Reusing a trainControl

MACHINE LEARNING WITH CARET IN R

Max Kuhn
Software Engineer at RStudio and creator of caret

A real-world example

- The data: customer churn at telecom company
- Fit different models and choose the best
- Models must use the same training/test splits
- Create a shared `trainControl` object

Example: customer churn data

```
# Summarize the target variables
library(caret)
library(C50)
data(churn)
table(churnTrain$churn) / nrow(churnTrain)
```

```
      yes        no
0.1449145 0.8550855
```

Example: customer churn data

```
# Create train/test indexes
set.seed(42)
myFolds <- createFolds(churnTrain$churn, k = 5)
```

```
# Compare class distribution
i <- myFolds$Fold1
table(churnTrain$churn[i]) / length(i)
```

```
      yes        no
0.1441441 0.8558559
```

Example: customer churn data

```
myControl <- trainControl(
  summaryFunction = twoClassSummary,
  classProbs = TRUE,
  verboseIter = TRUE,
  savePredictions = TRUE,
  index = myFolds
)
```

- Use folds to create a trainControl object
- Exact same cross-validation folds for each model

Let's practice!

MACHINE LEARNING WITH CARET IN R

Reintroducing glmnet

MACHINE LEARNING WITH CARET IN R

Zach Mayer

Data Scientist at DataRobot and co-author of caret

glmnet review

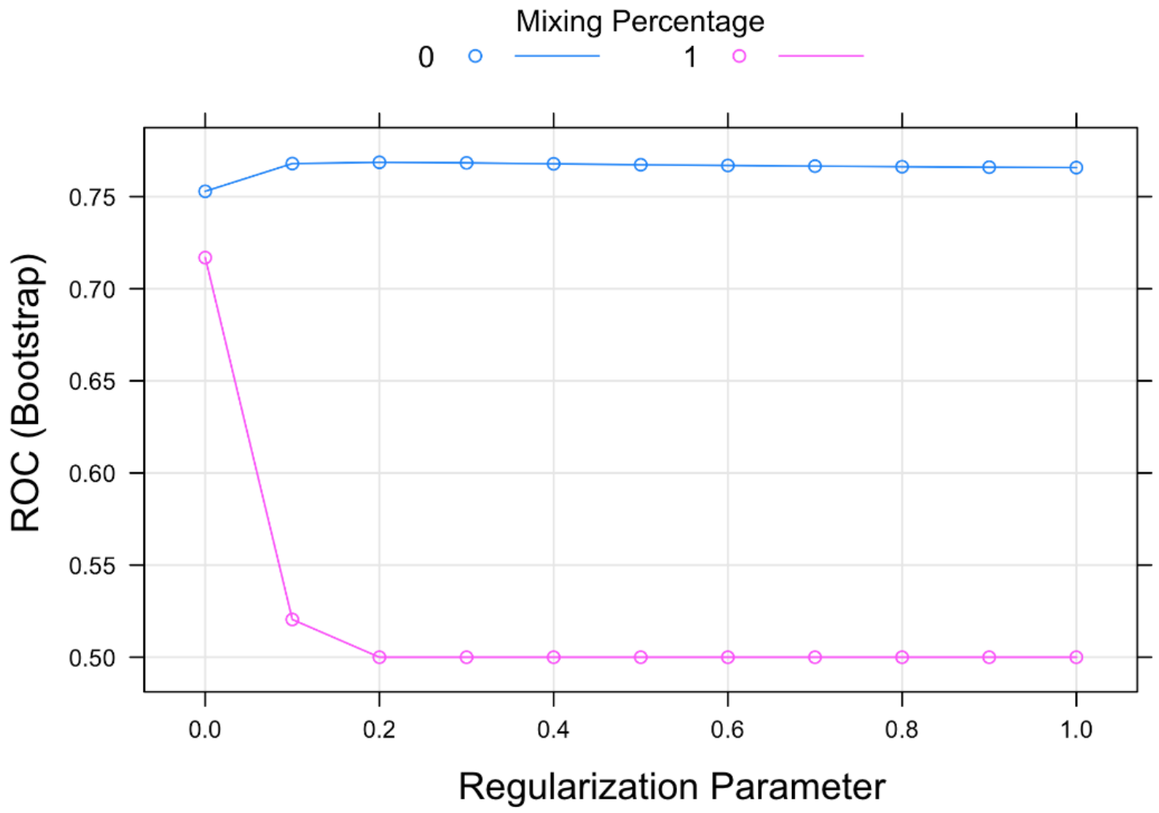
- Linear model with built-in variable selection
- Great baseline model
- Advantages
  - Fits quickly
  - Ignores noisy variables
  - Provides interpretable coefficients

Example: glmnet on churn data

```
set.seed(42)
model_glmnet <- train(
  churn ~ .,
  churnTrain,
  metric = "ROC",
  method = "glmnet",
  tuneGrid = expand.grid(
    alpha = 0:1,
    lambda = 0:10 / 10
  ),
  trControl = myControl
)
```

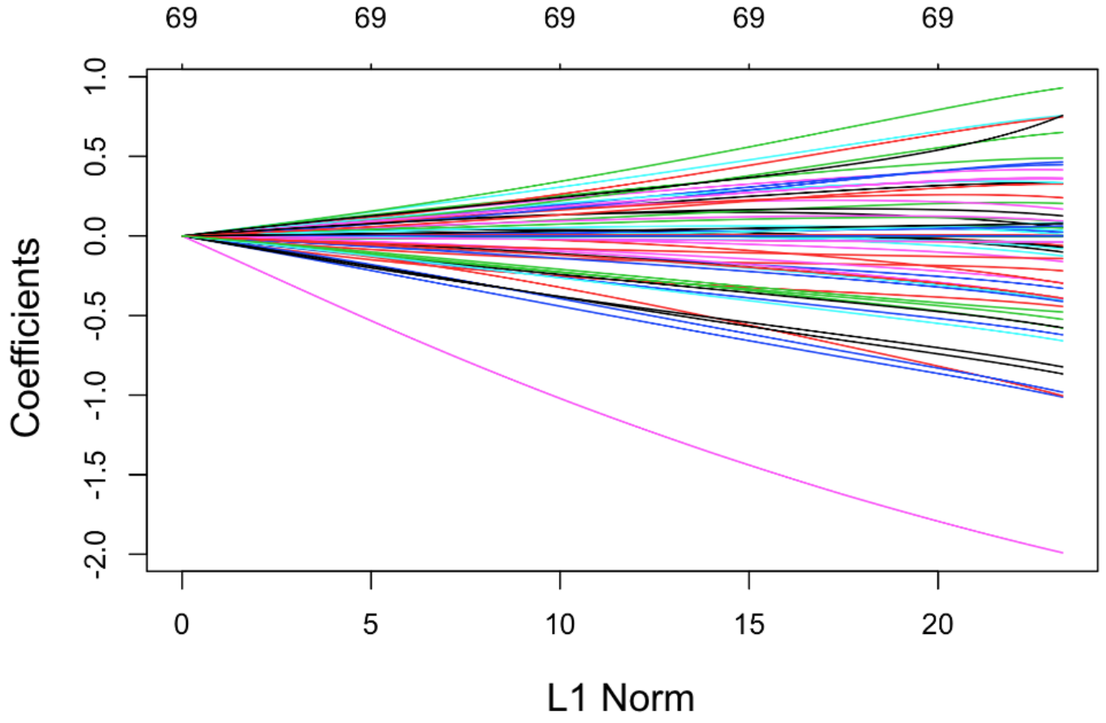
Visualize results

```
plot(model_glmnet)
```



Plot the coefficients

```
plot(model_glmnet$finalModel)
```



Let's practice!

MACHINE LEARNING WITH CARET IN R

Reintroducing random forest

MACHINE LEARNING WITH CARET IN R

Zach Mayer

Data Scientist at DataRobot and co-author of caret

Random forest review

- Slower to fit than glmnet
- Less interpretable
- Often (but not always) more accurate than glmnet
- Easier to tune
- Require little preprocessing
- Capture threshold effects and variable interactions

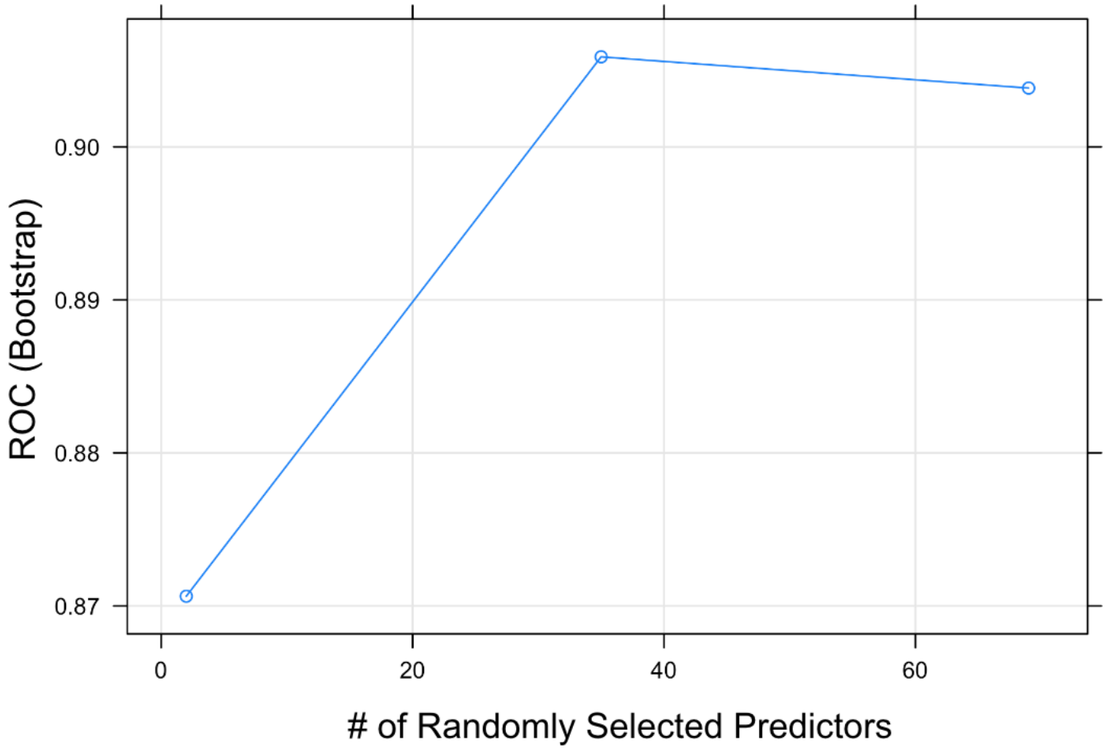
Random forest on churn data

```
set.seed(42)
churnTrain$churn <- factor(
  churnTrain$churn, levels = c("no", "yes")
)
```

```
model_rf <- train(
  churn ~ .,
  churnTrain,
  metric = "ROC",
  method = "ranger",
  trControl = myControl
)
```

Random forest on churn data

```
plot(model_rf)
```



Let's practice!

MACHINE LEARNING WITH CARET IN R

Comparing models

MACHINE LEARNING WITH CARET IN R

Zach Mayer

Data Scientist at DataRobot and co-author of caret

Comparing models

- Make sure they were fit on the same data!
- Selection criteria
  - Highest average AUC
  - Lowest standard deviation in AUC
- The `resamples()` function is your friend

Example: resamples() on churn data

```
# Make a list
model_list <- list(
  glmnet = model_glmnet,
  rf = model_rf
)
```

```
# Collect resamples from the CV folds
resamps <- resamples(model_list)
resamps
```

```
Call:
resamples.default(x = model_list)

Models: glmnet, rf
Number of resamples: 5
Performance metrics: ROC, Sens, Spec
Time estimates for: everything, final model fit
```

Summarize the results

```
# Summarize the results
summary(resamps)
```

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

Models: glmnet, rf
Number of resamples: 5

ROC
         Min. 1st Qu. Median   Mean 3rd Qu.   Max. NA's
glmnet 0.7526  0.7624 0.7719 0.7686  0.7722 0.7840    0
rf     0.8984  0.9028 0.9077 0.9061  0.9093 0.9125    0
```

Let's practice!

MACHINE LEARNING WITH CARET IN R

More on resamples

MACHINE LEARNING WITH CARET IN R

Zach Mayer

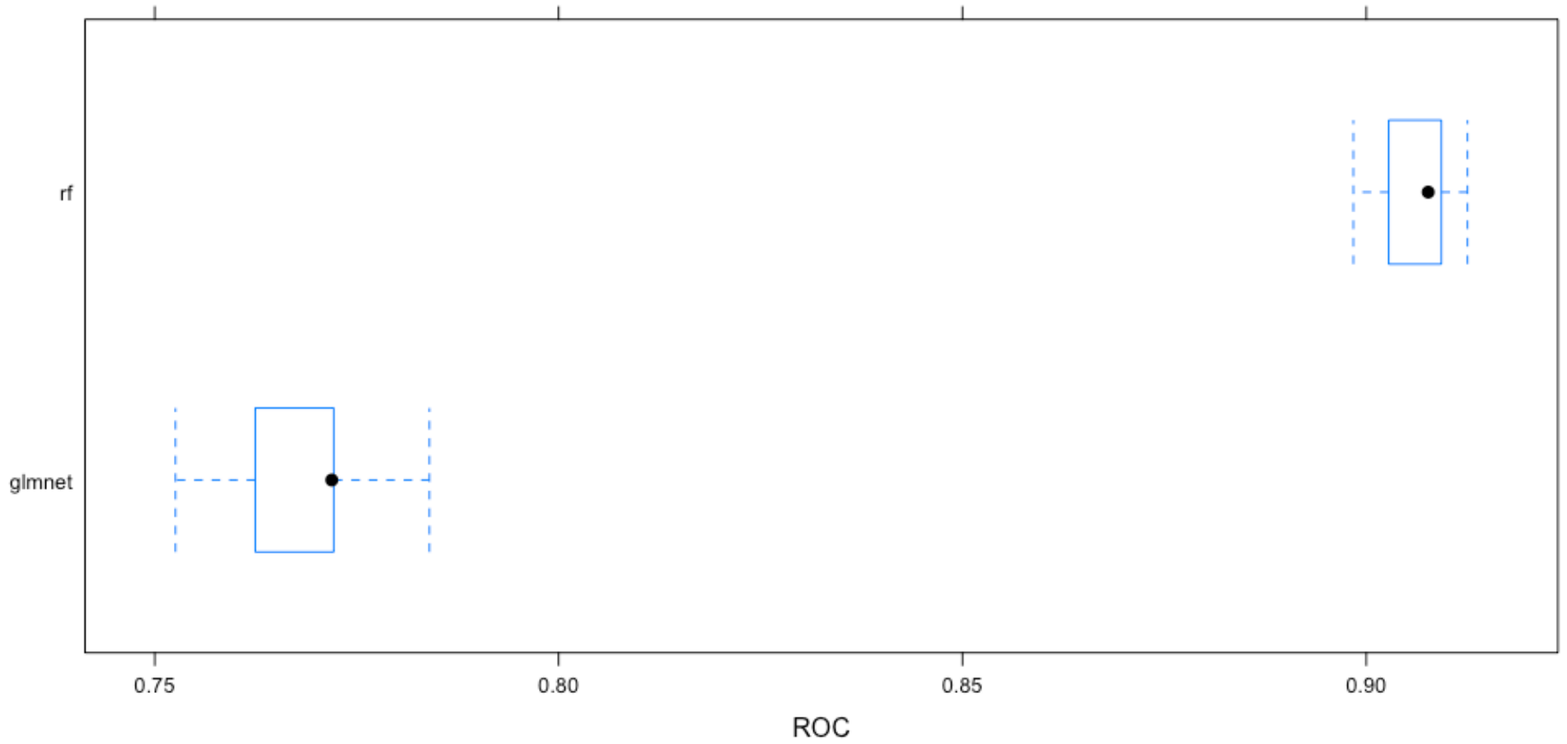
Data Scientist at DataRobot and co-author of caret

Comparing models

- Resamples has tons of cool methods
- One of my favorite functions (thanks Max!)
- Inspired the caretEnsemble package

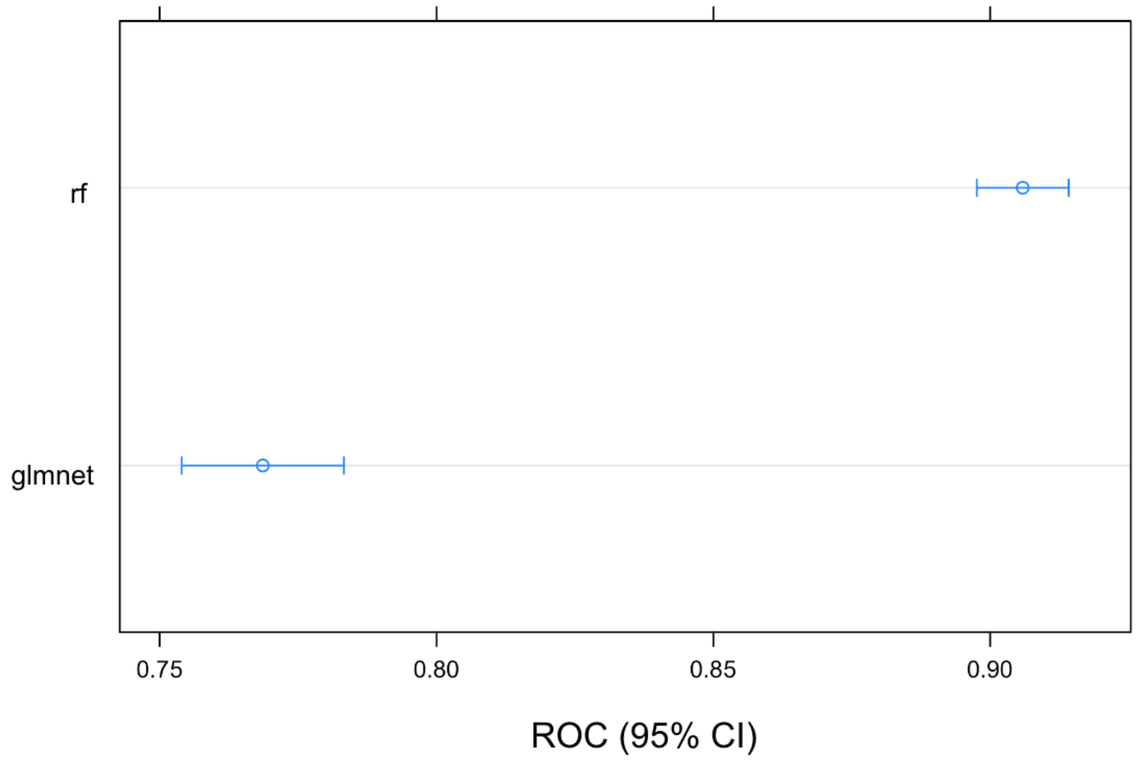
Box-and-whisker

```
bwplot(resamps, metric = "ROC")
```



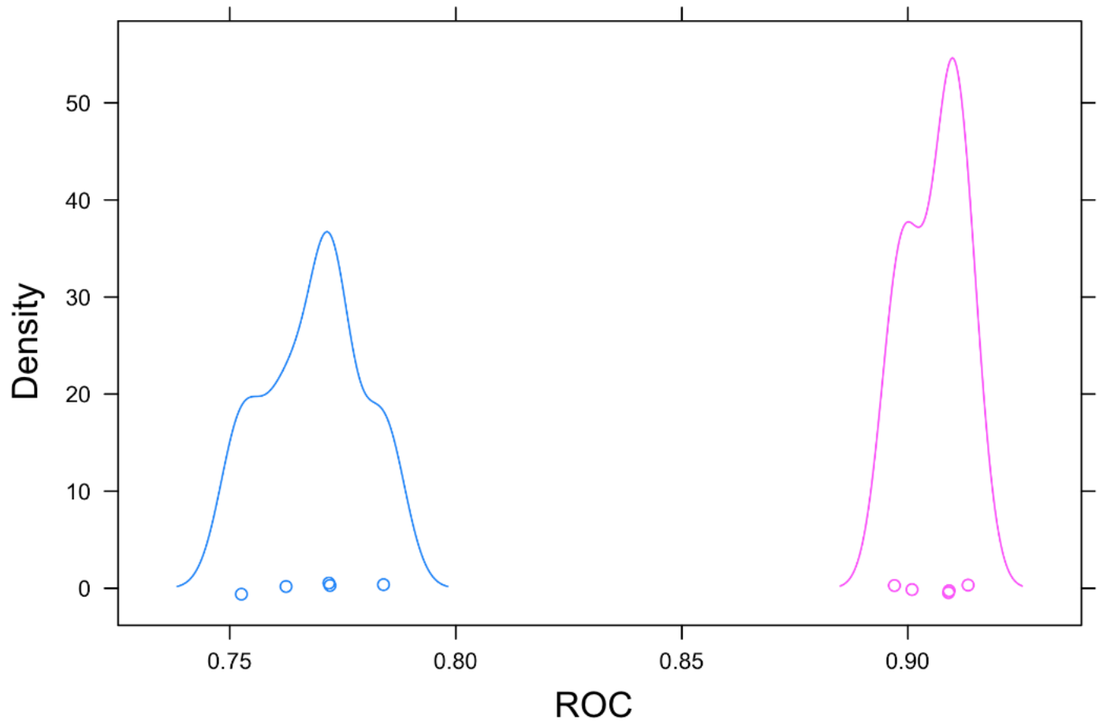
Dot plot

```
dotplot(resamps, metric = "ROC")
```



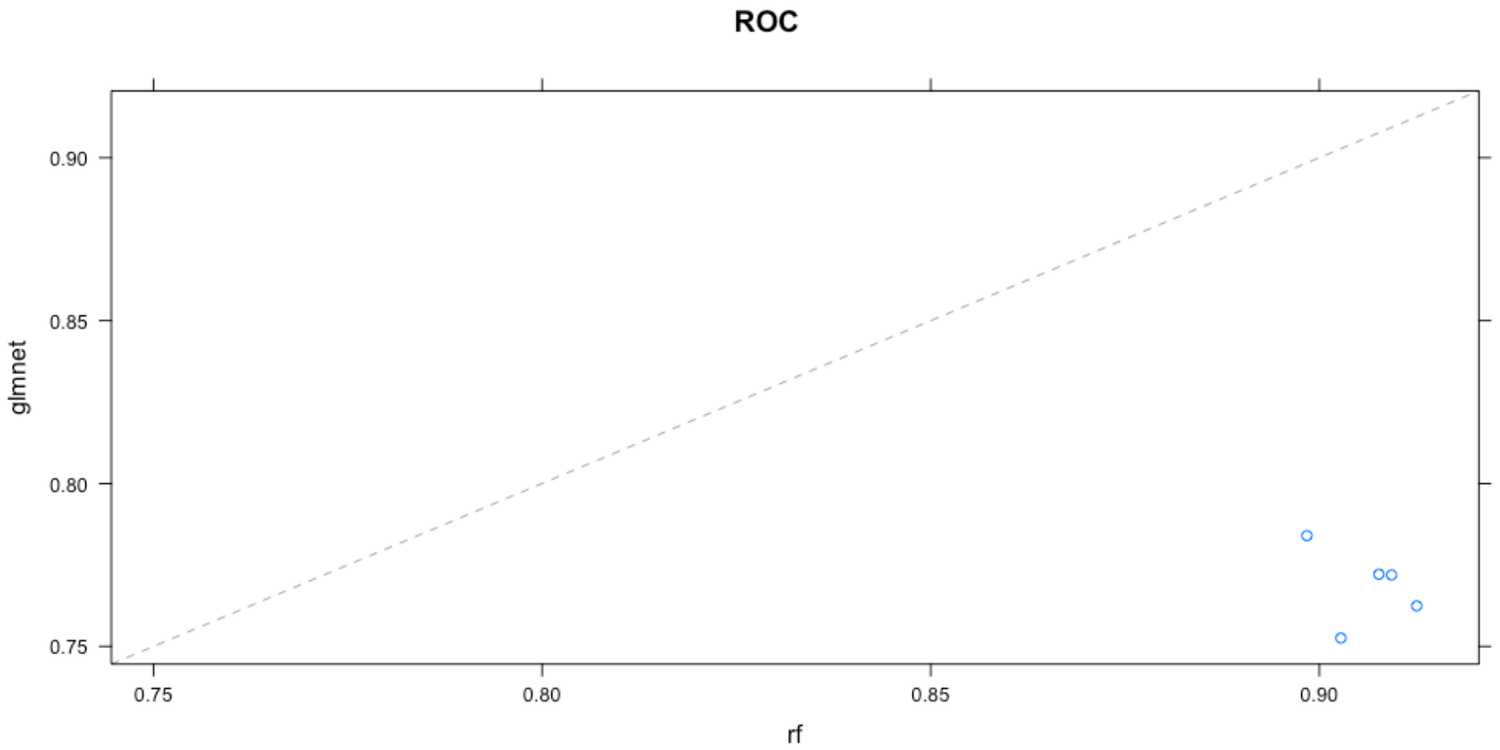
Density plot

```
densityplot(resamps, metric = "ROC")
```



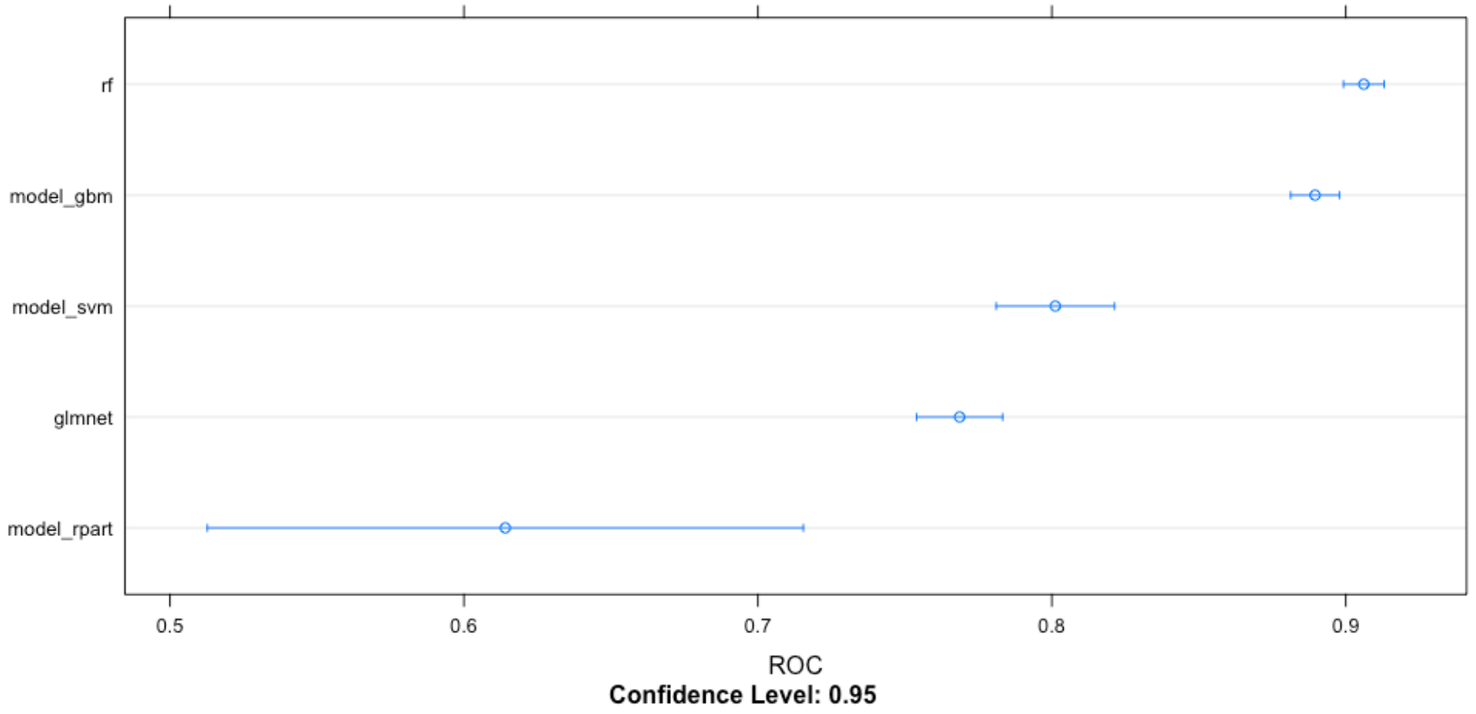
Scatter plot

```
xyplot(resamps, metric = "ROC")
```



Another dot plot

```
dotplot(lots_of_models, metric = "ROC")
```



Let's practice!

MACHINE LEARNING WITH CARET IN R

Summary

MACHINE LEARNING WITH CARET IN R

Max Kuhn

Software Engineer at RStudio and creator of caret

What you've learned

- How to use the caret package
- Model fitting and evaluation
- Parameter tuning for better results
- Data preprocessing

Goals of the caret package

- Simplify the predictive modeling process
- Make it easy to try many models and techniques
- Provide common interface to many useful packages

Go build some models!

MACHINE LEARNING WITH CARET IN R