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CONTENTS

❖ Material and Method

- This part of the study gives information and statistics about Gediz River Basin and it's four stations. Furthermore, it provides information about three AI methods; ANFIS, ANN, and KNN that were used in this study.

❖ Material

The GRB which is located in western Turkey is one of the largest and most important river basins of Turkey. The drainage area of the basin is about 17146 km2 which is 2.2% of the entire Turkey's area. n 2012, around 1.733 million people were living in the territory of the basin. Major socio-economical activities in the region are animal husbandry, agriculture, textile industry, food industry, and mining. Amongst them, agriculture's sector is the biggest water consumer.

Station	509	518	525	527
Northern Latitudes	38° 53' 25''	38° 38' 41''	38° 24' 44''	38° 46' 40''
Eastern Longitudes	27° 46' 09''	27° 26' 30''	27° 36' 47''	(27° 57' 58''
Area(km^2)	901.6 km^2	15616.4 km^2	64.0 km^2	430.5 km^2
Altitude	77(m)	23(m)	158 m	128 m

❖ **Figure.** Location of the Gediz River Basin in the map

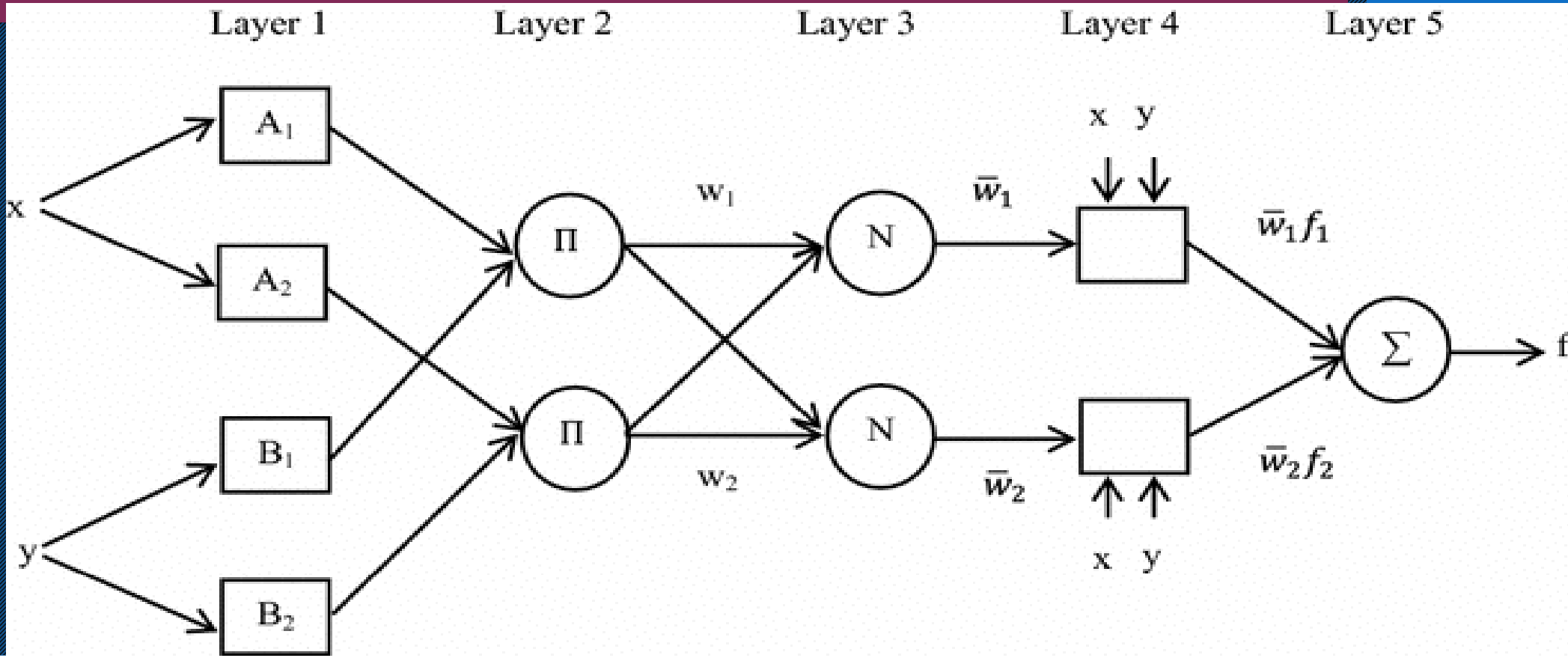
❖ Methods

Three methods; Adaptive Neuro Fuzzy İnference System (ANFIS), Artificial Neural Network (ANN), and K Nearest Neighbor Algorithm (KNN) have been used in this study

❖ Adaptive Neuro Fuzzy İnference System

An ANFIS model combines the learning ability of neural networks and fuzzy systems. It is consisted of five layers. 1 “Input Fuzzy Rules”, Layer 2 “Input MF”, Layer 3 “Fuzzy Neurons”, Layer 4 “Output MF” Layer 5 “Summation and Weights”.

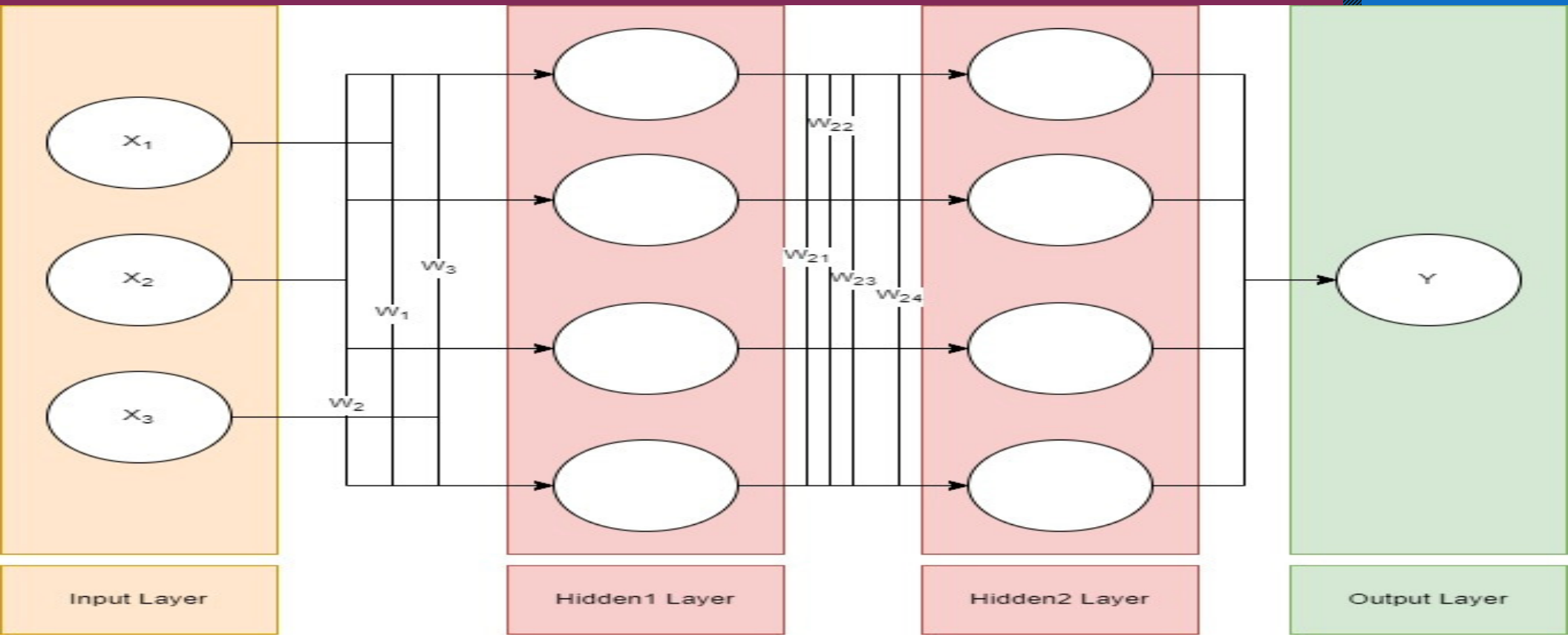
Figure. 2. The architecture of an ANFIS that has 2 inputs as well as 5 layers



Artificial Neural Network

Artificial Neural Networks have been broadly used in many fields of science and engineering such as, Improving peak flow estimates, streamflow, and so on.

ANN is made of an input, one or more than one hidden and an output layers. Figure. 3 shows the architecture of a three layer ANN



K Nearest Neighbor Algorithm

K Nearest neighbors is a non-parametric method, which was first developed by Hodges and Fix in 1951. In an unpublished US Air Force report, KNN can be used for both prediction and classification of problems.

Results

To evaluate the performance of the models; R^2, RMSE and Wilcoxon Test were observed. Furthermore, Taylor diagram was also used.

Train and test performances of the ANFIS model

		Train			Test		
Input	MFs	R^2	RMSE	Wilcoxon	R^2	RMSE	Wilcoxon
509	3-3-3	0,602	24,993	3,843	0,586	13,151	4,024
	4-4-4	0,616	28,426	3,789	0,588	12,486	3,754
	5-5-5	0,641	21,291	0,986	0,598	12,945	3,913
525	3-3-3	0,631	21,206	1,521	0,722	11,220	3,131
	4-4-4	0,659	20,389	1,227	0,739	11,024	3,237
	5-5-5	0,667	20,138	1,219	0,713	11,345	2,994
527	3-3-3	0,688	20,529	0,797	0,320	21,648	3,731
	4-4-4	0,692	21,178	0,737	0,442	18,935	3,787
	5-5-5	0,688	19,846	0,792	0,424	18,281	3,660
509-525	3-3-3	0,696	19,324	1,219	0,731	12,044	3,564
	4-4-4	0,735	18,144	1,241	0,789	10,465	3,364
	5-5-5	0,724	18,412	1,061	0,766	11,235	3,536
509-527	3-3-3	0,722	18,507	1,144	0,759	11,466	3,854
	4-4-4	0,740	17,950	1,100	0,711	11,723	3,017
	5-5-5	0,747	17,551	1,053	0,765	10,257	2,275
525-529	3-3-3	0,731	18,292	1,454	0,677	12,516	3,475
	4-4-4	0,735	18,051	1,368	0,747	11,510	3,494
	5-5-5	0,747	11,510	1,237	0,745	11,733	3,114
509-525-527	3-3-3	0,737	17,900	1,366	0,750	10,723	3,057
	4-4-4	0,752	17,528	1,333	0,754	10,595	3,120
	5-5-5	0,794	15,828	1,404	0,828	8,330	2,245

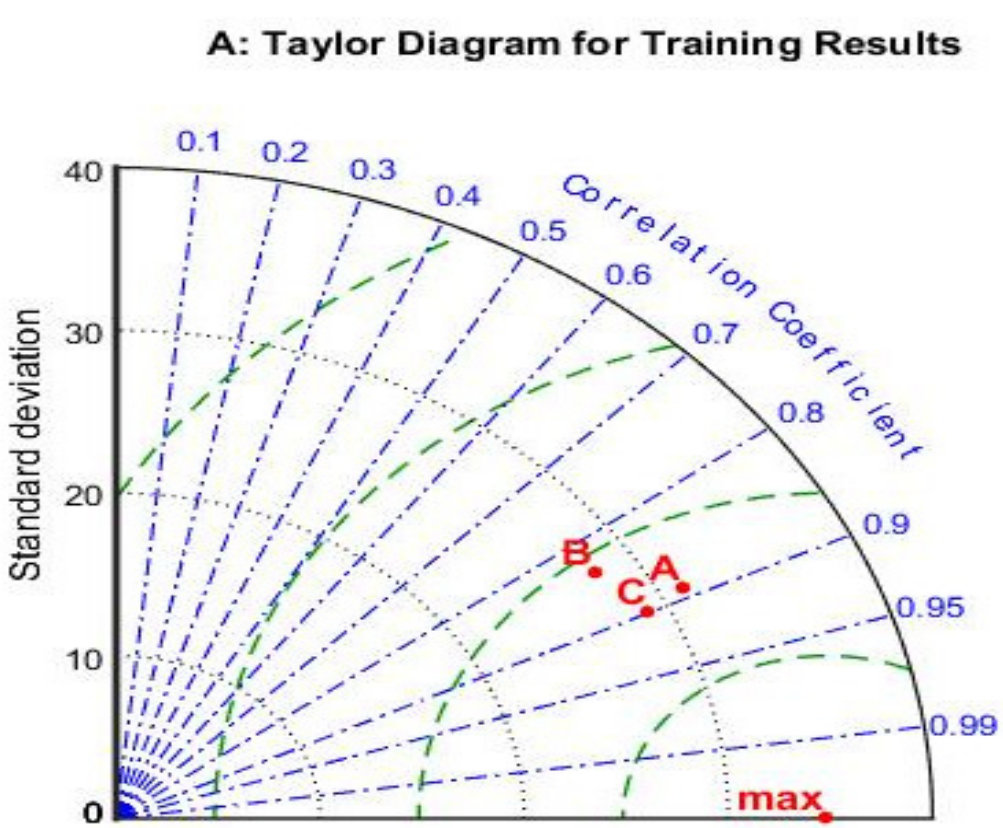
Summary of the training and testing performances of the ANN model.

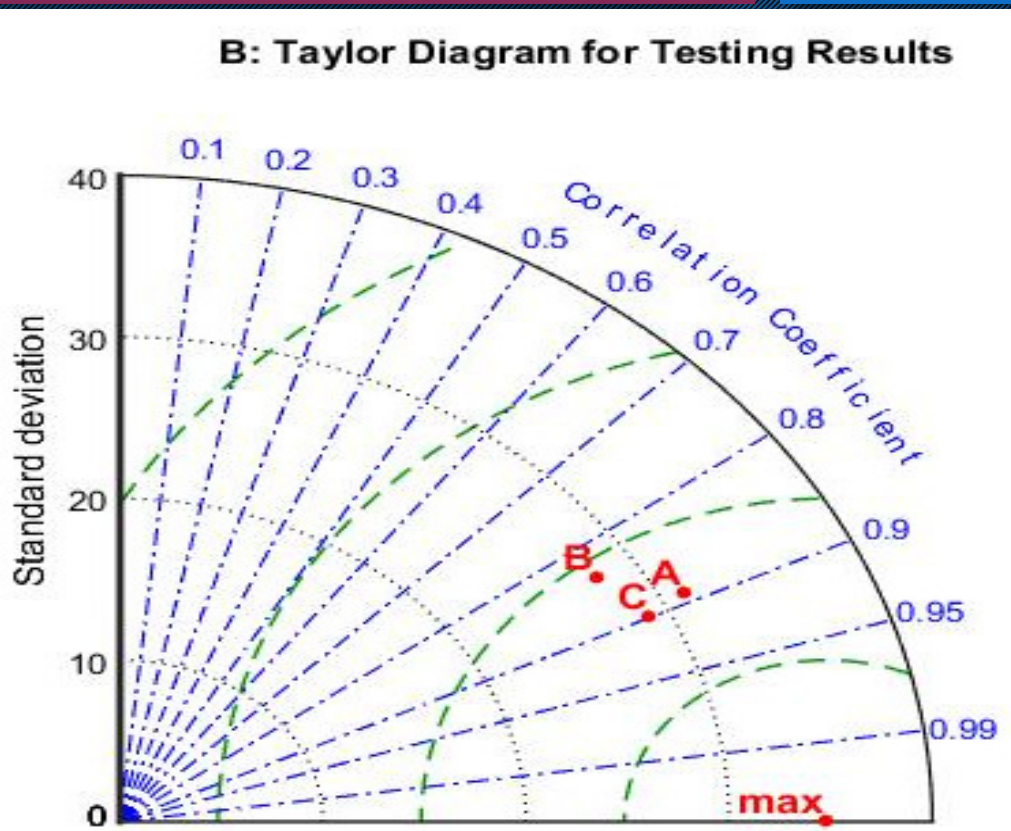
		Train			Test		
Input	Neuron	R^2	RMSE	Wilcoxon	R^2	RMSE	Wilcoxon
509	14	0,740	17,795	1,115	0,592	18,743	3,221
525	16	0,712	18,705	1,451	0,594	14,724	3,114
527	10	0,725	18,306	1,212	0,603	14,550	3,054
509-525	10	0,798	16,363	0,954	0,622	18,662	3,425
509-527	12	0,762	17,002	1,127	0,631	12,331	2,987
525-527	16	0,762	17,110	1,119	0,589	12,787	3,021
509-525-527	10	0,741	17,768	0,897	0,715	11,381	2,875

Performances obtained using KNN model

		Train			Test		
Input	neighborhood k	R^2	RMSE	Wilcoxon	R^2	RMSE	Wilcoxon
509-525-527	1	1,000	0,000	0	0,360	26,110	3,721
	3	0,743	23,340	1,714	0,474	16,720	3,214
	5	0,809	18,870	1,412	0,771	13,454	2,954
	7	0,579	31,841	2,054	0,59	17,705	3,623

The performances of A, B, and C models according to Taylor diagram
A(ANFIS), B(ANN) and C(KNN)





Thank you very much for your attention