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PREDICTING AUTOMOBILE PRICES USING NEURAL NETWORKS

When purchasing a car, people often gravitated toward different features. Some popular features included functionalities like navigation systems, leather seats, seat heaters, and cruise control. For cars intended for private use, personal preferences such as favourite colour and the desired vehicle shape came into play. Therefore, the price of one particular car model could vary according to these features.

A car manufacturing plant had designed several new car models with different features and accessories. On June 11, 2018, Adam Ebraham, the chief marketing officer at an automobile agency, was looking at a list, which he had received from the manufacturing plant, of different car model features. After receiving the manufacturer's suggested retail price (MSRP), the dealerships would decide on a final price that included environmental fees, air conditioning fees, and other fees. The MSRP was the base price of a vehicle model, set nationally for every dealer, before environmental costs and fees were applied. A car's features and accessories affected the MSRP. Ebraham needed to provide the MSRPs to dealers next week, and he had to decide on the base prices. He did not know how to determine which features were essential or to what extent each feature contributed to the price.

He had heard of a prediction system called neural networks that could help him to accurately predict the price. Yusuf Farid, a data scientist with expertise in machine learning and prediction, had recently been hired at the company research lab. Ebraham stopped by Farid's office and provided Farid with the data collected for the previous batch of cars (see Exhibit 1).

There were 28 variables provided in the dataset—one dependent variable and 27 independent variables. The dependent variable was the price of each car model. Farid hoped to provide Ebraham with an accurate MSRP recommendation for the new cars before the deadline the following week.

THE DECISION

For predicting the prices, Farid decided that he would try various machine-learning methods, including linear regression. He also knew that neural networks excelled in predicting price, so he decided to use a feed-forward neural network to train data and accurately predict the price. He wondered how neural networks would compare to linear regression. What about other algorithms, like logistic regression? For long-term marketing, he wanted to decide on one particular computing system to determine prices.

EXHIBIT 1: CONFIGURATIONS OF THE PREVIOUS YEAR'S CARS

Price	Age	KM	Fuel	HP	MC	Colour	Auto	CC	Drs	Cyl	Grs	Wght	G_P	Mfr_G	ABS	Abag_1	Abag_2	AC	Comp	CD	Clock	Pwi	PStr	Radio	SpM	M_Rim	Tow_Bar
21,000	26	31463	Petrol	195	0	Silver	0	1800	3	3	6	1189	10	1	1	1	1	1	0	1	1	1	1	0	0	1	0
20,000	23	43612	Petrol	195	0	Red	0	1800	3	3	6	1189	4	1	1	1	1	1	1	0	1	1	1	0	1	1	0
19,650	26	32191	Petrol	195	0	Red	0	1800	3	3	6	1189	4	1	1	1	1	1	1	0	1	1	1	0	1	1	0
21,550	32	23002	Petrol	195	1	Black	0	1800	3	3	6	1189	4	1	1	1	1	1	1	1	1	1	1	0	1	1	0
22,550	33	34133	Petrol	195	1	Grey	0	1800	3	3	6	1189	4	1	1	1	1	1	1	1	1	1	1	0	1	1	0
22,050	29	18741	Petrol	195	0	Grey	0	1800	3	3	6	1189	4	1	1	1	1	1	1	0	1	1	1	0	1	1	0
22,800	31	34002	Petrol	195	1	Grey	0	1800	3	3	5	1189	4	1	1	1	1	1	1	1	1	1	1	0	1	1	1
18,000	25	21718	Petrol	113	1	Blue	0	1600	3	3	5	1109	20	0	1	0	0	0	0	0	1	1	1	1	0	0	0
16,800	25	25565	Petrol	113	0	Grey	0	1600	3	3	5	1069	4	0	1	1	1	1	1	1	1	1	1	0	1	0	0
17,000	31	64361	Petrol	113	1	Grey	0	1600	3	3	5	1109	4	1	1	1	0	1	1	1	1	1	1	0	1	0	0
16,000	31	67662	Petrol	113	1	Blue	0	1600	3	3	5	1109	4	1	1	1	0	1	1	1	1	1	1	0	1	0	1
17,000	30	43907	Petrol	113	0	Grey	1	1600	3	3	5	1174	4	1	1	1	1	1	1	0	1	1	1	0	1	0	0
16,000	29	56351	Petrol	113	1	Black	0	1600	3	3	5	1124	4	1	1	1	1	1	1	1	1	1	1	0	1	1	1
17,000	29	32222	Petrol	113	1	Black	0	1600	3	3	5	1124	4	1	1	1	1	1	1	1	1	1	1	0	1	0	1
16,300	30	25815	Petrol	113	1	Grey	0	1600	3	3	5	1124	4	1	1	1	1	1	1	1	1	1	1	0	1	0	0
16,000	26	28452	Petrol	113	1	Blue	0	1600	3	3	5	1124	4	1	1	1	1	1	1	1	1	1	1	0	1	1	1
17,545	28	34547	Petrol	113	1	Blue	0	1600	3	3	5	1124	4	1	1	1	1	1	1	0	1	1	1	0	1	1	0
15,800	30	41417	Petrol	113	1	Black	0	1600	3	3	5	1124	4	1	1	1	1	1	1	1	1	1	1	0	1	0	1
17,000	29	44144	Petrol	113	0	Grey	0	1600	3	3	5	1124	4	1	1	1	1	1	1	1	1	1	1	0	1	0	0
18,000	31	11092	Petrol	113	1	Blue	0	1600	3	3	5	1124	4	1	1	1	1	1	1	1	1	1	1	0	1	0	0
13,000	30	9752	Petrol	100	1	Silver	0	1400	3	3	5	1104	10	1	1	1	0	0	0	0	0	0	1	1	1	0	0
15,800	23	35201	Petrol	100	1	Blue	0	1400	3	3	5	1104	4	1	1	1	1	1	1	1	1	1	1	0	1	0	1
16,000	28	29512	Petrol	100	1	Black	0	1400	3	3	5	1104	4	1	1	1	1	1	0	1	1	1	1	0	1	0	0
15,000	27	32694	Petrol	100	1	Grey	0	1400	3	3	5	1104	4	1	1	1	1	1	1	0	1	1	1	0	1	0	0
15,550	23	41002	Petrol	100	1	Grey	0	1400	3	3	5	1104	4	0	1	1	1	0	1	1	1	1	1	0	1	0	0
15,800	27	43002	Petrol	100	0	Grey	0	1400	3	3	5	1104	4	1	1	1	1	1	1	1	1	1	1	0	1	0	0
16,000	26	25002	Petrol	100	1	Grey	0	1400	3	3	5	1104	4	1	1	1	1	1	1	1	1	1	1	0	1	0	0
15,000	24	10002	Petrol	100	1	Blue	0	1400	3	3	5	1104	4	1	1	1	1	1	1	1	1	1	1	0	1	0	1
15,800	33	25331	Petrol	100	1	Green	0	1400	3	3	5	1104	4	1	1	1	1	1	1	1	1	1	1	0	1	0	0
14,800	28	27502	Petrol	100	0	Blue	0	1400	3	3	5	1104	4	1	1	1	1	1	0	0	0	0	1	0	1	0	0
14,000	23	49061	Petrol	100	0	Blue	0	1400	3	3	5	1104	4	1	1	1	1	1	1	0	0	0	1	0	1	0	0

EXHIBIT 1 CONTINUED

Configuration	Definition
Price	Offer price in CA$
Age	Age in months
KM	Accumulated kilometers on odometer
Fuel	Fuel type (Petrol, Diesel, CNG)
HP	Horse power
MC	Metallic colour? (Yes=1, No=0)
Colour	Colour (blue, red, grey, silver, black, etc.)
Auto	Automatic (Yes=1, No=0)
CC	Cylinder volume in cubic centimeters
Drs	Number of doors
Cyl	Number of cylinders
Grs	Number of gear positions
Wght	Weight in kilograms
G_P	Guarantee period in months
Mfr_G	Within manufacturer's guarantee period (Yes=1, No=0)
ABS	Anti-lock brake system (Yes=1, No=0)
Abag_1	Driver airbag (Yes=1, No=0)
Abag_2	Passenger airbag (Yes=1, No=0)
AC	Automatic air conditioning (Yes=1, No=0)
Comp	Board computer (Yes=1, No=0)
CD	CD player (Yes=1, No=0)
Clock	Central lock (Yes=1, No=0)
Pwin	Powered windows (Yes=1, No=0)
PStr	Power steering (Yes=1, No=0)
Radio	Radio (Yes=1, No=0)
SpM	Sport model (Yes=1, No=0)
M_Rim	Metallic rim (Yes=1, No=0)
Tow_Bar	Tow bar (Yes=1, No=0)

Source: Created by the case author.