Bike Share Linear Regression

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Data Background

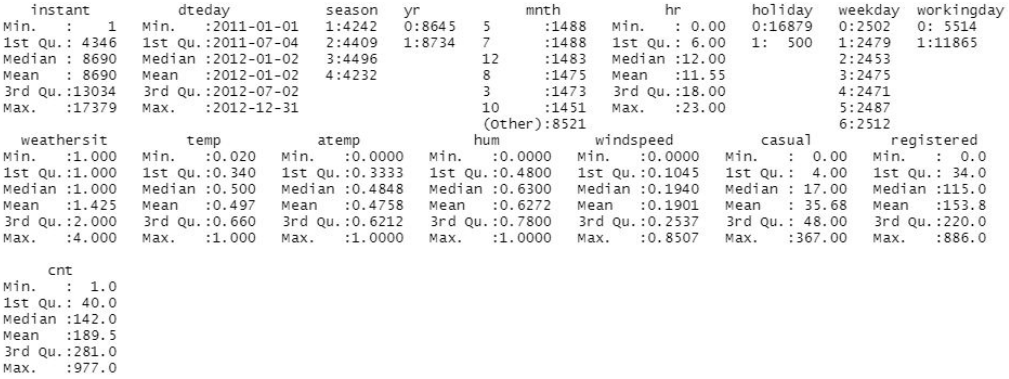
- University of California Irvine Machine Learning Repository: https://archive.ics.uci.edu/ml/datasets/bike+sharing+dataset
- 17,379 Instances & 17 Variables
- Bike share records by the hour from 2011 to 2012 based in Washington, D.C
- Dataset contains environmental and seasonal settings (windspeed, temperature, working day, season, etc.)

Questions

- What are the main predictors for bike share count?
- How does the environment and weather affect the bike share count?
- When is the best time to rent a bike share?

Exploratory Data Analysis

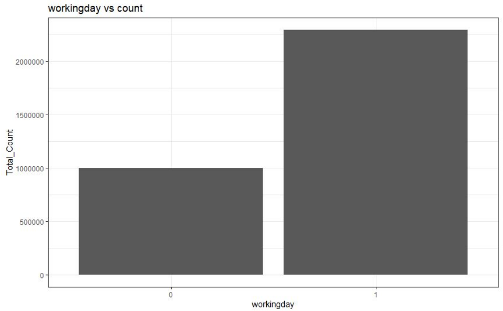
- Load dataset and libraries
  - library(caret)
  - library(ggplot2)
  - library(dplyr)
  - library(GGally)
- Data cleaning
  - Removed columns
  - Renamed columns
  - Changed data types to factors



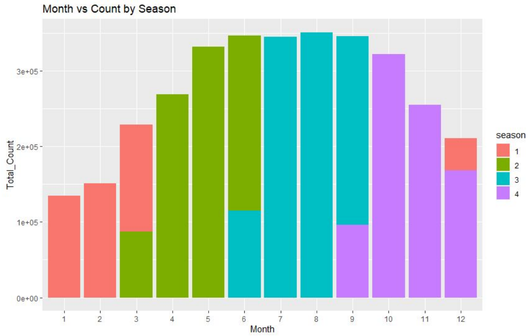
```
   instant           dteday           season   yr           mnth            hr         holiday   weekday  workingday
Min.   :    1   Min.   :2011-01-01   1:4242   0:8645   5      :1488   Min.   : 0.00   0:16879   0:2502   0: 5514
1st Qu.: 4346   1st Qu.:2011-07-04   2:4409   1:8734   7      :1488   1st Qu.: 6.00   1:   500  1:2479   1:11865
Median : 8690   Median :2012-01-02   3:4496            12     :1483   Median :12.00             2:2453
Mean   : 8690   Mean   :2012-01-02   4:4232            8      :1475   Mean   :11.55             3:2475
3rd Qu.:13034   3rd Qu.:2012-07-02                     3      :1473   3rd Qu.:18.00             4:2471
Max.   :17379   Max.   :2012-12-31                     10     :1451   Max.   :23.00             5:2487
                                                       (Other):8521                             6:2512
  weathersit         temp            atemp              hum            windspeed          casual          registered
Min.   :1.000   Min.   :0.020   Min.   :0.0000   Min.   :0.0000   Min.   :0.0000   Min.   :  0.00   Min.   :  0.0
1st Qu.:1.000   1st Qu.:0.340   1st Qu.:0.3333   1st Qu.:0.4800   1st Qu.:0.1045   1st Qu.:  4.00   1st Qu.: 34.0
Median :1.000   Median :0.500   Median :0.4848   Median :0.6300   Median :0.1940   Median : 17.00   Median :115.0
Mean   :1.425   Mean   :0.497   Mean   :0.4758   Mean   :0.6272   Mean   :0.1901   Mean   : 35.68   Mean   :153.8
3rd Qu.:2.000   3rd Qu.:0.660   3rd Qu.:0.6212   3rd Qu.:0.7800   3rd Qu.:0.2537   3rd Qu.: 48.00   3rd Qu.:220.0
Max.   :4.000   Max.   :1.000   Max.   :1.0000   Max.   :1.0000   Max.   :0.8507   Max.   :367.00   Max.   :886.0

     cnt
Min.   :  1.0
1st Qu.: 40.0
Median :142.0
Mean   :189.5
3rd Qu.:281.0
Max.   :977.0
```

Exploratory Data Analysis

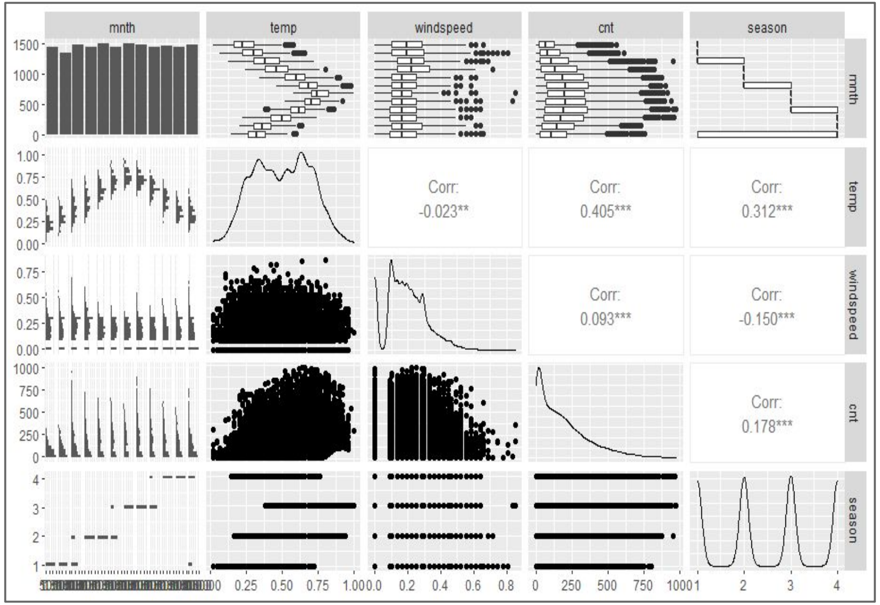
- Visualize distribution of counts
  - Working day vs. Count: increased bike rentals during working days



  - Month vs Count by Season: increased bike rentals during Spring and Summer months

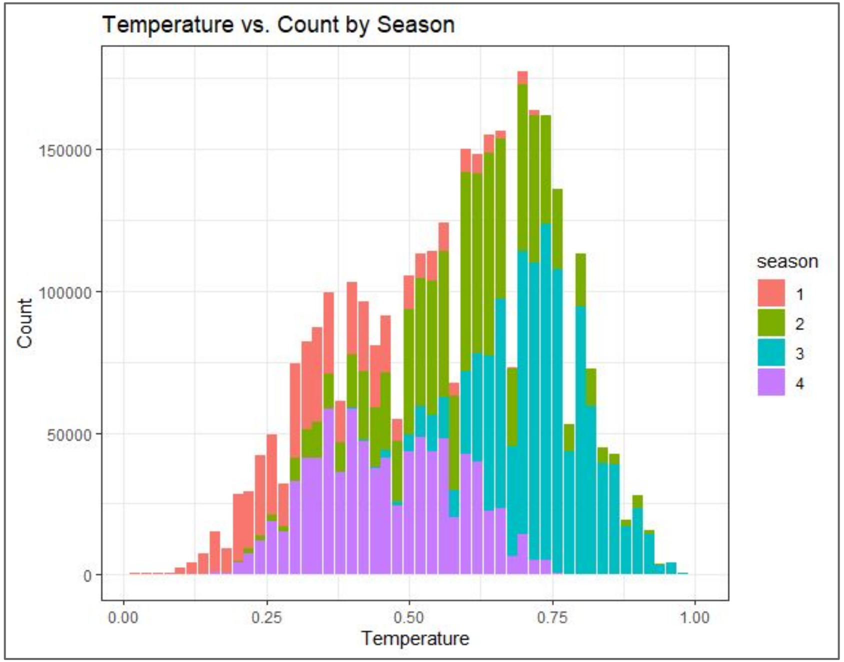


Variable Selection



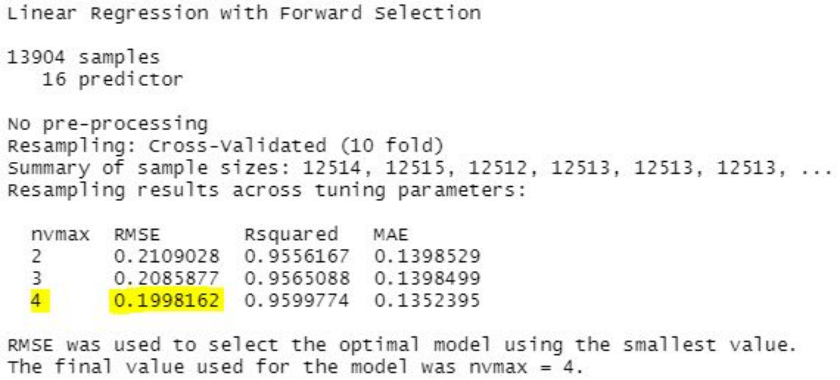
- ggpairs to explore correlation between variables
- Highly positive correlation between count and temp at 0.405
- Determined that count and wind speed correlation is low at 0.093

Variable Selection

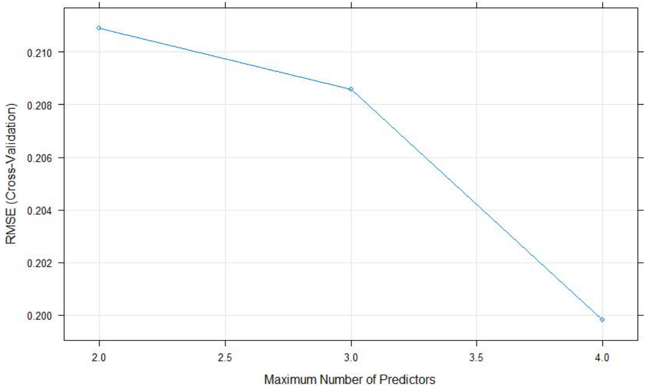


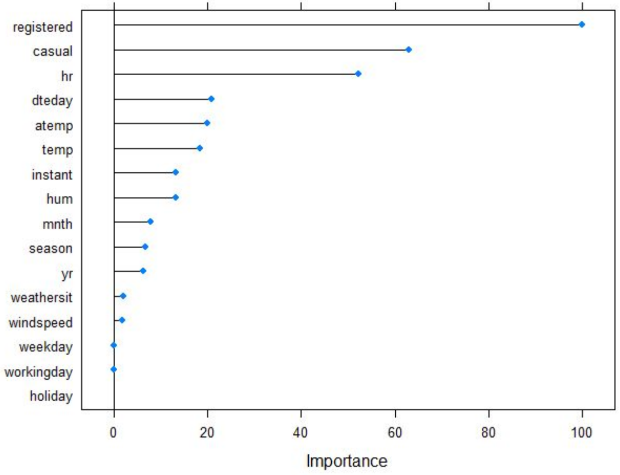
- Focused on temperature as the variable vs. count of bike rentals
- Increased in Spring and Summer
- Decreased in Fall and Winter

Forward Selection Model

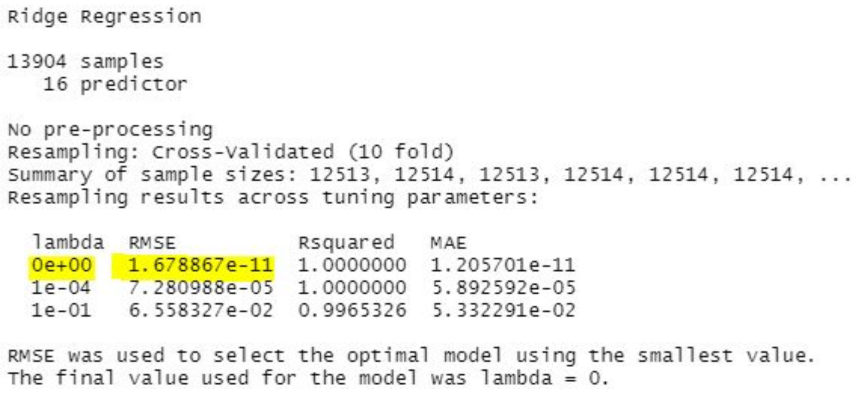


```
Linear Regression with Forward Selection

13904 samples
   16 predictor

No pre-processing
Resampling: Cross-Validated (10 fold)
Summary of sample sizes: 12514, 12515, 12512, 12513, 12513, 12513, ...
Resampling results across tuning parameters:

  nvmax  RMSE       Rsquared   MAE
  2      0.2109028  0.9556167  0.1398529
  3      0.2085877  0.9565088  0.1398499
  4      0.1998162  0.9599774  0.1352395

RMSE was used to select the optimal model using the smallest value.
The final value used for the model was nvmax = 4.
```

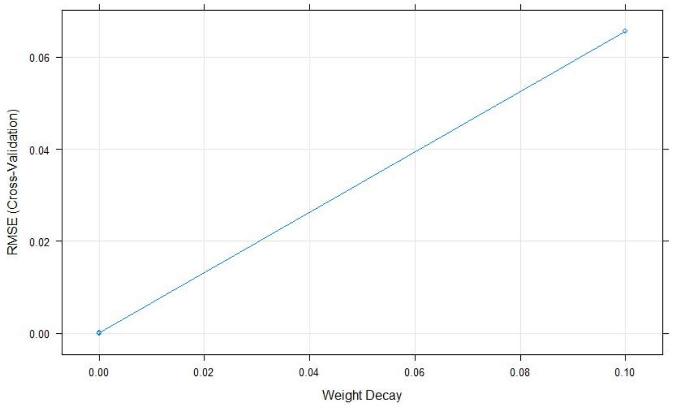




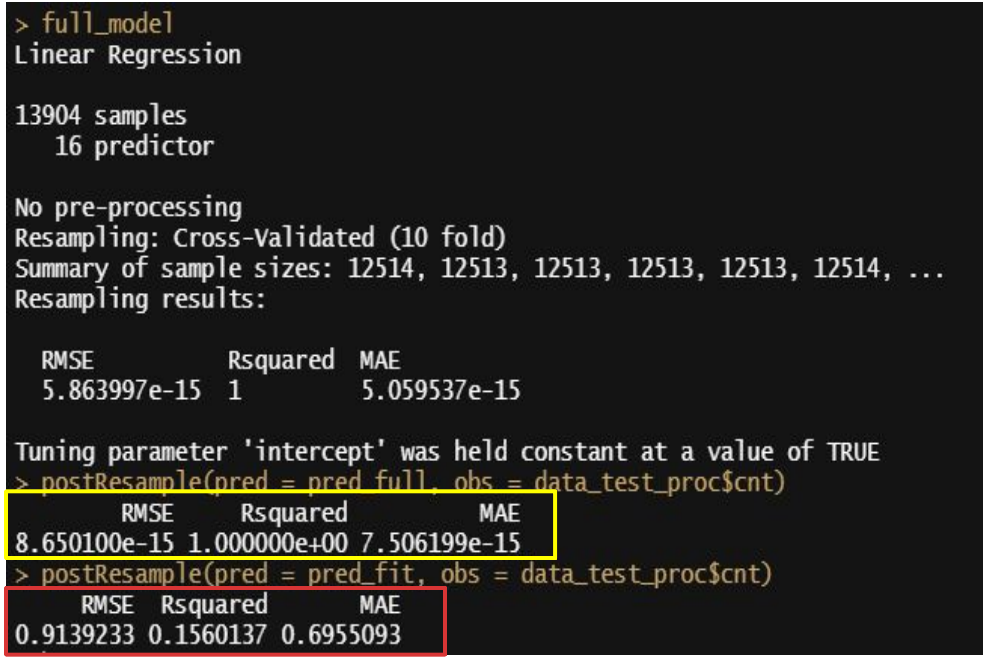
Ridge Model



```
Ridge Regression

13904 samples
   16 predictor

No pre-processing
Resampling: Cross-Validated (10 fold)
Summary of sample sizes: 12513, 12514, 12513, 12514, 12514, 12514, ...
Resampling results across tuning parameters:

  lambda  RMSE          Rsquared   MAE
  0e+00   1.678867e-11  1.0000000  1.205701e-11
  1e-04   7.280988e-05  1.0000000  5.892592e-05
  1e-01   6.558327e-02  0.9965326  5.332291e-02

RMSE was used to select the optimal model using the smallest value.
The final value used for the model was lambda = 0.
```



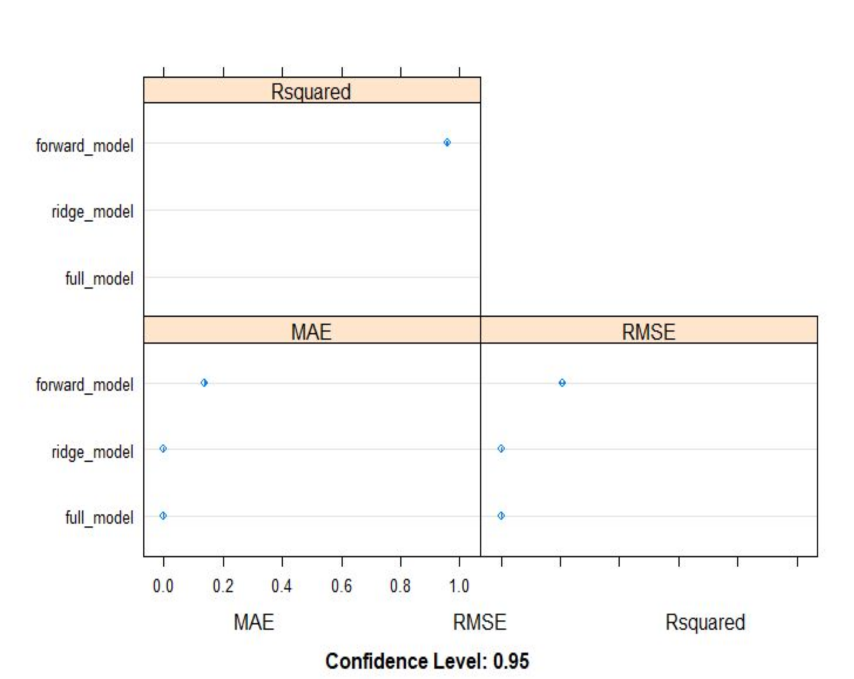
Full Model



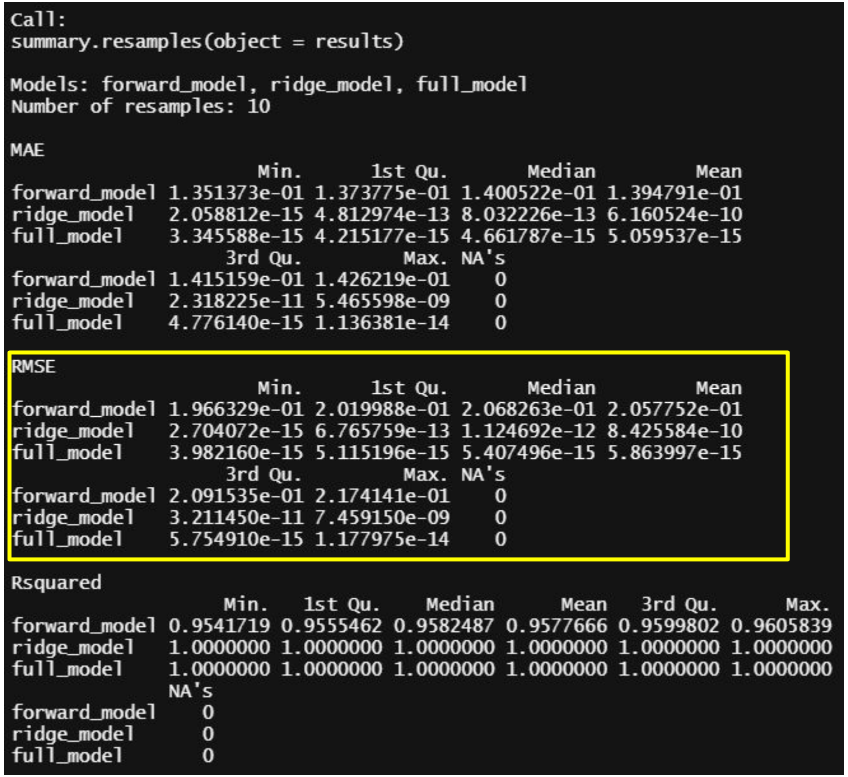
```
> full_model
Linear Regression

13904 samples
   16 predictor

No pre-processing
Resampling: Cross-Validated (10 fold)
Summary of sample sizes: 12514, 12513, 12513, 12513, 12513, 12514, ...
Resampling results:

  RMSE          Rsquared  MAE
  5.863997e-15  1         5.059537e-15

Tuning parameter 'intercept' was held constant at a value of TRUE
> postResample(pred = pred_full, obs = data_test_proc$cnt)
        RMSE     Rsquared          MAE
8.650100e-15 1.000000e+00 7.506199e-15
> postResample(pred = pred_fit, obs = data_test_proc$cnt)
     RMSE  Rsquared       MAE
0.9139233 0.1560137 0.6955093
```

- RMSE from the Full Model improved from the model fit from 0.9139233 to 8.650100e-15

Model Comparison



Confidence Level: 0.95



```
Call:
summary.resamples(object = results)

Models: forward_model, ridge_model, full_model
Number of resamples: 10

MAE
                      Min.      1st Qu.       Median         Mean
forward_model 1.351373e-01 1.373775e-01 1.400522e-01 1.394791e-01
ridge_model   2.058812e-15 4.812974e-13 8.032226e-13 6.160524e-10
full_model    3.345588e-15 4.215177e-15 4.661787e-15 5.059537e-15
                   3rd Qu.         Max. NA's
forward_model 1.415159e-01 1.426219e-01    0
ridge_model   2.318225e-11 5.465598e-09    0
full_model    4.776140e-15 1.136381e-14    0

RMSE
                      Min.      1st Qu.       Median         Mean
forward_model 1.966329e-01 2.019988e-01 2.068263e-01 2.057752e-01
ridge_model   2.704072e-15 6.765759e-13 1.124692e-12 8.425584e-10
full_model    3.982160e-15 5.115196e-15 5.407496e-15 5.863997e-15
                   3rd Qu.         Max. NA's
forward_model 2.091535e-01 2.174141e-01    0
ridge_model   3.211450e-11 7.459150e-09    0
full_model    5.754910e-15 1.177975e-14    0

Rsquared
                   Min.   1st Qu.    Median      Mean   3rd Qu.      Max.
forward_model 0.9541719 0.9555462 0.9582487 0.9577666 0.9599802 0.9605839
ridge_model   1.0000000 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000
full_model    1.0000000 1.0000000 1.0000000 1.0000000 1.0000000 1.0000000
              NA's
forward_model    0
ridge_model      0
full_model       0
```

- The Full Model had a significantly lower RMSE mean than both the Forward Selection Model & Ridge Model

Conclusion & Recommendations

Conclusion:

- Temperature and working day are the main predictors for bike rental share count
- The environment and weather affect the bike share count, since there is an increase in count as temperature increases
- The best time to rent a bike share is when it is a warmer temperature (Summer and Spring) and on a working day.

Recommendations:

- Increase the number of bike rentals in the warmer seasons for more usage
- Increase the number of bike rentals near offices on working days for commuters
- Schedule maintenance for bike rentals on weekend evenings when it is being used less