (7%), inactive ovaries (5.7%), silent heat (5.1%) and abortion (1.2%), respectively.

The above-mentioned results differed between cattle and buffaloes probably due to variation in breed susceptibility to diseases, the management system applied a hygienic condition on the farm, owner experience in heat detection, milking system, a season of calving, method of mating (NS or AI), hormonal level especially, estradiol in buffaloes, level and quality of feed, veterinary supervision, and level of milk production. The results come in contact with those of some studies[20] they found the incidence of endometritis was 22.4%, and the most prominent risk factors leading to the occurrence of endometritis were retained placenta, stillbirth, and external interference by herd men during calving.

Others, [21] reported retention of fetal membranes (afterbirth) is observed more frequently in cows than in buffaloes and the frequency of retained placenta averages 7 to 10% under normal conditions in a dairy herd. Also, [22] reported that the incidence of mastitis differed significantly according to dairy breed, as buffaloes were less affected than other cattle breeds.

The reported incidence of abortion ranges from 0.4 to 10.6% [23]. The incidence of repeat breeding was greater in cattle than in buffaloes, while ovarian inactivity, silent heat, and anestrous were greater in buffaloes than in cattle[24]. Moreover, the incidence of clinical repeat breeder in the examined buffalo was 4.34 % [25].

N.B: Some animals complained of more than one disorder.

Our results concluded that, the statistical tests (Analysis of variance test, t.test, and Chi^3-test can be used effectively to evaluate the diseases losses in dairy animals especially cattle and buffaloes including clinical mastitis, endometritis, lameness, repeat breeder, retained placenta, anestrous, inactive ovaries, silent heat, and abortion, respectively.

TABLE 1. Total cost components and percentages of decreased milk yield as a result of common productive and reproductive disorders in cattle and buffaloes

Disorder	Cost of discarded milk	Cost of milk production lost	Treatment cost	Total cost	Avoided return from a missed calf	% of the decrease in milk yield
Clinical mastitis	136.34±2.87^a (55.7kg)	633.77±10.29^b (250.38 kg)	100.12±3.55^c	870.23±16.71^b	0	(10 %)
Retained placenta	19.65±1.33^d (8.2 kg)	145.00±12.64^e (65.87 kg)	80.66±5.81^d	235.31±19.78^{de}	0	(2.2%)
Endometritis	29.10±2.11^d (13.40kg)	132.71±6.96^e (57.00kg)	78.21±9.65^d	240.02±18.72d	0	(2%)
Silent heat	0	0	105.71±10.90^{bc}	105.71±10.90^h	0	0
Inactive ovaries	0	0	148.22±14.00a	148.22±14.00^f	0	0
Anestrous	0	0	157.33±18.45a	157.33±18.45f	0	0
Repeat breeder	0	93.63±4.01f (37.98kg)	135.87±15.65^{ab}	210.6±19.66e	0	(1.4%)
Abortion	0	5900±37.33^a ®1 (2380kg)	128.00±10.82^b	6028.0±48.13^a	1200±44.56	(97%)
			128.00±11.82^b	653.64±37.87^c	780.33±32.89	(4.7%)
	55.44±3.20^b (19.88kg)	470.20±23.04^c ®2 (170.0kg)				
Lameness	60.20±13.51^b (25.50kg)	470.80±22.20^c (223.76 kg)	113.65±12.52^b	645.57±48.21^c	0	(7%)

a-b: means in the same column that bearing superscripts are significantly differed at ($P<0.05$).

®1- Abortion occurred in the last stage of pregnancy (in the dry period).

®2- Abortion occurred in the early stage of pregnancy (in the lactation period).

TABLE 2. Incidences of common productive and reproductive disorders among dairy cattle and buffaloes

Disorders	Cattle No. of observed = (3774 cows)		Buffaloes No. of observed = (1502 buffalo)	
	No. affected	%	No. affected	%
Clinical mastitis	1095	29%	176	11.7%
Retained placenta	502	13.3%	113	7.5%
Endometritis	963	25.5%	200	13.2%
Silent heat	193	5.1%	340	22.6%
Inactive ovaries	216	5.7%	469	31.2%
Anestrous	265	7%	504	33.5%
Repeat breeder	536	14.2%	133	8.8%
Lameness	657	17.4%	65	4.3%
Abortion	64	1.2%	27	1.8%
Chi Sq. X2 = 51.82*				

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Author`s contributions

The authors confirm contribution to the paper as follows: study conception and design: Mohammed I. Marie, Mahmoud S. El-Tarabany; data collection: Mohammed I. Marie and Atallah S. T analysis and interpretation of results Mohammed I. Marie, and Fatma D. Mohamed .

All authors reviewed the results and approved the final version of the manuscript.

Ethical approve:

All study procedures were conducted according to the rules and guidelines of Research Ethics review committee.

Conflicts of interest:

We declare that there was no conflict of interest included in my manuscript here.

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استخدام الاختبارات الإحصائية لدراسة خسائر أمراض الجهاز التناسلي في مزارع الألبان.

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[4] قسم تنمية الثروة الحيوانية – كلية الطب البيطري - جامعة الزقازيق - مصر

تهدف هذه الدراسة إلى تطبيق بعض الطرق الإحصائية المعملية واللامعلمية في تحليل البيانات البيولوجية المتمثلة في بيانات مزرعة لإنتاج الألبان بها العديد من المتغيرات الكمية والوصفية

الاختبارات الإحصائية المعلمية (تحليل التباين– تحليل التباين لأكثر من متغير – الانحدار والارتباط بين المتغيرات – اختبار ت لعينتين مستقلتين)

الاختبارات الإحصائية اللامعلمية (اختبار مربع كاي) ، والمقارنة بينهم في نتائجهم ثم اختيار الطرق الأكثر ملاءمة وقد تم ذلك باستخدام اختبارات التحليل الإحصائي للتنبؤ بالتغيرات في إنتاج الألبان بسبب التغيرات في موارد الإنتاج والتنبؤ بأهم موارد الإنتاجية أو الاقتصادية التي تؤثر على إنتاج الألبان.

أثناء الدراسة تم عمل مسح ميداني في مناطق مختلفة من مصر (محافظة المنوفية والقليوبية والبحيرة والجيزة) خلال الفترة الممتدة من صيف 2017 إلى شتاء 2020 على عينات عشوائية من قطاعات إنتاج الألبان، وهذه القطاعات هي قطاع المزارعين، والقطاع الخاص، والقطاع الحكومي.

خلصت نتائجنا إلى أنه يمكن استخدام الاختبارات الإحصائية (تحليل اختبار التباين، واختبار T test، واختبار مربع كاي بشكل فعال لتقييم فقدان الأمراض في الماشية الأبقار والجاموس بما في ذلك ارتفاع حالات الاضطرابات الإنتاجية والإنجابية في الجاموس كان أمرًا خياليًا (33.5٪)، المبيض غير النشط (31.2٪)، الشياع الصامت (22.6٪)، التهاب بطانة الرحم (13.2٪) والتهاب الضرع (11.7٪)، العرج (17.4٪)، احتجاز المشيمة (13.3٪)، الإجهاض (1.2٪).

الكلمات الدالة: الاختبارات الإحصائية، خسائرأمراض الجهاز التناسلي ، مزارع الألبان

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