

A Study on Correlation of Subjects on Electrical Engineering Courses Using Artificial Neural Network (ANN)

- Fathiah Zakaria
- Siti Aishah Che Kar
- Rina Abdullah
- Syila Izawana Ismail
- Nur Edawati Enzai

Faculty of Electrical Engineering

UiTM Cawangan Terengganu

Kampus Dungun

Introduction

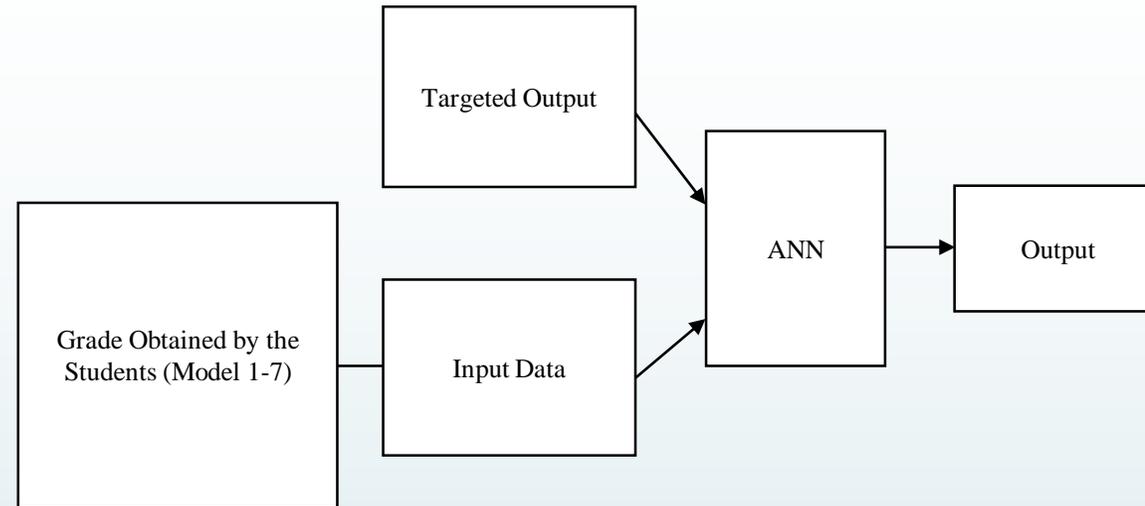
- This study is about a study of correlation between subjects of Diploma in Electrical Engineering (Electronics/Power) at Universiti Teknologi MARA (UiTM) Cawangan Terengganu using Artificial Neural Network (ANN).
- The analysis was done to see the effect of mathematical subjects (Pre-calculus and Calculus 1) and core subject (Electric Circuit 1) on Electronics 1. Electronics 1 is found to be a core subject with the history of high failure rate percentage (more than 25%) in previous semester. This research has been conducted on current final semester students (Semester 5).
- Seven (7) models of ANN are developed to observe the correlation between the subjects. In order to develop an ANN model, ANN design and parameters need to be chosen to find the best model. In this study, historical data from students' database were used for training and testing purpose.
- Total number of datasets used are 58 sets (70% and 30% of the datasets are used for training and testing processes respectively). The Regression Coefficient, (R) values from the developed models was observed and analyzed to see the effect of the subject on the performance of students.
- It can be proven that Electric Circuit 1 has significant correlation with the Electronics 1 subject respected to the highest R value obtained (0.8100).
- The result obtained proves that student's understanding on Electric Circuit 1 subject (taken during semester 2) has direct impact on the performance of students on Electronics 1 subject (taken during semester 3). Hence, early preventive measures could be taken by the respective parties.

Methodology

- Seven (7) ANN models are developed (Model 1-7) and the input and the targeted output of the developed ANN models are tabulated in table below.

Model	Input Parameters (Grade)	Output Parameters (Grade)
1	Pre-Calculus (MAT133)	Electronics 1 (ELE232)
2	Calculus 1 (MAT183)	
3	Electric Circuit 1 (EEE121)	
4	Electric Circuit 1 (EEE121) Pre-Calculus (MAT133)	
5	Electric Circuit 1 (EEE121) Calculus 1 (MAT183)	
6	Electric Circuit 1 (EEE121) Pre-Calculus (MAT133) Calculus 1 (MAT183)	
7	Pre-Calculus (MAT133) Calculus 1 (MAT183)	

- In this study, the inputs consist of Grade of subjects including Pre-Calculus (MAT133), Calculus 1 (MAT183) and Electric Circuit 1 (EEE121). The targeted output of the ANN is the grade of Electronics 1 (ELE232).

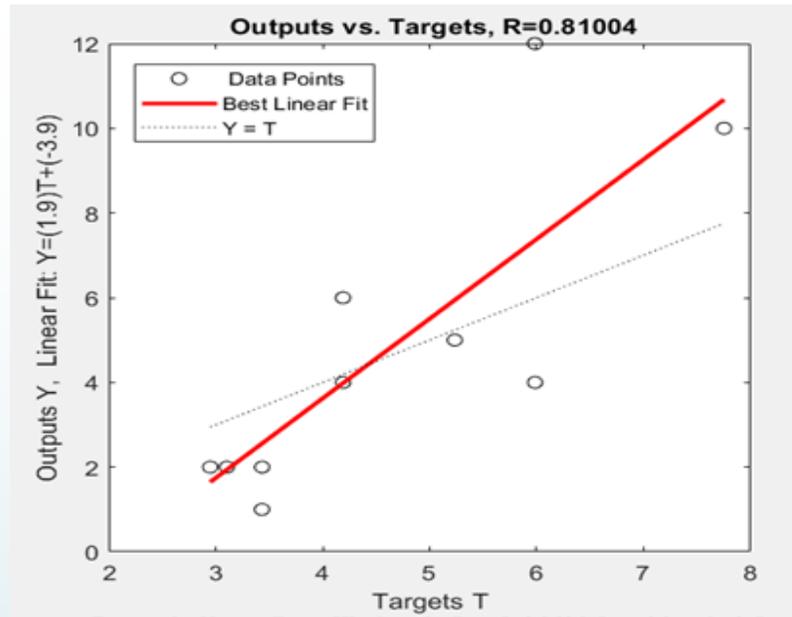


- ▶ Figure above illustrate the developed ANN block diagram. The ANN will produce the output based on input and targeted output feed to the ANN.
- ▶ To develop an ANN model, parameters such as momentum constant (MC), learning rate (LR), transfer function, number of hidden layer and neurons need to be determined.
- ▶ These parameters are varied and determined heuristically (using trial and error method). The model structure that has been selected is three-layer structure which consists of input, hidden layer and output layers. The learning technique used is Lavenberg-Marquart (LM).

Results & Discussion

Model	R Values
1	0.6185
2	0.6239
3	0.8100
4	0.8005
5	0.8016
6	0.7316
7	0.7122

- Table above shows the values of R obtained for each of the respective model.
- Model 3 has the highest R values which is **0.8100**. Model 3 has been feed with **Electric Circuit 1 (EEE121)** as the input and **Electronics 1 (ELE232)** as the output.
- Comparison on the results was made. The Model with EEE121 subject (Model 3,4,5 and 6) obtained higher R values as compared to the Models without EEE121 subject (Model 1,2 and 7).
- It can be seen that EEE121 subject which is taken during Semester 2 has significant impact on the grade obtained by the students for ELE232 during Semester 3.
- Based on the syllabus of the subjects, it can be concluded that the basic circuit analysis concept in EEE121 subject is crucial and vital for ELE232 subject.



Correlation Coefficient, R of ANN for Model 3

- As the result, the selected ANN configuration for Model 3 is a three-layer feed forward back-propagation network with 4 neurons in hidden layer. The learning rate and momentum constant values are 0.5 and 0.95 respectively and the training algorithm used is Levenberg-Marquardt.

ANN Properties	Model 3
ANN Configuration	[1 4 1]
Transfer Function	tansig
Learning Rate	0.5
Momentum Constant	0.95
Regression Coefficient, R	0.8100
Training Algorithm	Lavenberg-Marquart



Conclusion

- ▶ A study on impact of MAT133, MAT183 and EEE121 on ELE232 by using ANN has been done.
- ▶ By using the developed ANN models, it can be concluded that EEE121 subject has significant impact on the ELE232 subject.
- ▶ In order to achieve University's objective to improve the percentage of GOT among the students and to reduce the percentage of failure rate that is higher than 25%, proactive actions measures should be taken.
- ▶ Early preventive measures taken in semester 2 might improve the overall performance of Faculty and University since the EEE121 subject is taken by the students during semester 2.
- ▶ From this research finding, proactive actions should be taken by the University and Faculty such as creating a better lesson plan during semester 2, choosing experienced lecturers to teach the particular subject, deliver the lesson using different medium of teaching such as blended learning and taking proactive preventive measures before final exam such as clinic day.



Recommendation for Future Work

- ▶ For future works, analysis of the ANN performance should consider another evaluation method such as Mean Square Error(MSE) and Mean Absolute Error(MAE) to verify the efficiency of the system.
- ▶ The process of designing ANN model (the parameter selection process) could be optimized by using another computational method such as Evolutionary Programming, Particle Swarm Optimization and etc. This optimization could process provides more efficient platform for analysis since ANN is heuristic in nature.
- ▶ This area of research is essential since it uses computational method analysis which is more systematic in order to find the root cause of problems related to academic performance. Once the problem is identified, future plans and measures could be planned.



Acknowledgment

Special acknowledgment goes to **Universiti Teknologi MARA (UiTM) Cawangan Terengganu Kampus Dungun** for the **Special Interest Group Grant, (SIG)- (600-IRMI 5/3/DDN) (11)** for funding the research activities.



Thank You 😊