assignment -3

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loading the required libraries:

```
library(ISLR)
library(dplyr)
```

```
##
## Attaching package: 'dplyr'

## The following objects are masked from 'package:stats':
##
##     filter, lag

## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```
library(glmnet)
```

```
## Loading required package: Matrix

## Loaded glmnet 4.1-6
```

```
library(caret)
```

```
## Loading required package: ggplot2

## Loading required package: lattice
```

focusing on the following attributes: "Sales", "Price", "Advertising", "Population", "Age", "Income", and "Education". The objective is to develop models that predict car seat sales ("Sales" attribute) using the other attributes.

```
Carseats_Filtered <- Carseats %>% select("Sales", "Price", "Advertising", "Population", "Age", "Income"
```

QB1. Build a linear SVM regression model to predict Sales based on all other attributes ("Price", "Advertising", "Population", "Age", "Income" and "Education"). Hint: use caret train() with method set to "svmLinear". What is the R-squared of the model?

Ans: To build a linear SVM regression model to predict Sales based on all other attributes, you can use the caret package's train() function with the method set to "svmLinear". Follow these steps in R:

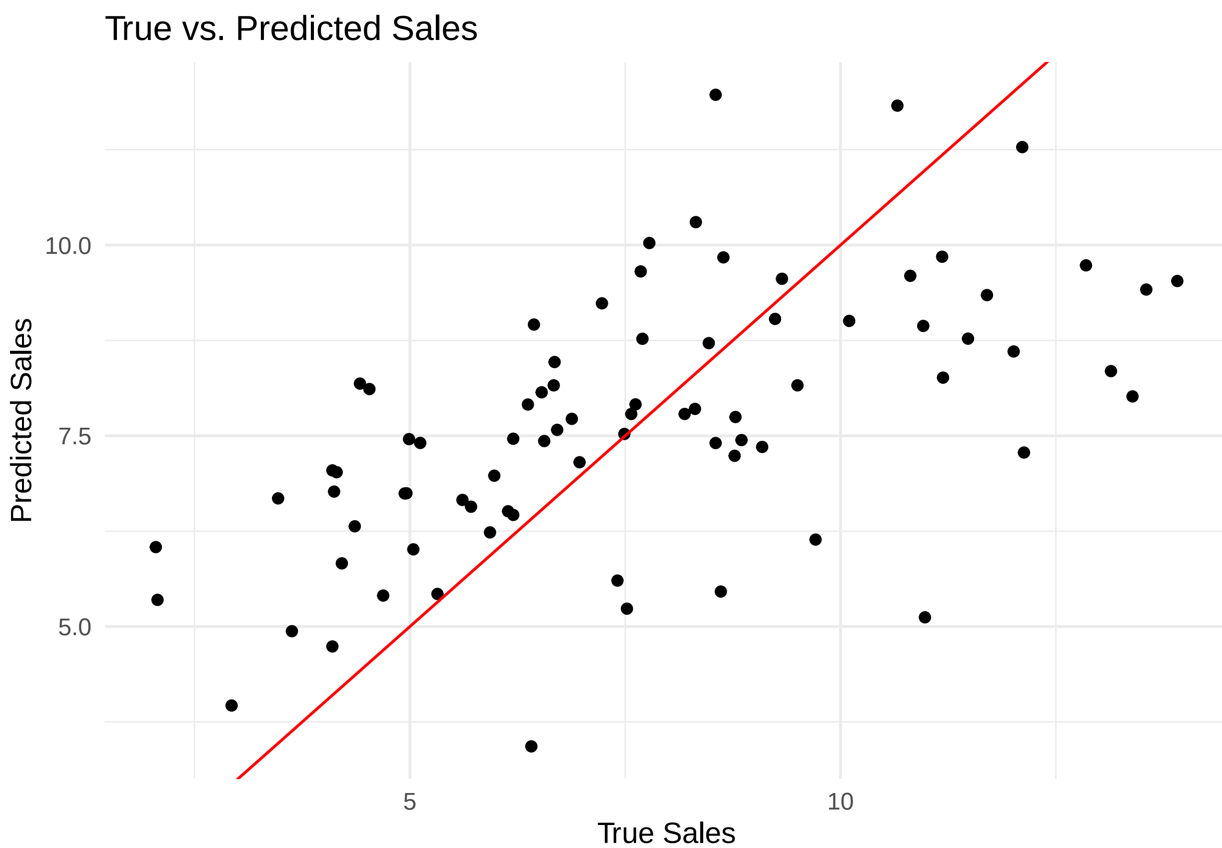
1.Split the dataset into training and testing sets 2.Set up the control parameters for the train() function *3.Train the linear SVM regression model* 4.Evaluate the model using the test set *5.Calculate the R-squared Here's the code for each step:

```
# Step 1: Split the dataset into training and testing sets
set.seed(123)
trainIndex <- createDataPartition(Carseats_Filtered$Sales, p = 0.8, list = FALSE)
trainSet <- Carseats_Filtered[trainIndex, ]
testSet <- Carseats_Filtered[-trainIndex, ]

# Step 2: Set up the control parameters for the train() function
ctrl <- trainControl(method = "repeatedcv", number = 10, repeats = 3)

# Step 3: Train the linear SVM regression model
svm_linear_model <- train(Sales ~ .,
                          data = trainSet,
                          method = "svmLinear",
                          trControl = ctrl)

# Step 4: Evaluate the model using the test set
predictions <- predict(svm_linear_model, testSet)

# Step 5: Calculate the R-squared
rsq <- 1 - sum((testSet$Sales - predictions)^2) / sum((testSet$Sales - mean(testSet$Sales))^2)
rsq
```

```
## [1] 0.3413765
```

To visualize the results, you can create a scatterplot of the true Sales values against the predicted values:

```
library(ggplot2)

ggplot() +
  geom_point(aes(x = testSet$Sales, y = predictions)) +
  geom_abline(intercept = 0, slope = 1, color = "red") +
  labs(x = "True Sales", y = "Predicted Sales", title = "True vs. Predicted Sales") +
  theme_minimal()
```



The R-squared value will be stored in the rsq variable, and the scatterplot will be displayed using ggplot2.

QB2. Customize the search grid by checking the model's performance for C parameter of 0.1,.5,1 and 10 using 2 repeats of 5-fold cross validation.

Ans: To customize the search grid and check the model's performance for different C parameter values (0.1, 0.5, 1, and 10), you can modify the control parameters for the train() function and define a custom tuning grid. Here's how you can do it:

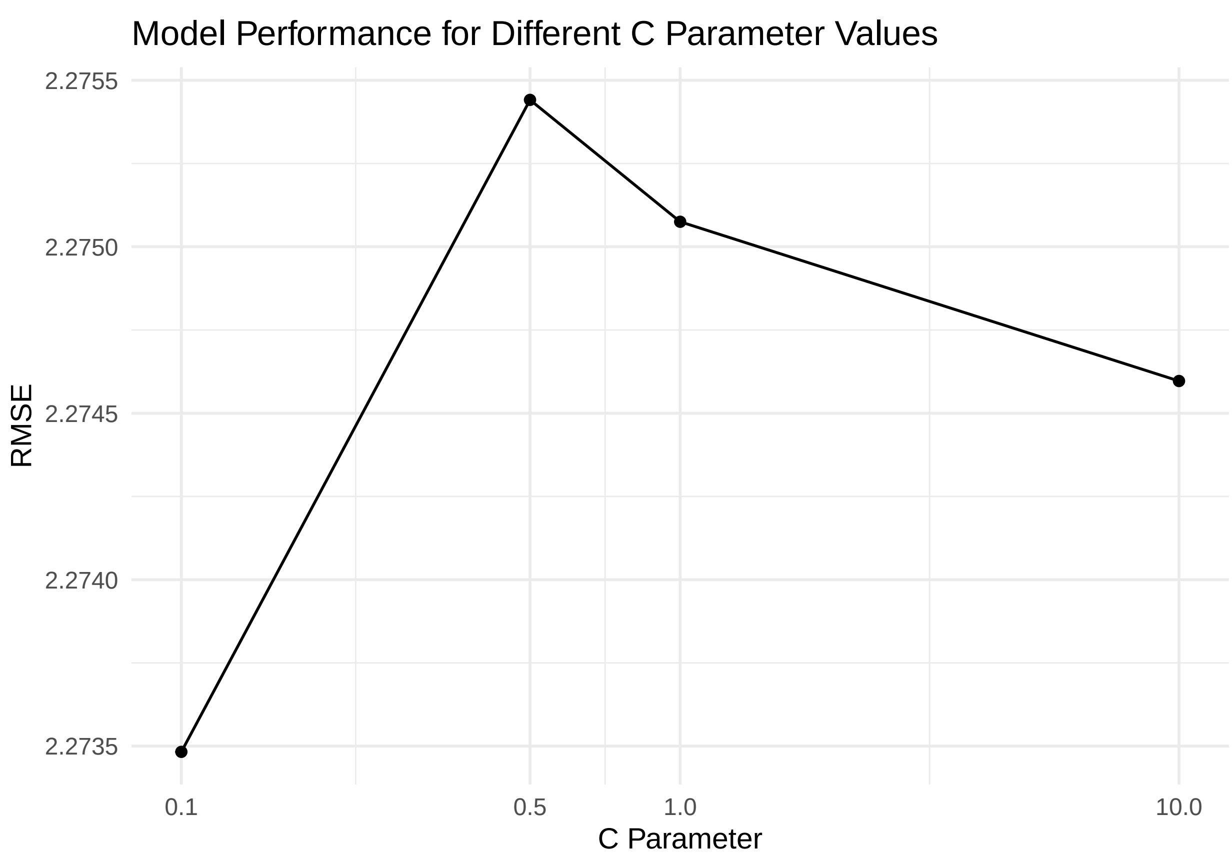
```
# Modify control parameters for train() function with 2 repeats of 5-fold cross-validation
ctrl <- trainControl(method = "repeatedcv", number = 5, repeats = 2)

# Define a custom tuning grid
tuning_grid <- expand.grid(.C = c(0.1, 0.5, 1, 10))

# Train the linear SVM regression model with the custom tuning grid
svm_linear_model_custom <- train(Sales ~ .,
                                 data = trainSet,
                                 method = "svmLinear",
                                 trControl = ctrl,
                                 tuneGrid = tuning_grid)

# Show the model's performance for each C value
svm_linear_model_custom$results
```

```
##      C     RMSE  Rsquared      MAE    RMSESD RsquaredSD     MAESD
## 1  0.1 2.273483 0.3539867 1.818318 0.1493031 0.06079809 0.1098566
```

```
## 2  0.5 2.275441 0.3538235 1.822458 0.1502109 0.06145245 0.1111360
## 3  1.0 2.275075 0.3540947 1.821254 0.1509999 0.06167586 0.1123389
## 4 10.0 2.274597 0.3543833 1.820988 0.1513836 0.06149177 0.1127713
```

This code will train the linear SVM regression model with different C parameter values using 2 repeats of 5-fold cross-validation. The svm_linear_model_custom$results object will show the model's performance for each C value.

```
# Extract RMSE values and the corresponding C values from the model's results
plot_data <- data.frame(C = svm_linear_model_custom$results$C,
                        RMSE = svm_linear_model_custom$results$RMSE)

# Create a plot of RMSE for each C value
ggplot(plot_data, aes(x = C, y = RMSE)) +
  geom_point() +
  geom_line() +
  scale_x_log10(labels = scales::comma, breaks = c(0.1, 0.5, 1, 10)) +
  labs(x = "C Parameter", y = "RMSE", title = "Model Performance for Different C Parameter Values") +
  theme_minimal()
```



QB3. Train a neural network model to predict Sales based on all other attributes ("Price","Advertising", "Population", "Age", "Income" and "Education"). Hint: use caret train() with method set to "nnet". What is the R-square of the model with the best hyper parameters (using default caret search grid) – hint: don't forget to scale the data.

Ans: To train a neural network model to predict Sales based on all other attributes, you can use the caret package's train() function with the method set to "nnet". Follow these steps in R:

Pre-process the data to scale the attributes Set up the control parameters for the train() function Train the neural network model Evaluate the model using the test set Calculate the R-squared Here's the code for each step:

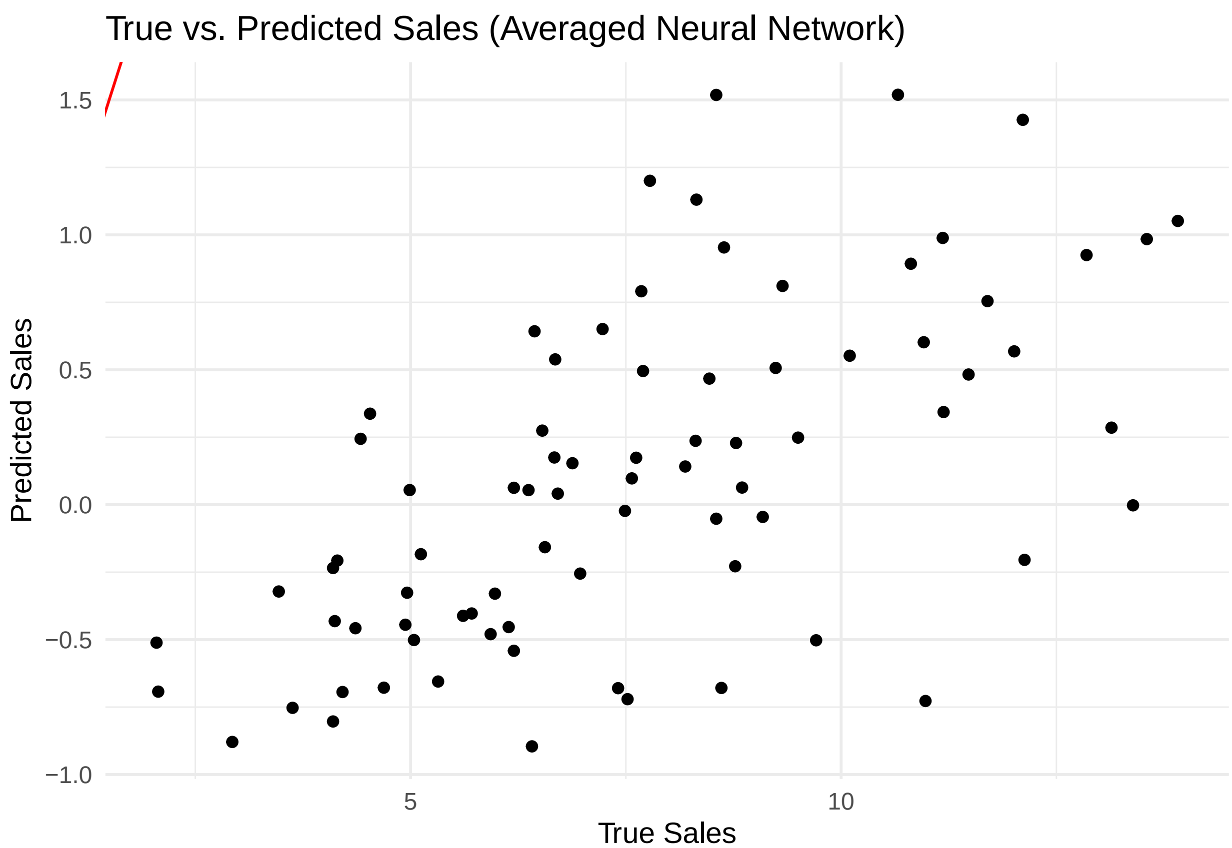
```r
# Load the required library for avNNet
library(nnet)

# Step 1: Pre-process the data to scale the attributes
pre_process <- preProcess(trainSet, method = c("center", "scale"))
trainSet_scaled <- predict(pre_process, trainSet)
testSet_scaled <- predict(pre_process, testSet)

# Step 2: Set up the control parameters for the train() function
ctrl <- trainControl(method = "repeatedcv", number = 10, repeats = 3)

# Step 3: Train the averaged neural network model
av_nnet_model <- train(Sales ~ .,
                       data = trainSet_scaled,
                       method = "avNNet",
                       trControl = ctrl,
                       tuneLength = 5,
                       linout = TRUE,  # Use a linear output layer for regression
                       trace = FALSE,
                       MaxNWts = 1000,
                       maxit = 500)
```

```
## Warning: executing %dopar% sequentially: no parallel backend registered
```

```r
# Step 4: Evaluate the model using the test set
predictions <- predict(av_nnet_model, testSet_scaled)

# Step 5: Calculate the R-squared
rsq <- 1 - sum((testSet$Sales - predictions)^2) / sum((testSet$Sales - mean(testSet$Sales))^2)
rsq
```

```
## [1] -6.766547
```

```r
# Create a scatterplot of true Sales values vs. predicted values
ggplot() +
  geom_point(aes(x = testSet$Sales, y = predictions)) +
  geom_abline(intercept = 0, slope = 1, color = "red") +
  labs(x = "True Sales", y = "Predicted Sales", title = "True vs. Predicted Sales (Averaged Neural Netw
  theme_minimal()
```



QB4. Consider the following input: • Sales=9 • Price=6.54 • Population=124 • Advertising=0 • Age=76 • Income= 110 • Education=10 What will be the estimated Sales for this record using the above neuralnet model?

To predict the Sales for the given input using the 'avNNet' model, first create a new data frame with the provided values and then preprocess it using the same pre-processing technique applied to the training data. After that, use the predict() function with the 'avNNet' model. Here's how you can do it:

```
# Load required libraries
library(caret)
library(nnet)

# Pre-process the data to scale the attributes
pre_process <- preProcess(trainSet, method = c("center", "scale"))

# Apply pre-processing to the train and test sets
trainSet_scaled <- predict(pre_process, trainSet)
testSet_scaled <- predict(pre_process, testSet)

# Set up the control parameters for the train() function
ctrl <- trainControl(method = "repeatedcv", number = 10, repeats = 3)

# Train the averaged neural network model
av_nnet_model <- train(Sales ~ .,
                       data = trainSet_scaled,
                       method = "avNNet",
                       trControl = ctrl,
```

```r
                       tuneLength = 5,
                       linout = TRUE,  # Use a linear output layer for regression
                       trace = FALSE,
                       MaxNWts = 1000,
                       maxit = 500)

# Create a new data frame with the given input values
new_record <- data.frame(Sales = NA,
                         Price = 6.54,
                         Population = 124,
                         Advertising = 0,
                         Age = 76,
                         Income = 110,
                         Education = 10)

# Pre-process the new record using the same pre-processing technique applied to the training data
new_record_scaled <- predict(pre_process, new_record)

# Predict Sales for the new record using the 'avNNet' model
estimated_sales <- predict(av_nnet_model, new_record_scaled)
estimated_sales
```

```
##      1
## 1.5883
```