use R! Group of San Francisco Bay Area

2009 Kickoff Meeting
at
Predictive Analytics World 2009

www.meetup.com/R-Users/

The R and Science of Predictive Analytics: Four Case Studies in R

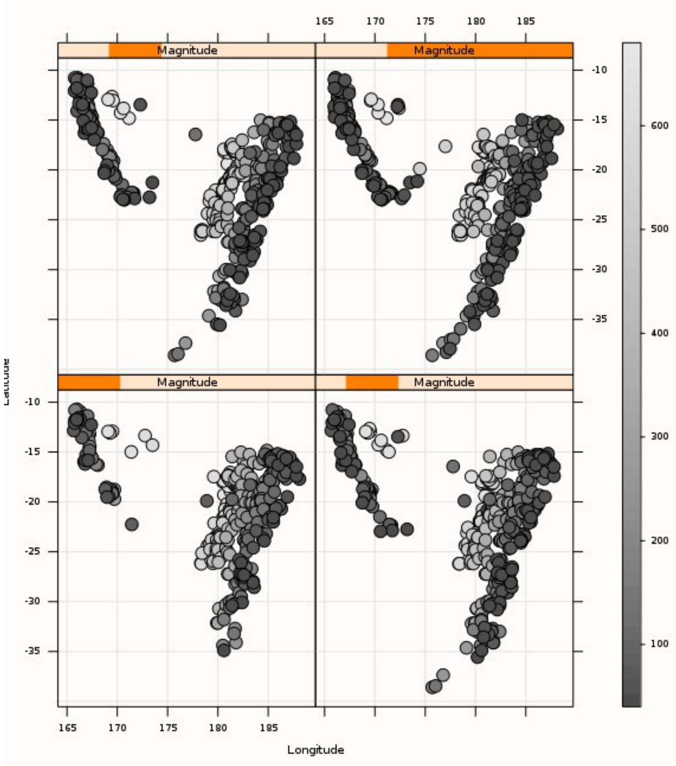
Panel:
Bo Cowgill, Google
Itamar Rosenn, Facebook
David Smith, Revolution Computing
Jim Porzak, The Generations Network

Moderator: Michael Driscoll, Dataspora LLC

What is R?

- A programming language designed for
  - Data manipulation
  - Statistics
  - Data Visualization

- Why sets it apart?
  - Developed by statisticians
  - Free, open source
  - Extensibility via packages

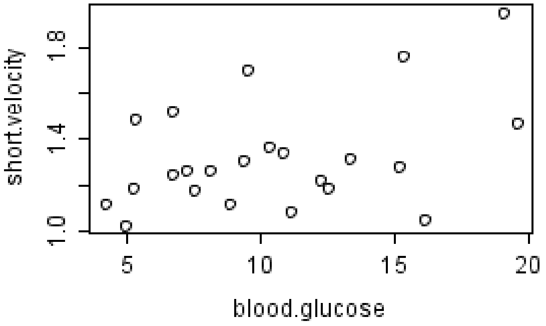


First there was S

- R is the free (GNU), open source, version of S
  - S developed by John Chambers et al while at Bell Labs in 80’s
  - For "data analysis and graphics" (with statistics emphasis)
  - Ver. 4 defined by the “Green Book” *Programming with Data*, 1998
- R was initially written in early 1990’s
  - by Robert Gentleman and Ross Ihaka
  - Statistics Department of the University of Auckland
  - GNU GPL release in 1995
  - “R” is before “S”, as “HAL” is before “IBM”
- Since 1997 a core group of ± 20 developers
  - Since 1997 a core group of ± 20 developers
  - Continually developed with a new 0.1 level release ~ 6 months

A Simple R Example

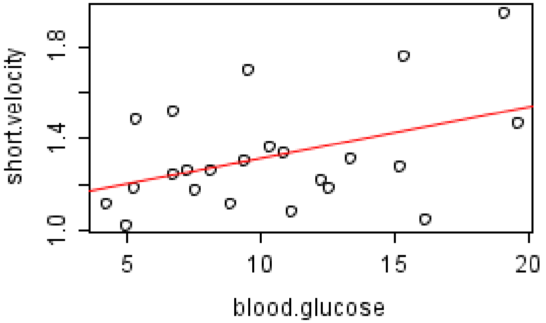
```
> plot(short.velocity ~ blood.glucose,
  data=thuesen)
```



```
> fit <- lm(short.velocity ~ blood.glucose,
  data=thuesen)
> summary(fit)
Call:
lm(formula = short.velocity ~ blood.glucose, data = thuesen)
Residuals:
     Min       1Q   Median       3Q      Max
-0.40141 -0.14760 -0.02202  0.03001  0.43490

Coefficients: Estimate Std. Error t value Pr(>|t|)
(Intercept)    1.09781    0.11748   9.345 6.26e-09 ***
blood.glucose  0.02196    0.01045   2.101   0.0479 *

Residual standard error: 0.2167 on 21 degrees of freedom
Multiple R-squared: 0.1737, Adjusted R-squared: 0.1343
F-statistic: 4.414 on 1 and 21 DF,  p-value: 0.0479
> abline(fit, col = "red")
```



```
> predict(fit, data.frame(blood.glucose = 15))
       1
1.427253
```

Current State of R

As of October, 2004

- V2.0 Released October, 2004
- Windows, Mac, Linux & Unix ports
- Over 400 submitted packages from "abind" to "zoo"
- 12th newsletter (Volume 4/2) published September 2004
- The first useR! - R User Conference held in Vienna May 2004
- ~400 R-help messages per week
- ~ Dozen texts specifically on R or with R examples and code
- R language generally accepted to be more powerful than S-Plus
- Some interesting GUI work in progress

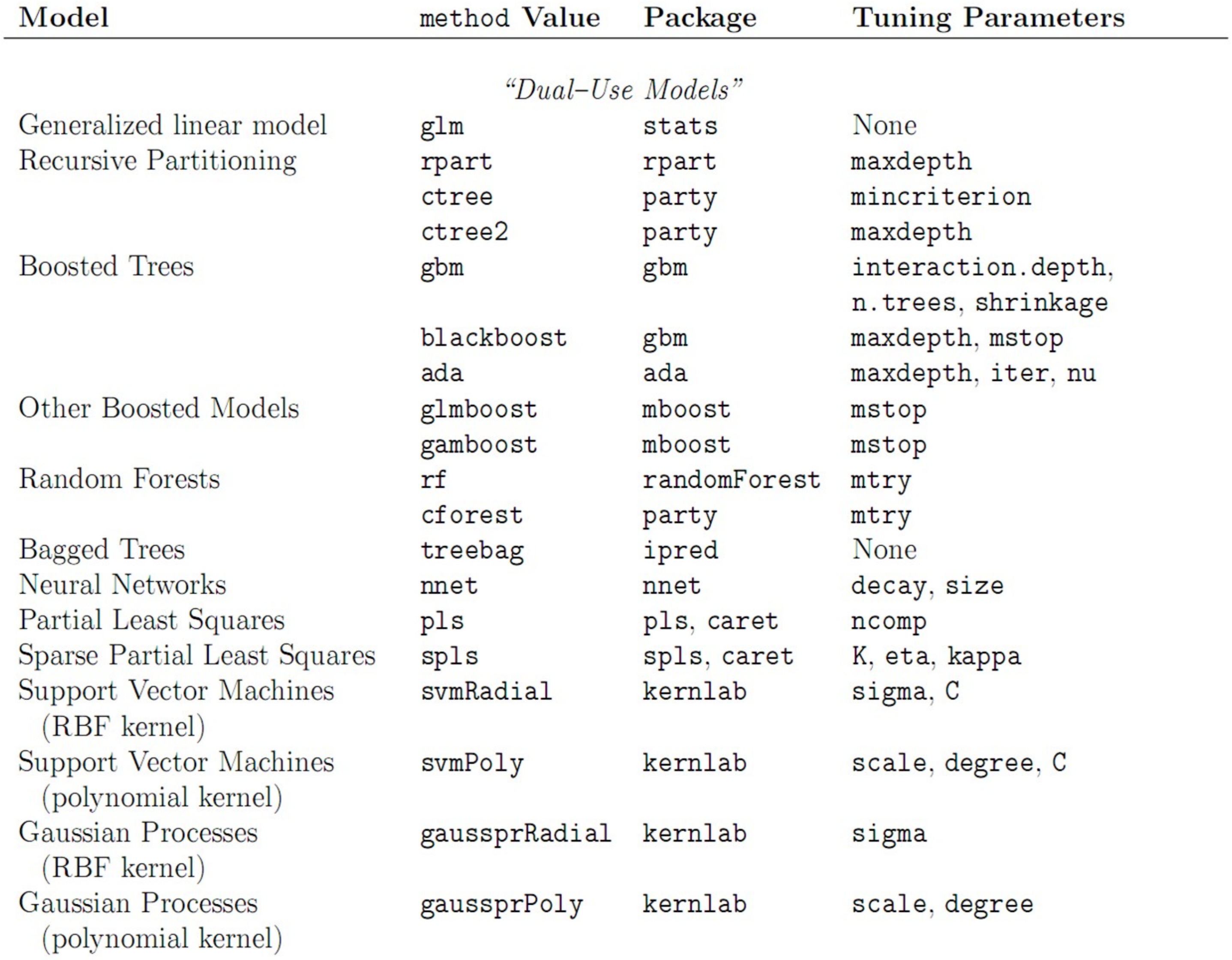
As of February, 2009

- V2.8.1 Released December, 2008
- Vista, Ubuntu, 64bit versions
- 1697 packages; "ADaCHG" to "zyp" (+37 Omega, +296 Bioconductor)
- 23rd Newsletter(Vol. 8/2), October 2008
- 5th useR! this July in Rennes, France
- ~ 700 R-help messages per week
- 74 texts now listed on r-project, including: *Software for Data Analysis, Programming with R* by John Chambers
- R ~ universally taught & used academically for development
- JGR, Rattle, RCmdr, …
- Interesting large application work in progress including R in the clouds

Finding Prediction Methods in R

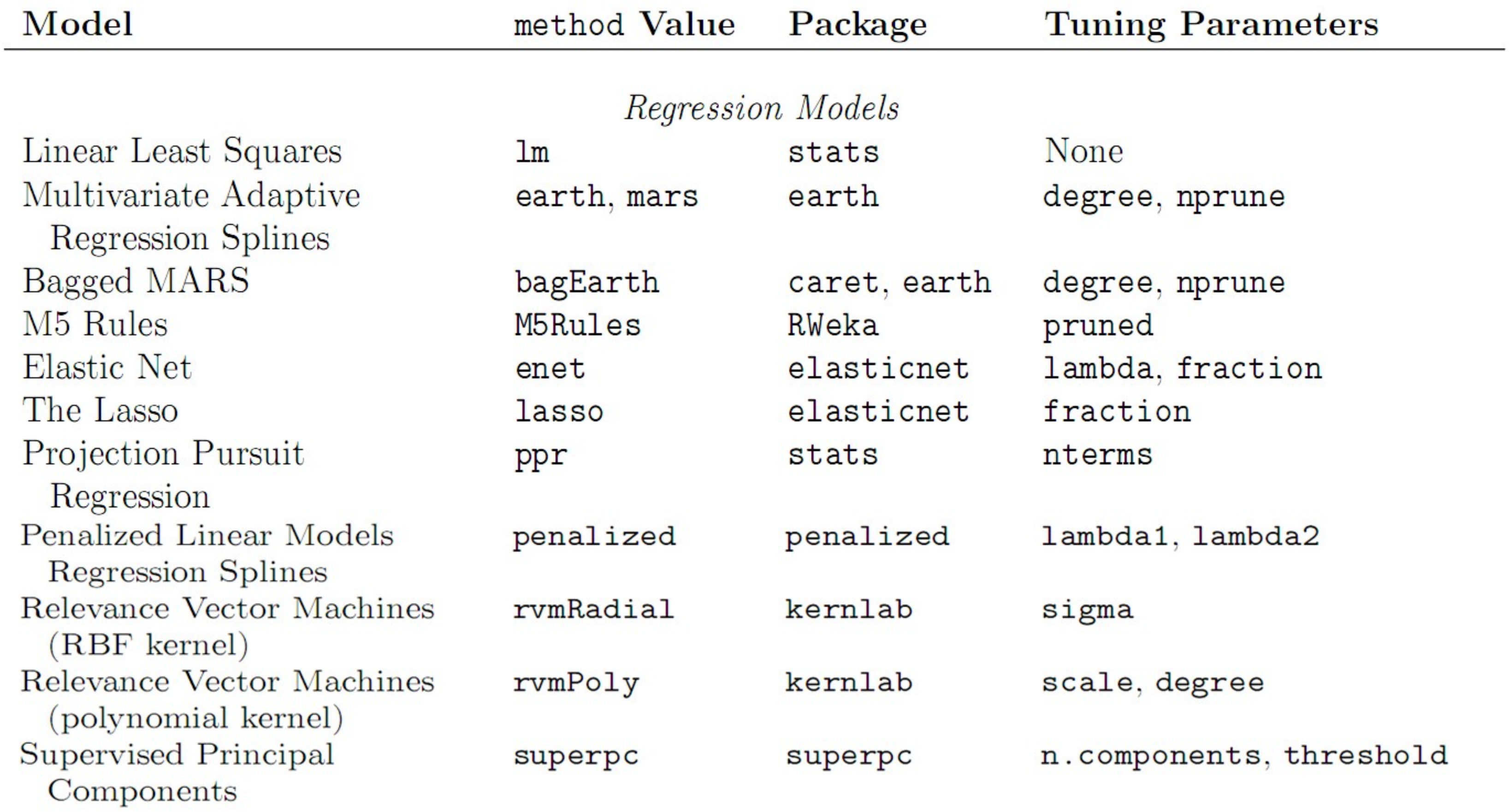
- CRAN Task Views for quick guide to packages:
  - Machine Learning & Statistical Learning
    http://cran.cnr.berkeley.edu/web/views/MachineLearning.html
  - Multivariate Statistics
    http://cran.cnr.berkeley.edu/web/views/Multivariate.html
- R News for introductory articles.
  - Search PDFs for “predict(“
  - 33 hits in 13 issues
- Max Kuhn's caret Package:
  Building Predictive Models in R Using the caret Package
  www.jstatsoft.org/v28/i05

Models supported by caret (1 of 4)



Model	method Value	Package	Tuning Parameters
	"Dual–Use Models"		
Generalized linear model	glm	stats	None
Recursive Partitioning	rpart	rpart	maxdepth
	ctree	party	mincriterion
	ctree2	party	maxdepth
Boosted Trees	gbm	gbm	interaction.depth, n.trees, shrinkage
	blackboost	gbm	maxdepth, mstop
	ada	ada	maxdepth, iter, nu
Other Boosted Models	glmboost	mboost	mstop
	gamboost	mboost	mstop
Random Forests	rf	randomForest	mtry
	cforest	party	mtry
Bagged Trees	treebag	ipred	None
Neural Networks	nnet	nnet	decay, size
Partial Least Squares	pls	pls, caret	ncomp
Sparse Partial Least Squares	spls	spls, caret	K, eta, kappa
Support Vector Machines (RBF kernel)	svmRadial	kernlab	sigma, C
Support Vector Machines (polynomial kernel)	svmPoly	kernlab	scale, degree, C
Gaussian Processes (RBF kernel)	gaussprRadial	kernlab	sigma
Gaussian Processes (polynomial kernel)	gaussprPoly	kernlab	scale, degree

Models supported by caret (2 of 4)

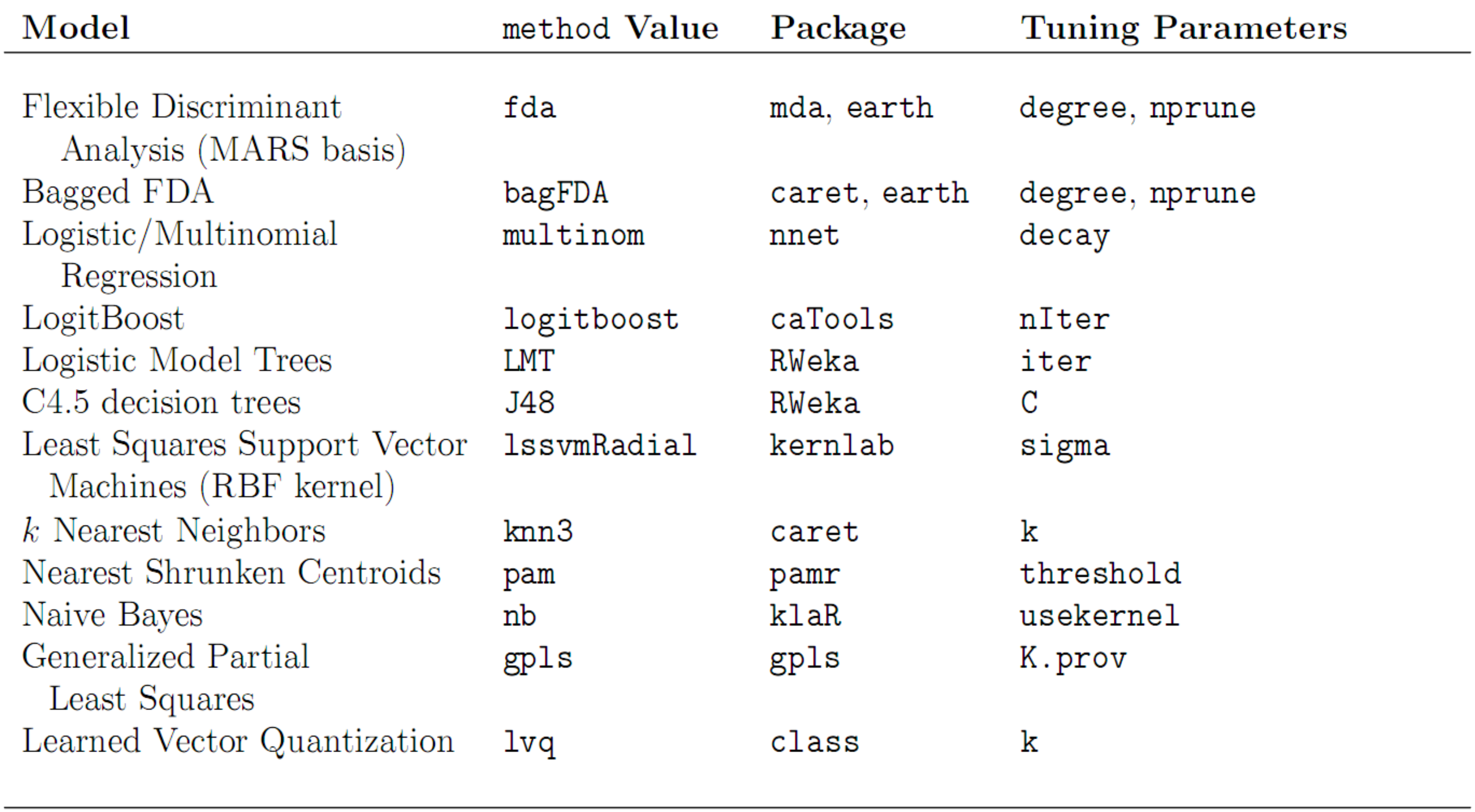


Model	method Value	Package	Tuning Parameters
Regression Models			
Linear Least Squares	lm	stats	None
Multivariate Adaptive Regression Splines	earth, mars	earth	degree, nprune
Bagged MARS	bagEarth	caret, earth	degree, nprune
M5 Rules	M5Rules	RWeka	pruned
Elastic Net	enet	elasticnet	lambda, fraction
The Lasso	lasso	elasticnet	fraction
Projection Pursuit Regression	ppr	stats	nterms
Penalized Linear Models Regression Splines	penalized	penalized	lambda1, lambda2
Relevance Vector Machines (RBF kernel)	rvmRadial	kernlab	sigma
Relevance Vector Machines (polynomial kernel)	rvmPoly	kernlab	scale, degree
Supervised Principal Components	superpc	superpc	n.components, threshold

Models supported by caret (3 of 4)

Model	method Value	Package	Tuning Parameters
	Classification Models		
Linear Discriminant Analysis	lda	MASS	None
Quadratic Discriminant Analysis	qda	MASS	None
Stabilised Linear Discriminant Analysis	slda	ipred	None
Shrinkage Linear Discriminant Analysis	sda	sda	diagonal
Sparse Linear Discriminant Analysis	sparseLDA	sparseLDA	NumVars, lambda
Stepwise Diagonal Discriminant Analysis	sddaLDA, sddaQDA	SDDA	None
Regularized Discriminant Analysis	rda	klaR	lambda, gamma
Mixture Discriminant Analysis	mda	mda	subclasses
Penalized Discriminant Analysis	pda	mda	lambda
	pda2	mda	df

Models supported by caret (4 of 4)



Model	`method` Value	Package	Tuning Parameters
Flexible Discriminant Analysis (MARS basis)	`fda`	`mda`, `earth`	`degree`, `nprune`
Bagged FDA	`bagFDA`	`caret`, `earth`	`degree`, `nprune`
Logistic/Multinomial Regression	`multinom`	`nnet`	`decay`
LogitBoost	`logitboost`	`caTools`	`nIter`
Logistic Model Trees	`LMT`	`RWeka`	`iter`
C4.5 decision trees	`J48`	`RWeka`	`C`
Least Squares Support Vector Machines (RBF kernel)	`lssvmRadial`	`kernlab`	`sigma`
k Nearest Neighbors	`knn3`	`caret`	`k`
Nearest Shrunken Centroids	`pam`	`pamr`	`threshold`
Naive Bayes	`nb`	`klaR`	`usekernel`
Generalized Partial Least Squares	`gpls`	`gpls`	`K.prov`
Learned Vector Quantization	`lvq`	`class`	`k`

From Table 1 in Max Kuhn's caret package vignette *The caret Package:* :
http://cran.cnr.berkeley.edu/web/packages/caret/index.html

Bo Cowgill, Google

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Revolution R Enterprise

An enhanced, high-performance distribution of R, designed for use in commercial environments.

http://www.revolution-computing.com

ParallelR

Easy-to-use parallel computing with R on multicore workstations and clusters

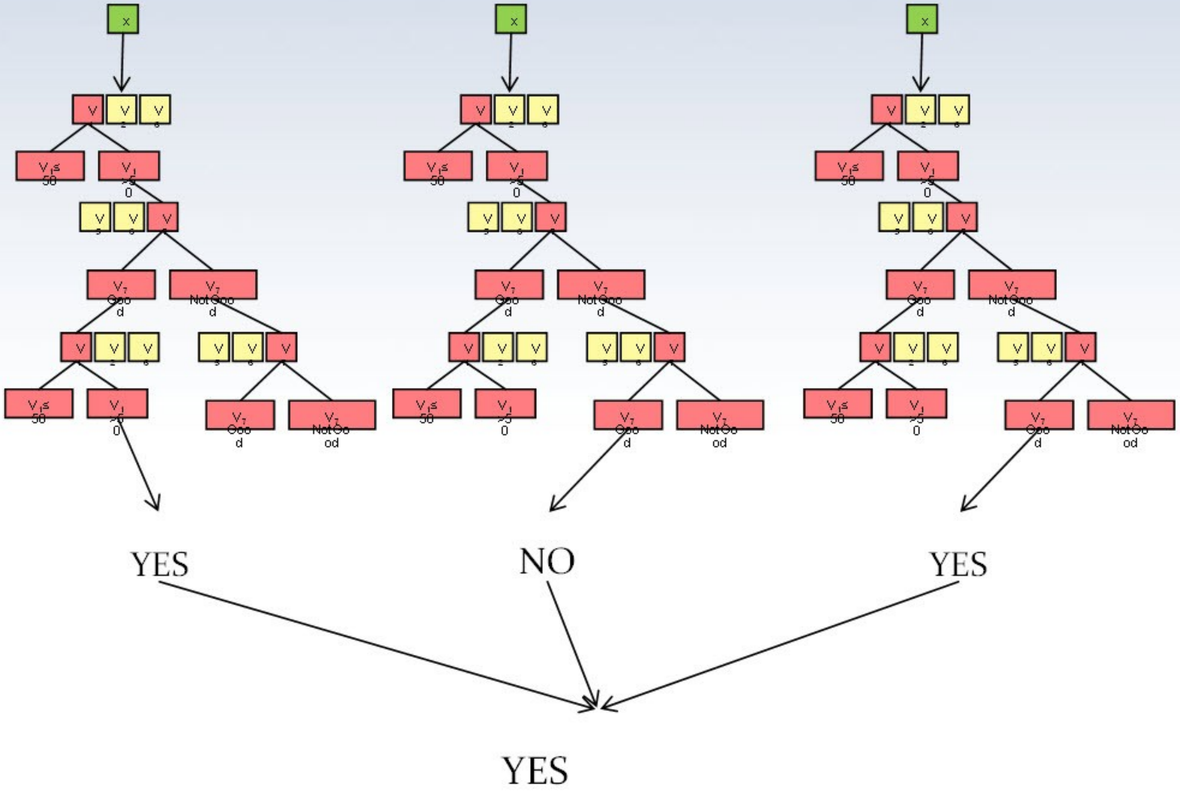
Revolutions blog

News about R, statistics and the world of open-source

http://blog.revolution-computing.com

Predicting with Random Forests

1. Build trees with `mtry` random features on bootstrap samples of training data
2. Run the new data down each tree in the forest (independent, parallelizable)
3. Take a majority vote (classification), average (regression), or other single-valued output function of all the tree results



YES NO YES

YES

Sequential Implementation

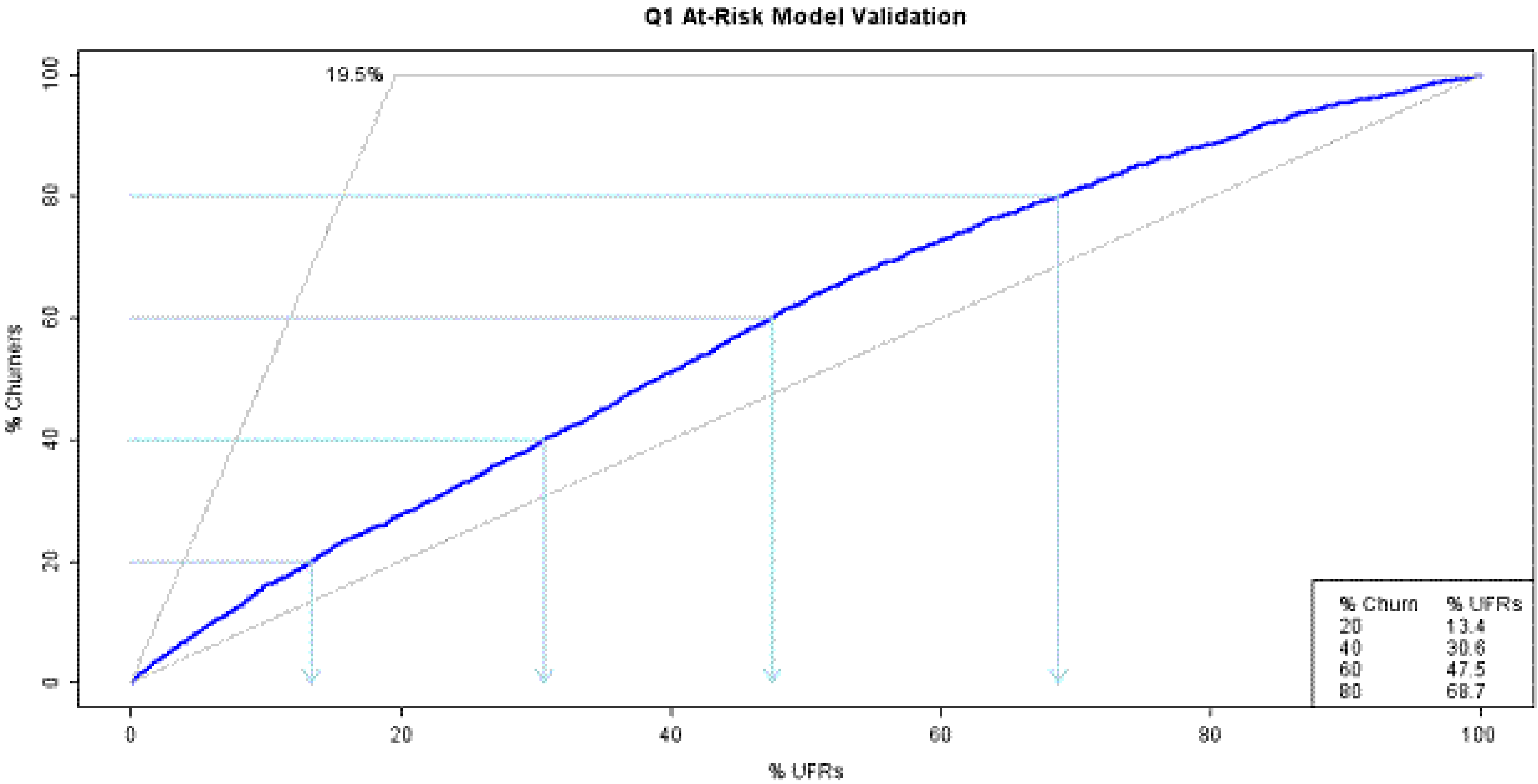
```
library (randomForest)
rf <- randomForest (x, y, ntree=1000)
```

Parallel Implementation with ParallelR

```
library (randomForest)
library (foreach) # from ParallelR 2.0
wc <- workerCount (getSleigh())
n <- ceiling (1000/wc)
rf <- foreach (j=rep(n, wc), COMBINE=combine,
              PACKAGES=‘randomForest’) %dopar%
              randomForest (x, y, ntree=j)
```

Jim Porzak, The Generations Network

Jim's Marketing Analytics Example



% Churn	% UFRs
20	13.4
40	30.6
60	47.5
80	68.7

More examples in my talk tomorrow with Alex Kriney from Sun.

Discussion

Q&A

Appendix

Getting Started with R

R Links

- R Homepage: www.r-project.org
  - The official R site
- R Foundation: www.r-project.org/foundation
  - Central reference point for R development
  - Holds copyright / GPL of R software & docs
- Local CRAN: cran.cnr.berkeley.edu
  - Find yours at: cran.r-project.org/mirrors.html
  - Current binaries, docs, FAQs, & more!
- JGR Site: jgr.markushelbig.org/JGR.html

R Basics – Learning More

Wikipedia

http://en.wikipedia.org/wiki/R_(programming_language)

An Introduction to R

http://cran.cnr.berkeley.edu/doc/manuals/R-intro.html

Links to all “official” manuals (html & pdf)

http://cran.cnr.berkeley.edu/manuals.html

R Graph Gallery

http://addictedtor.free.fr/graphiques/

R Wiki

http://wiki.r-project.org/rwiki/doku.php

For SAS & SPSS users (Bob Muenchen's Rosetta Stone)

http://rforsasandspssusers.com/