Course : Experiment Design

Semester : IV

Code : KI 16317

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Progamme Learning Outcome		Sub-CLO
PLO-2	Able to master theoretical concepts in the field of aquaculture, especially in the field of mariculture (M)	Sub-CLO 1 Students know the semester learning plan, understand the scope of the experimental design and be able to explain the basic statistics Sub-CLO 2 Students are able to simplify data, Explains about hypothesis testing, presents data systematically and independently
PLO-3	Capable of Managing Data and Conveying Information in the Field of Aquaculture and Providing Various Alternative Solutions (H)	Sub-CLO 3 Students are able to explain the basic experimental design, Explaining the basic principles of the experiment Explaining the classification of the experimental design in a systematic and measurable manner Sub-CLO 4 Students are able to explain a completely randomized design (CRD), design CRD, Collect data, Manage data CRD and interpreting the results logically, systematically, independently and responsibly Sub-CLO 6 Students are able to manage two-factor/factorial experimental design data, Analysis of the influence of interaction in a systematic and measurable manner

		Sub-CLO 7 Students are able to manage two-factor experimental data in CRD Designing a two-factor experiment in CRD Collecting data, Manage two-factor experimental data in CRD Interpret the results logically, systematically, independently and responsibly Sub-CLO 8 Students are able to design and analyze experimental data for the Factorial CGRD design. Collect data, Managing two-factor experimental data in CRD Interpreting the results Explaining interactions between factors logically, systematically, independently and responsibly Sub-CLO 9 Students are able to formulate a simple linear model. Formulate multiple regression. Formulate a diagnostic regression model. Formulate a correlation between two variables. Sub-CLO 10 Students are able to evaluate the assumptions of analysis of variance. Students are able to test assumptions. Students are able to handle data against assumption violations
CPL-7	Able to Evaluate and Provide Sustainable Aquaculture Production Solutions (H)	Sub CLO 3 Students are able to explain the basic experimental design, Explaining the basic principles of the experiment Explaining the classification of the experimental design in a systematic and measurable

		manner. Sub CLO 4 Students are able to explain completely randomized design (CRD), design CRD, Collecting data, managing CRD data and interpreting the results logically, systematically, independently and responsibly Sub CLO 6 Students are able to manage two-factor/factorial experimental design data, Analysis of the influence of interaction in a systematic and measurable manner Sub CLO 7 Students are able to manage two-factor experimental data in RAL Designing a two-factor experiment in RAL Collecting data, Managing two-factor experimental data in RAL Interpreting the results logically, systematically, independently and responsibly Sub-CLO 8 Students are able to design and analyze experimental data for the Factorial CGRD design. Collect data, Managing the experimental data of two factors in CRD Interpreting the results Explaining the interactions between factors in a logical, systematic, independent and responsible manner Sub-CLO 9 Students are able to formulate a simple linear model to formulate multiple regression, Formulating a Diagnostic Regression Model Formulating a Correlation

		between two variables Sub-CLO 10 Students are able to evaluate the assumptions of analysis of variance. Students are able to test assumptions, Students are able to handle data against assumption violations

Note : The **correlation between LO and CLO either H (high), M (moderate), or L (Low)**

Task 1 (PLO 3, Sub-CLO 2)

Question 1-5

A. The following is Rancob class A data. Determine

1. mean,
2. median,
3. mode,
4. range of the following data
5. Then determine the number of students graduating if passing is ≥ quartile 3.

Data

30	50	55	35	77	80
89	55	90	88	40	50
44	80	89	77	56	51
66	70	70	80	88	70

Answer

A	65.83
B	70
C	80
D	60
E	>80 = 5

Assesmen Rubrik

Mark	Criteria
1	The answer choices are CORRECT
0	The answer choice is FALSE

total value: Number of question numbers with the correct answer X 1

Task 2 (CPL 3, Su-CPMK 7)

Make a Factorial RAL Experiment Design Paper related to aquaculture data, with the following task details

1. Look for journals (data) of aquaculture research
2. Manage the data in the form of factorial RAL
3. Solving problems in the data
4. Data analysis

Assesmen rubrik

Table 1. Assessment rubric of Report/Paper

AspectI	Very Good	Good	Satisfactory	Moderate	Under Perform	Score
Comprehesiveness of the content	Comprehensive and related (9 –10)	Comprehensive (7 – 8)	Lack of comprehensive, many ascpec are not covered (4 – 6)	Not comprehensive (2 – 3)	The content is not inine with the instruction (0 – 1)	
Accuracy and correctness	Accurately discussed,correct and broad arguments based on theoretical basis (9 – 10)	The discussion is correct but over concise (7 – 8)	The discussion is correct but narrow coverage (4 – 6)	Discussions do existbut most of them arenot in line with the theory (2 – 3)	No discussion at all (0 – 1)	
Language	The language is interesting and inspires the reader togo deeper (9 – 10)	The Language is packaged in such away to be well understood by the reader (7 – 8)	The language followsthe appropriate duidelne (4 – 6)	The language is difficult to be understood by the reader (2 – 3)	The anguage is poor (0 – 1)	

The neatness of the paper	The paper is made very attractive, neat and is looking intererting rto the readers to furthe explore (9 – 10)	The paper is interesting and neat (7 – 8)	Binded, reguler (4 – 6)	Bunded, poor (2 – 3)	Very poor (0 – 1)	
TOTAL SCORE	40	32	24	12	4	

Task 3 (CPL 7, Sub CPMK 8)

1. Explain the meaning of a two-factorial randomized block design experiment

2. Give an example of the design in number one related to aquaculture

3. Make the experimental design including randomization

Assessment Rubrik

Question No.	Answer Criteria	Assessment criteria	Nilai
	– A two-factorial randomized block design experiment is an experimental design that involves setting groups or blocks from similar or similar experimental units. In this design, there are two independent factors or variables that affect the response or dependent variable that is observed. - In a two-factorial randomized block design, the groups are formed based on certain characteristics in common that can influence responses. Each group was then randomly divided into subgroups that received different treatment combinations. -The factors tested in this experiment can have two or more levels or levels. For example, factor A could have "A1" and "A2" levels, while factor B could have "B1" and "B2" levels. all combinations of factor A and B levels will be tested in each group or block. -The aim of this design is to control and reduce the effect of variability caused by different groups or blocks. In this way, the design allows more accurate identification of the impact of the factors being	- Answer 3 points with a correct and complete explanation - Answer 3 points with correct but incomplete explanation - Answer 3 points with incorrect and incomplete explanations - Answer 2 points with a correct and complete explanation - Answer 2 points with correct but incomplete explanation - Answer 1 point with a correct and complete explanation - Answer 1 point with a correct but incomplete explanation - Answer 1 point with the correct explanation but do not explain completely - Answer 1 point with correct explanation but don't explain anything - Didn't answer anything	80 77,5 75 72,5 70 67,5 65 62,5 60 <60

	tested. - To analyze the results of a two-factorial randomized block design experiment, analysis of variance (ANOVA) techniques can be used to determine whether the factors tested have a significant effect on the observed responses. - Two-factorial randomized block design trials are often used in a variety of fields, including agricultural science, social science, and economics, where similar groups or blocks tend to have similar responses to the factors tested.		
2	- For example, conducting a two-factorial randomized block design experiment in the context of aquaculture with the first factor being the type of feed (A) and the second factor being the dose of feed (B). There are two types of feed to be tested, namely feed A1 and feed A2, and there are two feed doses to be tested, namely dose B1 and dose B2. - First, select several groups or ponds that are similar in terms of size, water quality, and other environmental conditions. It is assumed to have four groups in this experiment. – Then, each group is randomly divided into two sub-groups. One sub group received feed A1 and dose B1, while the other sub group received feed A2 and dose B2. Thus, we have four different treatment combinations given to the four groups.	- Answer 5 points with a correct and complete explanation - Answer 5 points with correct but incomplete explanation - Answer 4 points with a correct and complete explanation - Answer 4 points with correct but incomplete explanation - Answer 3 points with a correct and complete explanation - Answer 3 points with correct but incomplete explanation - Answer 2 points with a correct and complete explanation - Answer 2 points with correct but incomplete explanation - Answer 1 point with a correct and complete explanation - Didn't answer anything	80 77,5 75 72,5 70 67,5 65 62,5 60 <60

	After that, monitor the response observed, such as fish growth, water quality, or fish survival rate, in each group and subgroup over a specified period of time. -Using a two-factorial randomized block design, this experiment allowed researchers to control for differences between groups in terms of water quality, pond size, and initial condition of fish. This helps reduce external factors that can affect response, making the results more accurate and reliable.		
3	The following is a two-factorial randomized block design experiment for examples of aquaculture that has been randomized: 1. step Group Formation - Select four groups that are similar in terms of pond size, initial water quality, and initial condition of the fish. - Select four groups that are similar in terms of pond size, initial water quality, and initial condition of the fish 2. step Division of Groups into Subgroups - Each group is divided into two subgroups (blocks) each consisting of three experimental units (for example, three pools) . - Label the subgroups as Block A and Block B 3. Step	- Answer 5 points with a correct and complete explanation - Answer 5 points with correct but incomplete explanation - Answer 4 points with a correct and complete explanation - Answer 4 points with correct but incomplete explanation - Answer 3 points with a correct and complete explanation - Answer 3 points with correct but incomplete explanation - Answer 2 points with a correct and complete explanation - Answer 2 points with correct but incomplete explanation - Answer 1 point with a correct and complete explanation - Didn't answer anything	80 77,5 75 72,5 70 67,5 65 62,5 60 <60

	Label the subgroups as Block A and Block B - Randomly, give different treatment combinations of feed and temperature to each subgroup. - For example, within each group: - Block A sub-group: - Unit 1: Feed A, Low Temperature - Unit 2: Feed B, Low Temperature - Unit 3: Feed A, High Temperature - Block B sub-group: - Unit 1: Feed B, High Temperature - Unit 2: Feed A, High Temperature Unit 3: Feed B, Low Temperature 4. step Experimental Implementation - Apply the prescribed treatment in each experimental unit in the aquaculture pond. - Be sure to periodically monitor and record the observed fish growth parameters. With the above steps, this experiment resulted in a two-factorial randomized block design experiment that ensured randomization. randomized treatment in each group and reduced external factors that could affect the results of the experiment.		

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Kelas : A

Rancangan Percobaan

Data diambil dari jurnal, Rancangan Acak Lengkap Dan Rancangan Acak Kelompok Pada Bibit Ikan (Bayu Satria Adinugraha, Taswati Nova Wijayaningrum).

Tabel 9. Data Pertambahan Berat pada Bibit Ikan Lele umur 70 hari (dalam Ons)

Ulangan (jenis ikan)	Perlakuan (jumlah pakan/kg)				Jumlah	Rata-rata
	0,25	0,5	0,75	1		
1 (Lele 3-5 cm)	19.6	28.2	26.6	24.8	99.2	24.8
2 (Lele 4-6 cm)	20.8	29.4	27.2	25.6	103	25.75
Total Perlakuan (Yi)	40.4	57.6	53.8	50.4	202.2	50.55

Tabel 10. Tabel *analysis of variance* pertambahan Berat pada Bibit Ikan Lele Umur 70 Hari

Sumber Keragaman	Derajat Bebas	Jumlah Kuadrat	Kuadrat Tengah	F-hitung	F-tabel
Perlakuan	3	81.655	27.21833333	56.12027	6.59
Galat	4	1.94	0.485		
Total	7	83.595			

Hipotesis:

H_0: Tidak ada pengaruh pemberian jumlah pakan terhadap berat bibit ikan

H_1: Paling sedikit ada satu pengaruh pemberian jumlah pakan terhadap berat bibit ikan

Taraf Uji: α : 5% = 0,05

Kriteria Uji: Tolak H0 jika nilai F-hitung > F-tabel(α: 0,05) atau sig. < α

Keputusan: 56,12027 > 6,59 maka H0 ditolak

Kesimpulan: Paling sedikit ada satu pengaruh pemberian jumlah pakan terhadap berat bibit ikan

Berdasarkan pengambilan keputusan tersebut diperoleh nilai 56,12027 > 6,59 atau nilai F-hitung > F-tabel(α:0,05) sehingga dapat disimpulkan bahwa paling sedikit ada satu pengaruh pemberian jumlah pakan terhadap berat bibit ikan pada percobaan Rancangan Acak Lengkap (RAL) ini.

Tabel 12. Data Pertambahan Berat pada Bibit Ikan Umur 70 hari

Kelompok (jenis ikan)	Perlakuan (jumlah pakan/kg)				Jumlah	Rata-rata
	0,25	0,5	0,75	1		
1 (Lele)	19.6	28.2	26.6	24.8	99.2	24.8
2 (Nila)	13.6	16	17.6	19.8	67	16.75
3 (Karper)	13.2	15	16.8	18.6	63.6	15.9
4 (Bawal)	11.8	15.4	18.4	21.2	66.8	16.7
5 (Gurami)	12.6	14.8	14.2	13.6	55.2	13.8
Total Perlakuan (Yi)	70.8	89.4	93.6	98	351.8	87.95

Tabel 13. Tabel *Analysis of Varience* Pertambahan Berat pada Bibit Ikan umur 70 hari

Sumber Keragaman	Derajat Bebas	Jumlah kuadrat	Kuadrat Tengah	F-hitung	F-tabel
Perlakuan	3	85.83	28.61	7.767421	3.49
Kelompok	4	282.808	70.702	19.19511	3.26
Galat	12	44.2	3.683333333		
Total	19	412.838			

Hipotesis untuk pengaruh perlakuan :

H_0: Tidak ada pengaruh pemberian jumlah pakan terhadap berat bibit ikan

H_1: Paling sedikit ada satu pengaruh pemberian jumlah pakan terhadap berat bibit ikan

Hipotesis untuk pengaruh kelompok :

H_0: Tidak ada pengaruh jenis ikan terhadap berat bibit ikan

H_1: Paling sedikit ada satu pengaruh jenis ikan terhadap berat bibit ikan

Taraf Uji: 5% = 0,05

Kriteria Uji: Tolak H0 jika nilai F-hitung > F-tabel(α: 0,05) atau sig. < α

Keputusan: 7,767421 > 3,49 maka H0 ditolak untuk pengaruh perlakuan dan 19,19511 >3,26 maka H_0 ditolak untuk pengaruh kelompok

Kesimpulan: Paling sedikit ada satu pengaruh pemberian jumlah pakan terhadap berat bibit ikan dan paling sedikit ada satu pengaruh jenis ikan terhadap berat bibit ikan

Berdasarkan pengambilan keputusan tersebut diperoleh nilai 7,767421 > 3,49 atau nilai F-hitung > F-tabel(α: 0,05) sehingga dapat disimpulkan bahwa paling sedikit ada satu pengaruh perlakuan terhadap respon yang diamati dan juga diperoleh nilai 19,19511 > 3,26 atau nilai F-hitung > F-tabel(α: 0,05) sehingga dapat disimpulkan bahwa paling sedikit ada satu pengaruh pemberian jumlah pakan terhadap berat bibit ikan.