Data

```
pacman::p_load(dplyr, magrittr, data.table)
x =
read.csv("C:\\Users\\jaime\\OneDrive\\Desktop\\housing_data_2016_2017.csv",
header = TRUE)
xhat = x %>%
  select(coop_condo, full_address_or_zip_code, approx_year_built,
common_charges, maintenance_cost, parking_charges,
listing_price_to_nearest_1000, total_taxes, date_of_sale, fuel_type,
garage_exists, kitchen_type, num_total_rooms, num_bedrooms,
num_floors_in_building, sale_price)
```

Regression Tree Modeling

```
pacman::p_load(rpart)
rpart(sale_price~coop_condo, data = xhat)

## n=528 (1702 observations deleted due to missingness)
##
## node), split, n, loss, yval, (yprob)
##       * denotes terminal node
##
## 1) root 528 517 $155,000  (0.0019 0.0019 0.0019 0.0019 0.0038 0.0019
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0.0019 0.0019 0.0019 0.0019 0.0019 0.0038 0.0019 0.0019 0.0019 0.0019 0.0019
0.0019) *
```
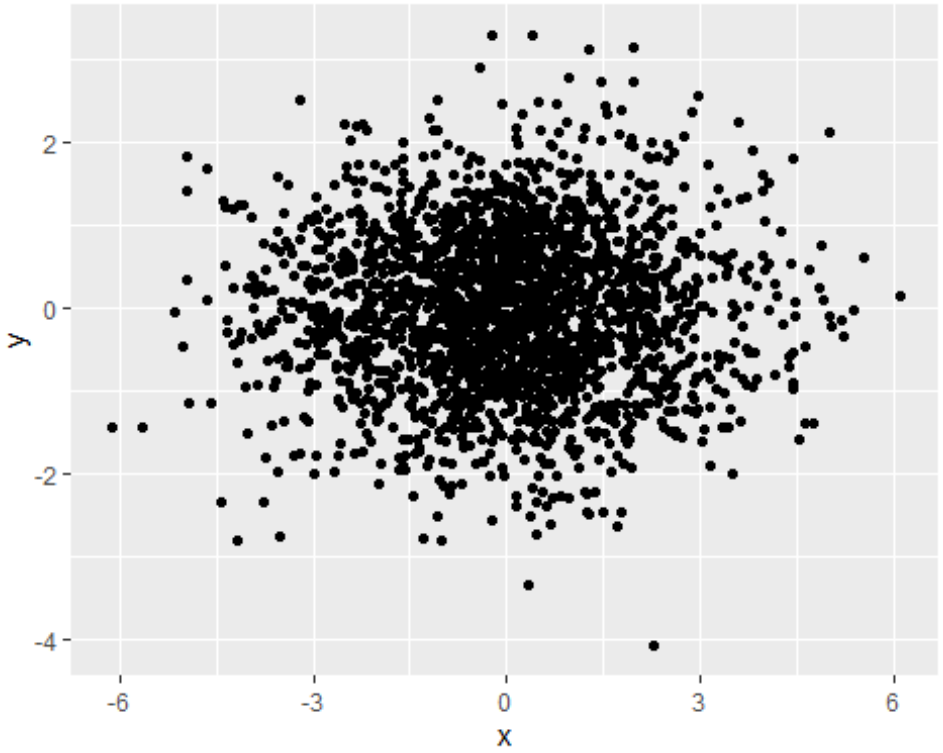

Linear Modeling

```
y = rnorm(xhat$sale_price)
x0 = rnorm(xhat$coop_condo)
x1 = rnorm(xhat$num_total_rooms)
x2 = rnorm(xhat$parking_charges)
data_set = lm(y ~ x0 + x1 + x2)
summary(data_set)

##
## Call:
## lm(formula = y ~ x0 + x1 + x2)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -4.0746 -0.6439  0.0062  0.6375  3.3461
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) -0.034478   0.020185  -1.708   0.0878 .
## x0           0.003352   0.020036   0.167   0.8671
## x1           0.014030   0.019827   0.708   0.4792
## x2          -0.011799   0.020244  -0.583   0.5601
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9529 on 2226 degrees of freedom
## Multiple R-squared:  0.0003774,  Adjusted R-squared:  -0.0009698
## F-statistic: 0.2801 on 3 and 2226 DF,  p-value: 0.8398

pacman::p_load(ggplot2)
ggplot(data.frame(x = x0 + x1 + x2, y = y)) +
  geom_point(aes(x = x, y = y))
```



Random Forest

```
pacman::p_load(randomForest)

n = 500
sigma = 0.5
x_min = min(y)
x_max = max(y)
f_x = function(x){sin(x)}
y_x = function(x, sigma){f_x(x) + rnorm(n, 0, sigma)}
x_train = runif(n, x_min, x_max)
y_train = y_x(x_train, sigma)
x_test = runif(n, x_min, x_max)
y_test = y_x(x_test, sigma)
node_sizes = 1:500

se_by_node_sizes = array(NA, length(node_sizes))
for (i in 1:length(node_sizes)) {
  rf_mod = randomForest(x = data.frame(x = x_train), y = y_train, ntree = 1,
replace = FALSE, sampsize = n, nodesize = node_sizes[i])
  y_hat_test = predict(rf_mod,data.frame(x = x_test))
  se_by_node_sizes[i] = sd(y_test - y_hat_test)
}
```

Finding R^2 and RMSE

```
  # x0 = coop_condo
  x_bar0 = sum(x0)/n
  y_bar = sum(y)/n
  b_1 = (sum(x0*y)-n*x_bar0*y_bar) / (sum(x0^2)-n*x_bar0^2)
  b_0 = y_bar - b_1*x_bar0
  yhat = b_0 + b_1 *x0
  e0 = y -yhat
  SSE0 = sum(e0^2)
  SST0 = sum((y-y_bar)^2)
  MSE0 = SSE0 /(n-2)
  RMSE0 = sqrt(MSE0)
  Rsq0 = 1 - SSE0 / SST0

  # x1 = num_total_rooms
  x_bar1 = sum(x1)/n
  b_1 = (sum(x1*y)-n*x_bar1*y_bar) / (sum(x1^2)-n*x_bar1^2)
  b_0 = y_bar - b_1*x_bar1
  yhat = b_0 + b_1 *x1
  e1 = y -yhat
  SSE1 = sum(e1^2)
  SST1 = sum((y-y_bar)^2)
  MSE1 = SSE1 /(n-2)
  RMSE1 = sqrt(MSE1)
  Rsq1 = 1 - SSE1 / SST1

  # x2 = parking_charges
  x_bar2 = sum(x2)/n
  b_1 = (sum(x2*y)-n*x_bar2*y_bar) / (sum(x2^2)-n*x_bar2^2)
  b_0 = y_bar - b_1*x_bar2
  yhat = b_0 + b_1 *x2
  e2 = y -yhat
  SSE2 = sum(e2^2)
  SST2 = sum((y-y_bar)^2)
  MSE2 = SSE2 /(n-2)
  RMSE2 = sqrt(MSE2)
  Rsq2 = 1 - SSE2 / SST2
```

oobRsq and oobRMSE

```
nstar = 500
ystar = rnorm(xhat$sale_price)
x0_star = rnorm(xhat$coop_condo)
x1_xtar = rnorm(xhat$num_total_rooms)
x2_xtar = rnorm(xhat$parking_charges)
# x0 = coop_condo
  x_bar0 = sum(x0_star)/n
  y_bar = sum(ystar)/n
  b_1 = (sum(x0_star*ystar)-n*x_bar0*y_bar) / (sum(x0_star^2)-n*x_bar0^2)
  b_0 = y_bar - b_1*x_bar0
  yhat = b_0 + b_1 *x0_star
```

```
oobe0 = ystar -yhat
oobSSE0 = sum(oobe0^2)
oobSST0 = sum((ystar-y_bar)^2)
oobMSE0 = oobSSE0 /(n-2)
oobRMSE0 = sqrt(oobMSE0)
oobRsq0 = 1 - oobSSE0 / oobSST0

# x1 = num_total_rooms
x_bar1 = sum(x1_xtar)/n
b_1 = (sum(x1_xtar*ystar)-n*x_bar1*y_bar) / (sum(x1_xtar^2)-n*x_bar1^2)
b_0 = y_bar - b_1*x_bar1
yhat = b_0 + b_1 *x1_xtar
oobe1 = ystar -yhat
oobSSE1 = sum(oobe1^2)
oobSST1 = sum((ystar-y_bar)^2)
oobMSE1 = oobSSE1 /(n-2)
oobRMSE1 = sqrt(oobMSE1)
oobRsq1 = 1 - oobSSE1 / oobSST1

# x2 = parking_charges
x_bar2 = sum(x2_xtar)/n
b_1 = (sum(x2_xtar*ystar)-n*x_bar2*y_bar) / (sum(x2_xtar^2)-n*x_bar2^2)
b_0 = y_bar - b_1*x_bar2
yhat = b_0 + b_1 *x2_xtar
oobe2 = ystar -yhat
oobSSE2 = sum(oobe2^2)
oobSST2 = sum((ystar-y_bar)^2)
oobMSE2 = oobSSE2 /(n-2)
oobRMSE2 = sqrt(oobMSE2)
oobRsq2 = 1 - oobSSE2 / oobSST2
```