Thurs, 4-25-19
Validation (cont.)

1. **Cross-validation stopping rule**
2. **Sample runs of geosa12**

Assignment a12: due next Tuesday
(last day of class)

Cross-validation stopping rules -- references

A stopping rule is a guideline for stopping entry of predictors into the regression during automated predictor selection. The general idea of using cross-validation as a guide has been applied in various fields, including hydrology and dendroclimatology. Myers (1990) is a good reference for the idea. The other references listed below are tree-ring applications.

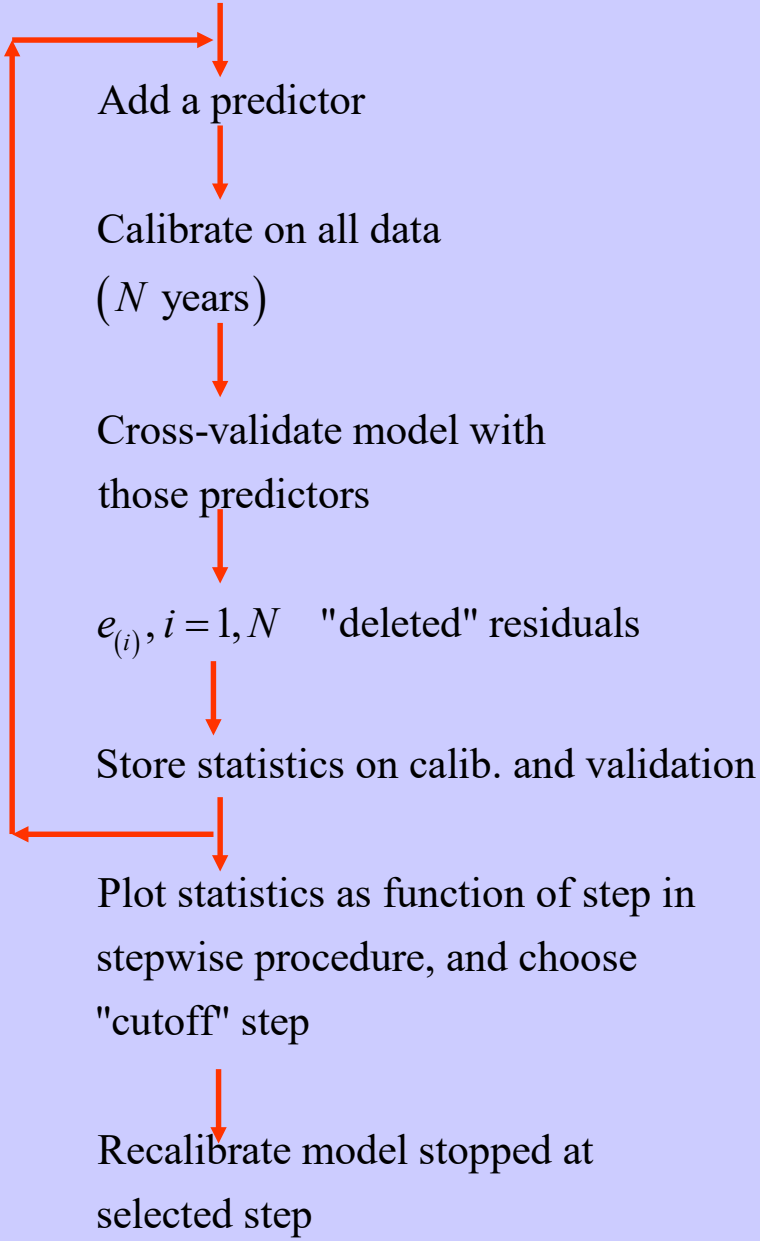
Hidalgo, H. G., T. C. Piechota, and Dracup, John A. 2000. Alternative principal components regression procedures for dendrohydrologic reconstructions. Water Resources Research 36(11): 3241-3249.

Meko, D. M. 1997. Dendroclimatic reconstruction with time varying subsets of tree indices. Journal of Climate 10: 687-696.

Meko, D. M., M. D. Therrell, C. H. Baisan, and M. K. Hughes. 2001. Sacramento River flow reconstructed to A.D. 869 from tree rings. J. of the American Water Resources Association 37(4): 1029-1040.

Myers, R. H. 1990. Classical and modern regression with applications, second edition. Duxbury, Pacific Grove, California.

Cross-validation stopping rule



- *N*-observation calibration period, *p* potential predictors
- Forward stepwise of *y* on x_1, x_2, …, x_p

Geos11: entry of predictors

1 Choose x_i with highest correlation $r_{y,x}$

2 Compute $\hat{e}_t = y_t - \hat{y}_t$

3 Choose the x_i with highest $r_{\hat{e}_t,x}$

Till all predictors in

Geos11: statistics monitored stepwise

Calibration: computed from sums of squares (SS) and mean-square (MS) terms
Validation: computed from deleted residuals

$$\mathrm{MS} = \frac{\mathrm{SS}}{\mathrm{df}}$$

Degrees of freedom

SS		df
SST	total	$n-1$
SSR	regression	p
SSE	error	$n-p-1$

Geos11: statistics monitored stepwise (cont)

CALIBRATION

$$R^2 = 1 - \frac{\mathrm{SSE}}{\mathrm{SST}}$$

$$R^2_{adj} = 1 - \frac{\mathrm{MSE}}{\mathrm{MST}}$$

$$F = \frac{\mathrm{MSR}}{\mathrm{MSE}}$$

$$s_e = \mathrm{RMSE}_c = \sqrt{\mathrm{MSE}}$$

VALIDATION (leave-1-out)

$$R^2_{\mathrm{pred}} = \mathrm{RE} = 1 - \frac{\mathrm{SSE}}{\mathrm{SSE}_{\mathrm{ref}}}$$

$$\mathrm{RMSE}_v = \sqrt{\frac{\sum_{i=1}^{n} \hat{e}^2_{(i)}}{n}}$$

Reference (null) reconstruction for RE statistic is calibration period mean of *y*

Change in statistics with entry of additional predictors

Calibratiion

SSE must fall $\rightarrow$ R^2 must rise

MSEc and RMSEc $\rightarrow$ might fall (but penalty for additional predictors could make it rise)

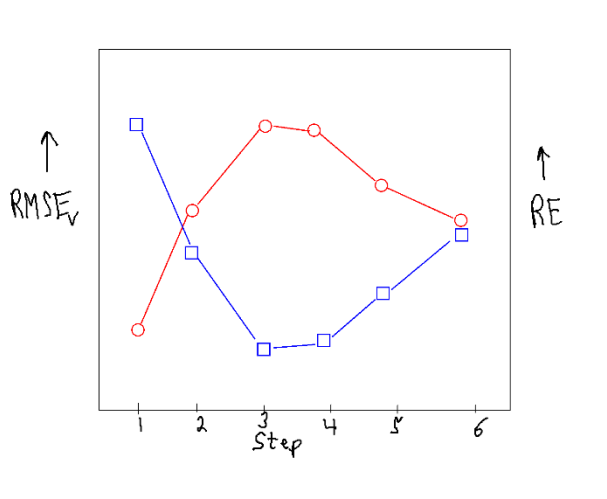
R^2_{adj} $\rightarrow$ might rise

F $\rightarrow$ might rise

Validation

RMSEv might fall or rise

RE will move in opposite direction as RMSEv



Sample runs of geosa11 (Validation mode)…