Pick-up method + machine learning: a proved efficient approach to forecast hotel demand

Rachel Zhang

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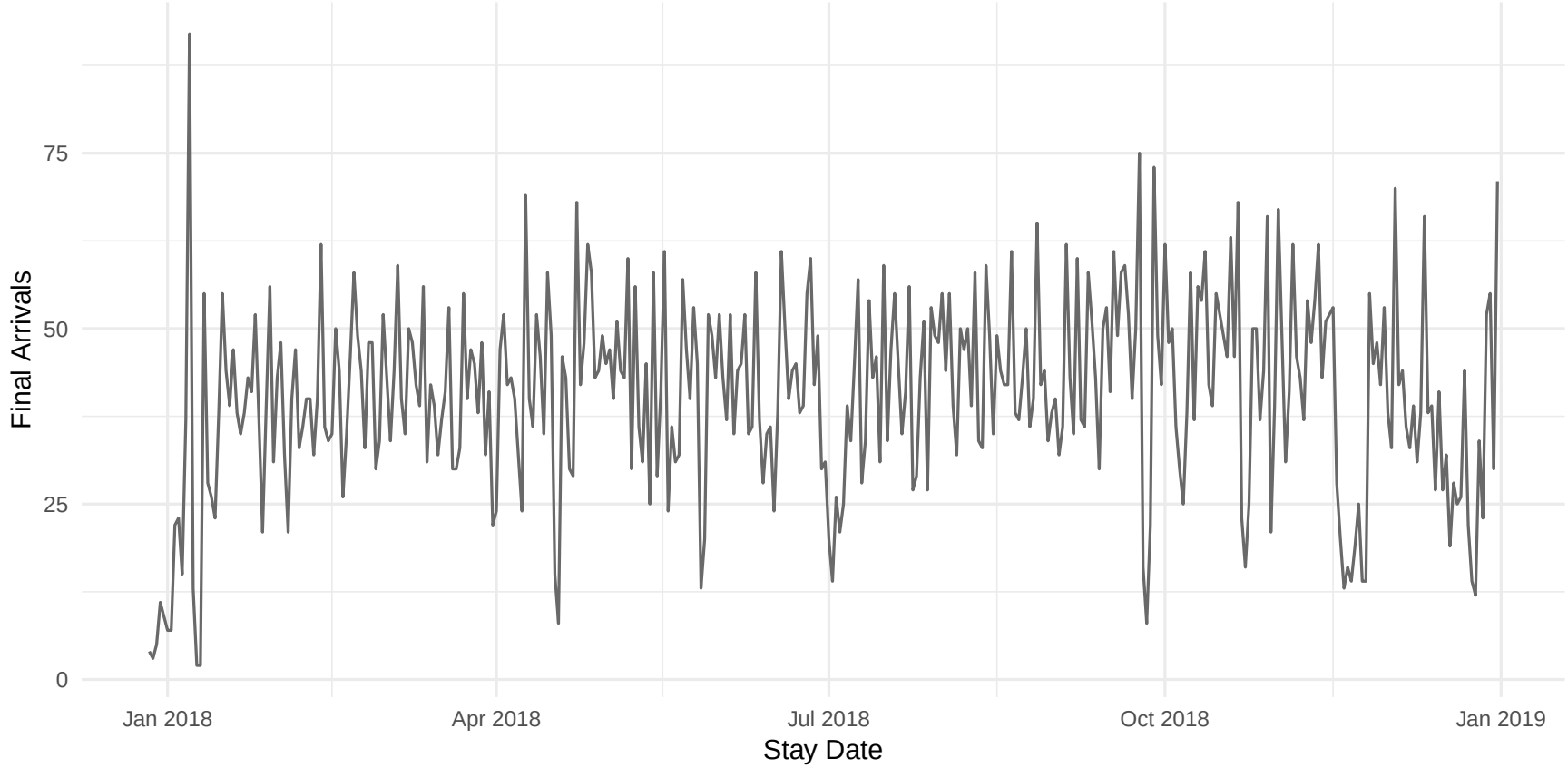
Data

Importe Dataset and Cross-Validation



This analysis is conducted under `R version 3.6.0` with `set.seed(0)`. The robust test in Section X is conducted under `set.seed(123)`.

We randomly selected 80% of the records as the training dataset to tune models, and the rest 20% records are used for model performance test. Here is a peek of the training set:

Table 1: Training Set Overview

	ROH0	DOW	ROH1	ROH2	ROH3	ROH4	ROH5	ROH6	ROH7	ROH14	ROH21	ROH30	ROH60	ROH90
2018-11-15	52	Thursday	49	46	42	41	41	41	38	29	25	22	7	1
2018-06-11	58	Monday	58	56	53	51	47	47	47	40	37	30	9	4
2018-05-04	51	Friday	48	47	46	44	41	38	38	30	28	21	4	1
2018-10-21	68	Sunday	67	67	66	66	64	59	54	44	20	18	10	5
2018-09-22	40	Saturday	38	36	36	35	33	32	31	27	20	8	5	5
2018-07-01	20	Sunday	17	16	16	14	13	13	13	10	10	6	2	2
2018-10-29	66	Monday	61	56	55	53	51	49	43	32	26	25	7	2
2018-03-21	30	Wednesday	28	25	21	21	21	20	20	9	5	5	3	0
2018-09-29	49	Saturday	45	45	42	39	37	36	36	31	26	23	17	12
2018-11-21	14	Wednesday	14	13	12	12	12	12	11	10	10	9	6	2

Modeling

Additive Pick-up

Table 2: Additive Pick Ups

DOW	ROH1	ROH2	ROH3	ROH4	ROH5	ROH6	ROH7	ROH14	ROH21	ROH30	ROH60	ROH90
Sunday	2.11	3.04	4.40	5.58	6.51	8.18	9.22	13.9	18.8	22.8	30.1	33.9
Monday	2.84	4.34	5.16	7.59	9.57	11.14	12.89	21.8	27.4	33.2	42.6	45.9
Tuesday	2.42	4.28	4.58	4.97	6.17	7.25	8.92	16.6	21.7	27.3	33.5	36.7
Wednesday	1.95	3.58	5.37	5.77	6.16	7.30	8.51	15.5	20.5	25.3	32.6	35.8
Thursday	3.40	5.11	6.84	8.31	8.84	9.67	10.84	17.0	21.4	25.8	34.1	37.3
Friday	3.32	5.76	7.61	9.27	10.83	11.54	12.24	17.9	21.6	25.5	33.6	37.5
Saturday	3.71	5.69	7.74	9.55	10.98	12.14	12.88	17.3	20.3	23.7	30.3	33.3

Note:
The pick-ups are calculated by taking the average of additive increments between current day and a future date by day of week.

Table 3: Multiplicative Pick Ups

DOW	ROH1	ROH2	ROH3	ROH4	ROH5	ROH6	ROH7	ROH14	ROH21	ROH30	ROH60	ROH90
Sunday	0.939	0.910	0.874	0.841	0.817	0.772	0.746	0.623	0.500	0.395	0.215	0.113
Monday	0.940	0.907	0.890	0.841	0.801	0.773	0.739	0.571	0.459	0.343	0.149	0.082
Tuesday	0.942	0.892	0.884	0.874	0.844	0.821	0.787	0.599	0.477	0.320	0.158	0.081
Wednesday	0.942	0.901	0.855	0.846	0.837	0.810	0.782	0.622	0.506	0.390	0.191	0.097
Thursday	0.914	0.873	0.835	0.802	0.789	0.766	0.738	0.585	0.482	0.380	0.181	0.106
Friday	0.921	0.864	0.822	0.785	0.748	0.733	0.717	0.590	0.507	0.419	0.236	0.145
Saturday	0.902	0.852	0.798	0.753	0.717	0.687	0.668	0.552	0.473	0.382	0.197	0.120

Note:
The pick-ups are calculated by taking the average of ratio increments between current day and a future date by day of week.

Multiplicative Pick-up

Regression

The regression model uses the nearest ROH and the DOW of the target day.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
(Intercept)	1.88***	2.54***	3.51***	4.17***	4.58***	5.92***	6.69***	11.59***	17.74***	21.88***	27.68***	32.50***
	(0.51)	(0.68)	(0.77)	(0.87)	(0.92)	(0.98)	(1.11)	(1.61)	(1.80)	(1.87)	(2.00)	(1.93)
DOWMonday	0.66	1.16	0.49	1.62	2.57**	2.35*	3.01**	7.60***	8.52***	10.36***	12.89***	12.19***
	(0.49)	(0.66)	(0.76)	(0.85)	(0.90)	(0.98)	(1.11)	(1.62)	(1.93)	(2.10)	(2.39)	(2.52)
DOWTuesday	0.30	1.23	0.15	−0.69	−0.44	−1.09	−0.44	2.91	3.02	4.68*	3.96	3.24
	(0.51)	(0.68)	(0.78)	(0.88)	(0.94)	(1.01)	(1.15)	(1.70)	(2.03)	(2.23)	(2.53)	(2.67)
DOWWednesday	−0.17	0.53	0.97	0.15	−0.43	−1.02	−0.86	1.65	1.77	2.61	2.90	2.19
	(0.48)	(0.65)	(0.74)	(0.84)	(0.89)	(0.97)	(1.10)	(1.62)	(1.93)	(2.12)	(2.41)	(2.53)
DOWThursday	1.28**	2.05**	2.42**	2.71**	2.28*	1.36	1.48	3.09	2.66	2.91	4.18	3.46
	(0.48)	(0.64)	(0.73)	(0.83)	(0.88)	(0.96)	(1.08)	(1.60)	(1.91)	(2.09)	(2.37)	(2.50)
DOWFriday	1.18*	2.68***	3.16***	3.62***	4.26***	3.22**	2.83*	3.87*	2.70	2.53	2.99	3.09
	(0.49)	(0.65)	(0.75)	(0.85)	(0.90)	(0.98)	(1.11)	(1.64)	(1.96)	(2.15)	(2.44)	(2.58)
DOWSaturday	1.62**	2.69***	3.45***	4.17***	4.78***	4.32***	4.04***	3.83*	1.63	0.94	0.49	−0.60
	(0.49)	(0.65)	(0.75)	(0.85)	(0.91)	(0.98)	(1.11)	(1.64)	(1.95)	(2.13)	(2.42)	(2.55)
ROH1	1.01***											
	(0.01)											
ROH2		1.01***										
		(0.01)										
ROH3			1.03***									
			(0.02)									
ROH4				1.04***								
				(0.02)								
ROH5					1.06***							
					(0.02)							
ROH6						1.07***						
						(0.02)						
ROH7							1.09***					
							(0.03)					
ROH14								1.09***				
								(0.05)				
ROH21									1.05***			
									(0.06)			
ROH30										1.06***		
										(0.07)		
ROH60											1.29***	
											(0.13)	
ROH90												1.31***
												(0.17)
R^2	0.97	0.95	0.93	0.92	0.91	0.89	0.86	0.69	0.56	0.47	0.32	0.24
Adj. R^2	0.97	0.95	0.93	0.91	0.90	0.89	0.85	0.68	0.55	0.46	0.30	0.22
Num. obs.	296	296	296	296	296	296	296	296	296	296	296	296
RMSE	2.27	3.03	3.48	3.94	4.19	4.53	5.13	7.60	9.07	9.92	11.25	11.87

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$