



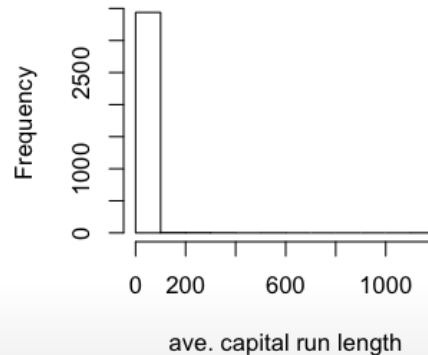
Preprocessing

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Why preprocess?

```
library(caret); library(kernlab); data(spam)
inTrain <- createDataPartition(y=spam$type,
                               p=0.75, list=FALSE)

training <- spam[inTrain,]
testing  <- spam[-inTrain,]
hist(training$capitalAve,main="",xlab="ave. capital run length")
```



Why preprocess?

```
mean(training$capitalAve)
```

```
[1] 4.709
```

```
sd(training$capitalAve)
```

```
[1] 25.48
```

Standardizing

```
trainCapAve <- training$capitalAve  
trainCapAveS <- (trainCapAve - mean(trainCapAve))/sd(trainCapAve)  
mean(trainCapAveS)
```

```
[1] 5.862e-18
```

```
sd(trainCapAveS)
```

```
[1] 1
```

Standardizing - test set

```
testCapAve <- testing$capitalAve  
testCapAveS <- (testCapAve - mean(trainCapAve))/sd(trainCapAve)  
mean(testCapAveS)
```

```
[1] 0.07579
```

```
sd(testCapAveS)
```

```
[1] 1.79
```

Standardizing - *preProcess* function

```
preObj <- preProcess(training[,-58],method=c("center","scale"))  
trainCapAveS <- predict(preObj,training[,-58])$capitalAve  
mean(trainCapAveS)
```

```
[1] 5.862e-18
```

```
sd(trainCapAveS)
```

```
[1] 1
```

Standardizing - *preProcess* function

```
testCapAveS <- predict(preObj,testing[,-58])$capitalAve  
mean(testCapAveS)
```

```
[1] 0.07579
```

```
sd(testCapAveS)
```

```
[1] 1.79
```

Standardizing - *preProcess* argument

```
set.seed(32343)
modelFit <- train(type ~.,data=training,
                  preProcess=c("center","scale"),method="glm")
modelFit
```

```
3451 samples
  57 predictors
   2 classes: 'nonspam', 'spam'
```

Pre-processing: centered, scaled

Resampling: Bootstrap (25 reps)

Summary of sample sizes: 3451, 3451, 3451, 3451, 3451, 3451, ...

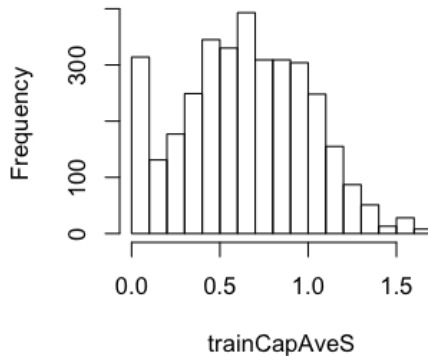
Resampling results

Accuracy	Kappa	Accuracy SD	Kappa SD
0.9	0.8	0.007	0.01

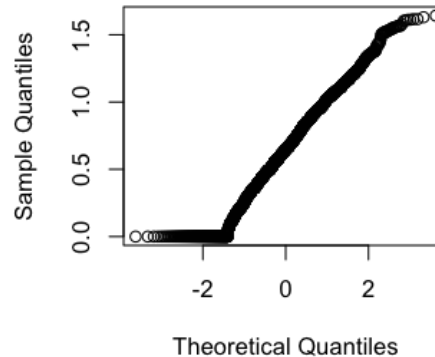
Standardizing - Box-Cox transforms

```
preObj <- preProcess(training[, -58], method=c("BoxCox"))  
trainCapAveS <- predict(preObj, training[, -58])$capitalAve  
par(mfrow=c(1,2)); hist(trainCapAveS); qqnorm(trainCapAveS)
```

Histogram of trainCapAveS



Normal Q-Q Plot



Standardizing - Imputing data

```
set.seed(13343)

# Make some values NA
training$capAve <- training$capitalAve
selectNA <- rbinom(dim(training)[1],size=1,prob=0.05)==1
training$capAve[selectNA] <- NA

# Impute and standardize
preObj <- preProcess(training[,-58],method="knnImpute")
capAve <- predict(preObj,training[,-58])$capAve

# Standardize true values
capAveTruth <- training$capitalAve
capAveTruth <- (capAveTruth-mean(capAveTruth))/sd(capAveTruth)
```

Standardizing - Imputing data

```
quantile(capAve - capAveTruth)
```

0%	25%	50%	75%	100%
-1.1324388	-0.0030842	-0.0015074	-0.0007467	0.2155789

```
quantile((capAve - capAveTruth)[selectNA])
```

0%	25%	50%	75%	100%
-0.9243043	-0.0125489	-0.0001968	0.0194524	0.2155789

```
quantile((capAve - capAveTruth)[!selectNA])
```

0%	25%	50%	75%	100%
-1.1324388	-0.0030033	-0.0015115	-0.0007938	-0.0001968

Notes and further reading

- Training and test must be processed in the same way
- Test transformations will likely be imperfect
 - Especially if the test/training sets collected at different times
- Careful when transforming factor variables!
- [preprocessing with caret](#)