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

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Data

Data Importing and Cross-Validation
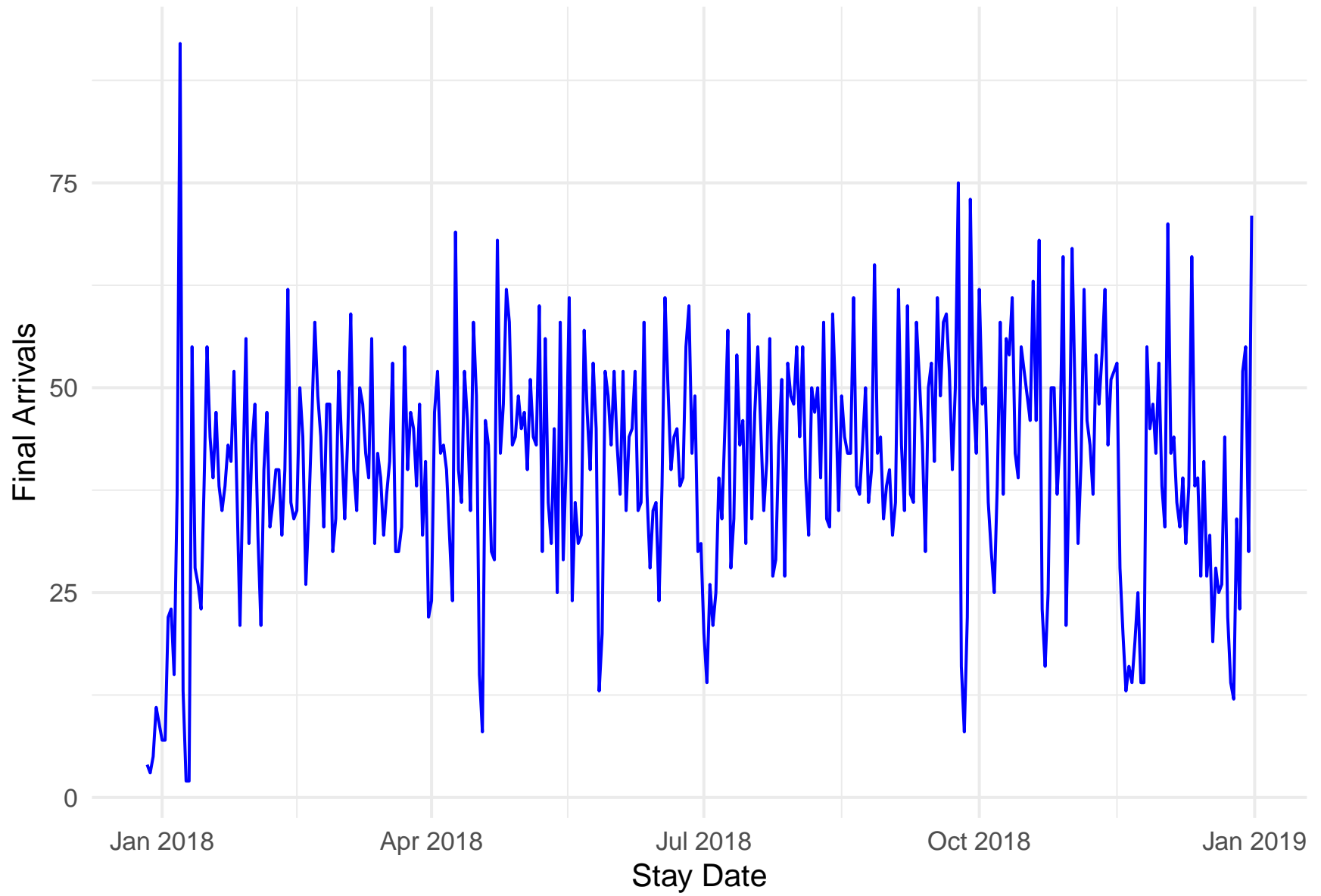
```
## [1] 370
```

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

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

Multiplicative Pick-up

Regression

Call: lm(formula = lm.formula, data = train)

Residuals: Min 1Q Median 3Q Max -3.784 -1.740 -0.365 1.541 9.298

Coefficients: Estimate Std. Error t value Pr(>|t|)
(Intercept) 2.5777 0.4268 6.04 4.8e-09   ***DOW.L 1.2973 0.3481 3.73 0.00023***   DOW.Q 0.4393 0.3486 1.26 0.20862
DOW.C 0.0510 0.3503 0.15 0.88431
DOW^4 -0.6021 0.3568 -1.69 0.09262 .
DOW^5 0.4842 0.3555 1.36 0.17430
DOW^6 0.5755 0.3529 1.63 0.10399
ROH1 1.0063 0.0105 96.04 < 2e-16 *** — Signif. codes: 0 '***0.001***' 0.01 '' 0.05 '.' 0.1 ' ' 1

Residual standard error: 2.27 on 288 degrees of freedom Multiple R-squared: 0.972, Adjusted R-squared: 0.972 F-statistic: 1.44e+03 on 7 and 288 DF, p-value: <2e-16

Call: lm(formula = lm.formula, data = train)

Residuals: Min 1Q Median 3Q Max -5.733 -2.257 -0.113 1.969 12.380

Coefficients: Estimate Std. Error t value Pr(>|t|)
(Intercept) 4.0204 0.5570 7.22 4.7e-12   ***DOW.L 2.2561 0.4665 4.84 2.2e-06***   DOW.Q 0.1648 0.4652 0.35 0.723
DOW.C 0.1466 0.4677 0.31 0.754
DOW^4 -0.9900 0.4755 -2.08 0.038 *
DOW^5 0.0769 0.4753 0.16 0.872

4

DOW^6 0.6033 0.4712 1.28 0.201

ROH2 1.0141 0.0143 71.04 < 2e-16 *** — Signif. codes: 0 '*' 0.001 '*' 0.01 '' 0.05 '.' 0.1 ' ' 1

Residual standard error: 3.03 on 288 degrees of freedom Multiple R-squared: 0.951, Adjusted R-squared: 0.949 F-statistic: 790 on 7 and 288 DF, p-value: <2e-16

Call: lm(formula = lm.formula, data = train)

Residuals: Min 1Q Median 3Q Max -6.792 -2.528 -0.368 2.166 12.392

Coefficients: Estimate Std. Error t value Pr(>|t|)

(Intercept) 5.0247 0.6313 7.96 4.0e-14 **DOW.L 3.3917 0.5402 6.28 1.3e-09** DOW.Q 0.6137 0.5364 1.14 0.25

DOW.C -0.6088 0.5392 -1.13 0.26

DOW^4 -0.5447 0.5495 -0.99 0.32

DOW^5 0.4483 0.5468 0.82 0.41

DOW^6 0.0281 0.5421 0.05 0.96

ROH3 1.0262 0.0168 61.11 < 2e-16 *** — Signif. codes: 0 '*' 0.001 '*' 0.01 '' 0.05 '.' 0.1 ' ' 1

Residual standard error: 3.48 on 288 degrees of freedom Multiple R-squared: 0.934, Adjusted R-squared: 0.933 F-statistic: 586 on 7 and 288 DF, p-value: <2e-16

Call: lm(formula = lm.formula, data = train)

Residuals: Min 1Q Median 3Q Max -8.008 -2.630 -0.472 2.304 12.924

Coefficients: Estimate Std. Error t value Pr(>|t|)

(Intercept) 5.827442 0.705530 8.26 5.4e-15 **DOW.L 3.764280 0.611443 6.16 2.5e-09** DOW.Q 1.548275 0.607578 2.55 0.0113 *

DOW.C -0.499676 0.608730 -0.82 0.4124

DOW^4 -1.713199 0.616017 -2.78 0.0058 ** DOW^5 1.434861 0.616042 2.33 0.0205 *

DOW^6 0.000173 0.612101 0.00 0.9998

ROH4 1.042709 0.019474 53.54 < 2e-16 *** — Signif. codes: 0 '*' 0.001 '*' 0.01 '' 0.05 '.' 0.1 ' ' 1

Residual standard error: 3.94 on 288 degrees of freedom Multiple R-squared: 0.916, Adjusted R-squared: 0.914 F-statistic: 450 on 7 and 288 DF, p-value: <2e-16

Call: lm(formula = lm.formula, data = train)

Residuals: Min 1Q Median 3Q Max -9.145 -2.905 -0.584 2.428 12.872

Coefficients: Estimate Std. Error t value Pr(>|t|)

(Intercept) 6.441820 0.744146 8.66 3.5e-16 **DOW.L 3.864760 0.651567 5.93 8.6e-09** DOW.Q 2.198307 0.648706 3.39 0.0008 **DOW.C 0.151276 0.647580 0.23 0.8155**

DOW^4 -2.758141 0.652038 -4.23 3.1e-05 DOW^5 1.266368 0.656182 1.93 0.0546 .

DOW^6 -0.000924 0.651749 0.00 0.9989

ROH5 1.060246 0.021226 49.95 < 2e-16 *** — Signif. codes: 0 '*' 0.001 '*' 0.01 '' 0.05 '.' 0.1 ' ' 1

Residual standard error: 4.19 on 288 degrees of freedom Multiple R-squared: 0.905, Adjusted R-squared: 0.903 F-statistic: 392 on 7 and 288 DF, p-value: <2e-16

Call: lm(formula = lm.formula, data = train)

Residuals: Min 1Q Median 3Q Max -11.687 -3.208 -0.651 2.990 12.791

Coefficients: Estimate Std. Error t value Pr(>|t|)
(Intercept) 7.2271 0.7954 9.09 < 2e-16 *DOW.L 3.2396 0.7022 4.61 6e-06* DOW.Q 2.7156 0.7032 3.86 0.00014 *DOW.C 0.4092 0.6999 0.58 0.55923*
DOW^4 -2.5671 0.7059 -3.64 0.00033 DOW^5 1.4277 0.7092 2.01 0.04503 *
DOW^6 -0.1559 0.7044 -0.22 0.82506
ROH6 1.0743 0.0235 45.75 < 2e-16 *** — Signif. codes: 0 '*' 0.001 '' 0.01 '' 0.05 '.' 0.1 ' ' 1

Residual standard error: 4.53 on 288 degrees of freedom Multiple R-squared: 0.889, Adjusted R-squared: 0.886 F-statistic: 330 on 7 and 288 DF, p-value: <2e-16

Call: lm(formula = lm.formula, data = train)

Residuals: Min 1Q Median 3Q Max -13.560 -3.420 -0.852 3.689 13.537

Coefficients: Estimate Std. Error t value Pr(>|t|)
(Intercept) 8.1256 0.8960 9.07 <2e-16 *DOW.L 2.5851 0.7934 3.26 0.0013* DOW.Q 2.2451 0.7954 2.82 0.0051 *DOW.C 0.9429 0.7929 1.19 0.2353*
DOW^4 -2.6525 0.8001 -3.32 0.0010 DOW^5 1.5717 0.8035 1.96 0.0514 .
DOW^6 0.0591 0.7986 0.07 0.9411
ROH7 1.0865 0.0275 39.58 <2e-16 ** — Signif. codes: 0 '*' 0.001 '' 0.01 '' 0.05 '.' 0.1 ' ' 1

Residual standard error: 5.13 on 288 degrees of freedom Multiple R-squared: 0.858, Adjusted R-squared: 0.854 F-statistic: 248 on 7 and 288 DF, p-value: <2e-16

Call: lm(formula = lm.formula, data = train)

Residuals: Min 1Q Median 3Q Max -18.995 -4.774 -0.711 5.057 24.496

Coefficients: Estimate Std. Error t value Pr(>|t|)
(Intercept) 14.8705 1.2134 12.26 < 2e-16 *DOW.L 0.7970 1.1678 0.68 0.49550*
DOW.Q -0.5921 1.1672 -0.51 0.61233
DOW.C 3.0147 1.1762 2.56 0.01088
DOW^4 -4.2646 1.1779 -3.62 0.00035 DOW^5 2.1504 1.1888 1.81 0.07151 .
DOW^6 -0.2598 1.1821 -0.22 0.82619
ROH14 1.0924 0.0462 23.62 < 2e-16 ** — Signif. codes: 0 '*' 0.001 '' 0.01 '' 0.05 '.' 0.1 ' ' 1

Residual standard error: 7.6 on 288 degrees of freedom Multiple R-squared: 0.688, Adjusted R-squared: 0.68 F-statistic: 90.6 on 7 and 288 DF, p-value: <2e-16

Call: lm(formula = lm.formula, data = train)

Residuals: Min 1Q Median 3Q Max -24.83 -5.81 0.06 5.32 29.23

Coefficients: Estimate Std. Error t value Pr(>|t|)
(Intercept) 20.6359 1.3063 15.80 <2e-16 *DOW.L -1.3474 1.3852 -0.97 0.3315*
DOW.Q -1.7443 1.3898 -1.26 0.2105
DOW.C 3.1888 1.4045 2.27 0.0239
DOW^4 -4.6280 1.4062 -3.29 0.0011 DOW^5 2.5177 1.4174 1.78 0.0768 .
DOW^6 -0.5216 1.4098 -0.37 0.7117
ROH21 1.0516 0.0601 17.51 <2e-16 *** — Signif. codes: 0 '*' 0.001* ' 0.01 ' 0.05 ': 0.1 ' 1

Residual standard error: 9.07 on 288 degrees of freedom Multiple R-squared: 0.556, Adjusted R-squared: 0.545 F-statistic: 51.5 on 7 and 288 DF, p-value: <2e-16

Call: lm(formula = lm.formula, data = train)

Residuals: Min 1Q Median 3Q Max -30.898 -5.912 0.366 6.393 27.038

Coefficients: Estimate Std. Error t value Pr(>|t|)
(Intercept) 25.3100 1.2650 20.01 < 2e-16 *DOW.L -2.7558 1.5151 -1.82 0.06996 .*
DOW.Q -3.1100 1.5212 -2.04 0.04182
DOW.C 4.2996 1.5467 2.78 0.00580 DOW^4 -5.1692 1.5372 -3.36 0.00088 *DOW^5 2.5556 1.5514 1.65 0.10059*
DOW^6 -0.4899 1.5433 -0.32 0.75115
ROH30 1.0603 0.0734 14.44 < 2e-16 — Signif. codes: 0 '*' 0.001* ' 0.01 ' 0.05 ': 0.1 ' 1

Residual standard error: 9.92 on 288 degrees of freedom Multiple R-squared: 0.468, Adjusted R-squared: 0.455 F-statistic: 36.2 on 7 and 288 DF, p-value: <2e-16

Call: lm(formula = lm.formula, data = train)

Residuals: Min 1Q Median 3Q Max -34.30 -6.61 0.53 7.57 27.91

Coefficients: Estimate Std. Error t value Pr(>|t|)
(Intercept) 31.60 1.20 26.34 < 2e-16 *DOW.L -3.42 1.72 -1.99 0.04752*
DOW.Q -3.67 1.73 -2.12 0.03480 *
DOW.C 4.15 1.76 2.36 0.01911 *
DOW^4 -6.78 1.73 -3.91 0.00011 DOW^5 4.49 1.76 2.55 0.01118
DOW^6 -1.01 1.75 -0.58 0.56237
ROH60 1.29 0.13 9.91 < 2e-16 *** — Signif. codes: 0 '*' 0.001* ' 0.01 ' 0.05 ': 0.1 ' 1

Residual standard error: 11.2 on 288 degrees of freedom Multiple R-squared: 0.316, Adjusted R-squared: 0.3 F-statistic: 19 on 7 and 288 DF, p-value: <2e-16

Call: lm(formula = lm.formula, data = train)

Residuals: Min 1Q Median 3Q Max -38.53 -6.24 0.87 8.10 28.97

Coefficients: Estimate Std. Error t value Pr(>|t|)
(Intercept) 35.87 1.01 35.38 < 2e-16 **DOW.L -3.74 1.82 -2.05 0.04088**
DOW.Q -3.48 1.82 -1.91 0.05747 .
DOW.C 3.38 1.85 1.82 0.06929 .
DOW^4 -7.17 1.83 -3.92 0.00011 *DOW^5 4.03 1.85 2.17 0.03066*
DOW^6 -1.17 1.84 -0.63 0.52706
ROH90 1.31 0.17 7.68 2.6e-13 *** — Signif. codes: 0 '**' 0.001** '' 0.01 '' 0.05 '.' 0.1 '' 1

Residual standard error: 11.9 on 288 degrees of freedom Multiple R-squared: 0.239, Adjusted R-squared: 0.22 F-statistic: 12.9 on 7 and 288 DF, p-value: 1.97e-14

In this way, do not talk about high dimensional data - instead, how machine learning is superior - if that's the case.

Neural Network

```
##                     Length Class      Mode
## call                    6  -none-     call
## response              296  -none-     numeric
## covariate            2368  -none-     numeric
## model.list              2  -none-     list
## err.fct                 1  -none-     function
## act.fct                 1  -none-     function
## linear.output          1  -none-     logical
## data                    9  data.frame list
## exclude                 0  -none-     NULL
## net.result              1  -none-     list
## weights                 1  -none-     list
## generalized.weights     1  -none-     list
## startweights            1  -none-     list
## result.matrix          34  -none-     numeric

## [[1]]
## [[1]][[1]]
##          [,1]    [,2]     [,3]
##   [1,]    2.43  -0.364  -1.480
##   [2,]   33.90   8.141  -1.524
##   [3,]    4.94   0.466  -0.128
##   [4,] -237.30  -2.609  -1.382
```

```
##  [5,]    40.92  1.149 -54.712
##  [6,]   -31.42 -2.043  -1.102
##  [7,]    27.82  1.063  -2.040
##  [8,]    25.94  5.509  -1.544
##  [9,]   -26.55 -3.270   0.638
##
## [[1]][[2]]
##           [,1]
## [1,] -0.0382
## [2,]  0.9328
## [3,] -1.4093
## [4,]  4.5742
```

K-Nearest Neighbor

```
##   [1]   5   5   5   5   5   5   5   5   7   9  13  13
```

```
##   [1]   5   5   5   5   5   5   5   5   7   9  13  13
```

Tree

```
## [[1]]
## [1] 7
##
## [[2]]
## [1] 7
##
## [[3]]
## [1] 7
##
## [[4]]
## [1] 7
##
## [[5]]
## [1] 7
##
## [[6]]
## [1] 7
```

```
## 
## [[7]]
## [1] 7
## 
## [[8]]
## [1] 4
## 
## [[9]]
## [1] 4
## 
## [[10]]
## [1] 4
## 
## [[11]]
## [1] 2
## 
## [[12]]
## [1] 2
## 
## [[13]]
## [1] 0
```

Support Vector Machine

```
## [[1]]
## [1] 0.0312
## 
## [[2]]
## [1] 0.0312
## 
## [[3]]
## [1] 0.0312
## 
## [[4]]
## [1] 0.0312
## 
## [[5]]
## [1] 0.0312
```

```
## 
## [[6]]
## [1] 0.0312
## 
## [[7]]
## [1] 0.0312
## 
## [[8]]
## [1] 0.0625
## 
## [[9]]
## [1] 0.1
## 
## [[10]]
## [1] 0.125
## 
## [[11]]
## [1] 0.1
## 
## [[12]]
## [1] 0.0312
```

Results

Table 4: Mean Errors

	apk	mpk	reg	nn	knn	wknn	dtree	rf	svm
DBA1	-0.344	-0.629	-0.380	-3.17	0.913	-0.085	-0.075	-0.523	-0.636
DBA2	-0.294	-0.806	-0.373	-4.87	0.977	0.225	-0.335	-0.455	-0.715
DBA3	-0.299	-1.045	-0.446	-6.26	0.927	0.143	-0.602	-0.292	-0.661
DBA4	-0.042	-0.943	-0.270	-7.29	1.169	-0.082	-0.236	-0.554	-0.555
DBA5	0.161	-0.888	-0.148	-8.25	1.171	-0.019	-0.581	-0.516	-0.337
DBA6	0.338	-0.964	-0.031	-9.21	1.263	0.436	-0.631	-0.316	-0.436
DBA7	0.485	-1.098	0.068	-10.34	1.141	0.512	-0.592	0.102	-0.706
DBA14	1.841	-0.756	1.521	-15.44	1.724	1.357	0.789	1.203	0.291
DBA21	2.354	-1.374	2.201	-19.46	2.598	0.530	0.395	0.972	1.379
DBA30	3.061	-1.315	2.926	-23.88	3.656	1.866	2.290	1.933	3.267
DBA60	3.938	-1.976	3.544	-29.92	4.627	3.489	3.480	3.954	4.278
DBA90	4.422	-2.626	4.151	-32.54	3.843	3.441	4.213	4.413	5.299
13	1.302	-1.202	1.064	-14.22	2.001	0.984	0.676	0.827	0.872

Table 5: Mean Absolute Errors

	apk	mpk	reg	nn	knn	wknn	dtree	rf	svm
DBA1	1.96	1.93	1.94	3.31	3.31	2.69	2.69	2.30	2.00
DBA2	2.57	2.60	2.54	4.91	3.85	3.07	3.19	2.57	2.57
DBA3	2.74	2.72	2.66	6.34	3.73	3.41	3.80	3.04	2.72
DBA4	3.06	3.19	2.97	7.37	4.12	3.70	3.75	3.38	2.98
DBA5	3.55	3.53	3.43	8.33	4.13	3.79	4.33	3.32	3.32
DBA6	4.04	3.98	3.88	9.24	4.57	4.38	4.55	3.83	3.72
DBA7	4.55	4.67	4.40	10.46	4.54	4.71	4.40	4.10	4.10
DBA14	6.03	6.58	5.84	15.62	6.03	5.57	5.73	5.53	5.17
DBA21	7.14	8.49	7.05	19.58	7.84	7.02	6.98	6.90	6.44
DBA30	8.33	10.56	8.22	23.93	8.87	8.95	7.79	7.78	7.77
DBA60	9.72	14.88	9.50	29.92	9.88	9.81	9.39	9.41	9.26
DBA90	10.77	22.73	10.70	32.54	10.85	11.94	11.01	11.00	11.20
13	5.37	7.15	5.26	14.29	5.97	5.75	5.63	5.26	5.10

Table 6: Standard Deviation Errors

	apk	mpk	reg	nn	knn	wknn	dtree	rf	svm
DBA1	2.63	2.60	2.61	2.73	4.09	3.34	3.30	2.78	2.68
DBA2	3.39	3.31	3.35	3.35	4.97	3.96	3.92	3.35	3.33
DBA3	3.66	3.58	3.58	3.81	4.88	4.41	4.66	3.96	3.61
DBA4	4.06	4.08	3.96	4.18	5.06	4.87	4.67	4.40	3.87
DBA5	4.51	4.49	4.38	4.73	5.13	4.84	5.45	4.27	4.24
DBA6	4.98	5.04	4.83	5.31	5.44	5.40	5.51	4.70	4.66
DBA7	5.48	5.87	5.36	5.64	5.49	5.61	5.45	5.05	5.06
DBA14	7.37	8.73	7.19	8.24	7.53	7.03	7.18	6.96	6.71
DBA21	8.64	11.60	8.54	9.83	9.50	9.52	8.68	8.92	8.21
DBA30	10.34	12.99	10.22	11.08	10.50	10.89	9.99	9.93	9.57
DBA60	11.96	17.99	11.60	13.08	11.90	12.22	11.65	11.69	11.34
DBA90	13.05	29.42	12.93	14.16	13.38	14.76	13.27	13.41	13.36
13	6.67	9.14	6.55	7.18	7.32	7.24	6.98	6.62	6.39

Table 7: Mean Percentage Errors

	apk	mpk	reg	nn	knn	wknn	dtree	rf	svm
DBA1	0.006	-0.025	0.003	-0.098	0.107	0.026	0.016	-0.022	-0.001
DBA2	0.019	-0.033	0.012	-0.150	0.124	0.035	0.002	-0.011	0.006
DBA3	0.028	-0.042	0.015	-0.189	0.122	0.038	-0.003	-0.002	0.016
DBA4	0.041	-0.045	0.020	-0.223	0.121	0.047	0.015	-0.016	0.020
DBA5	0.058	-0.043	0.031	-0.245	0.128	0.042	0.009	-0.014	0.034
DBA6	0.077	-0.043	0.044	-0.274	0.132	0.046	0.008	-0.010	0.036
DBA7	0.090	-0.051	0.053	-0.302	0.124	0.055	0.013	0.003	0.027
DBA14	0.193	-0.041	0.163	-0.419	0.174	0.130	0.059	0.115	0.095
DBA21	0.252	-0.060	0.238	-0.525	0.268	0.126	0.078	0.149	0.175
DBA30	0.325	-0.036	0.313	-0.655	0.335	0.237	0.215	0.208	0.295
DBA60	0.417	-0.035	0.388	-0.814	0.438	0.354	0.359	0.398	0.405
DBA90	0.463	-0.009	0.447	-0.881	0.447	0.444	0.451	0.468	0.503
13	0.164	-0.039	0.144	-0.398	0.210	0.132	0.102	0.105	0.134

Table 8: MAPE

	apk	mpk	reg	nn	knn	wknn	dtree	rf	svm
DBA1	0.060	0.061	0.059	0.105	0.158	0.103	0.098	0.078	0.064
DBA2	0.091	0.087	0.088	0.153	0.185	0.119	0.112	0.091	0.088
DBA3	0.100	0.094	0.094	0.196	0.180	0.127	0.128	0.105	0.097
DBA4	0.113	0.112	0.103	0.230	0.183	0.143	0.131	0.117	0.105
DBA5	0.137	0.121	0.123	0.253	0.189	0.145	0.146	0.114	0.122
DBA6	0.159	0.128	0.139	0.276	0.200	0.156	0.148	0.130	0.134
DBA7	0.180	0.146	0.156	0.313	0.196	0.174	0.147	0.140	0.144
DBA14	0.283	0.207	0.257	0.440	0.261	0.226	0.203	0.215	0.204
DBA21	0.352	0.266	0.341	0.540	0.380	0.276	0.254	0.288	0.283
DBA30	0.426	0.349	0.415	0.662	0.441	0.393	0.328	0.343	0.385
DBA60	0.529	0.499	0.506	0.814	0.539	0.486	0.470	0.501	0.501
DBA90	0.586	0.714	0.576	0.881	0.583	0.612	0.583	0.593	0.616
13	0.251	0.232	0.238	0.405	0.291	0.247	0.229	0.226	0.229

Table 9: Model Performances

	ME	MAE	SDE	MPE	MAPE	Time
Additive Pickup	1.302	5.37	6.67	0.164	0.251	0.307
Multiplicative Pickup	-1.202	7.15	9.14	-0.039	0.232	0.299
Regression	1.064	5.26	6.55	0.144	0.238	0.141
Neural Network	-14.218	14.29	7.18	-0.398	0.405	120.865
K-Nearest Neighbor	2.001	5.97	7.32	0.210	0.291	49.475
Weighted K-Nearest Neighbor	0.984	5.75	7.24	0.132	0.247	5.738
Decision Tree	0.676	5.63	6.98	0.102	0.229	0.289
Random Forest	0.827	5.26	6.62	0.105	0.226	244.640
Support Vector Machine	0.872	5.10	6.39	0.134	0.229	25.361

[1] Mean Error
[2] Mean Absolute Error
[3] Standard Deviation Error
[4] Mean Percentage Error
[5] Mean Absolute Percentage Error
[6] Time is calculated in seconds