Specialization and Extrapolation of Software Cost Models

Tim Menzies, Portland State,USA
Dan Port, U.Hawaii, USA
Zhihao Chen, USC, USA
Jairus Hihn, JPL, USA

CORE IDEA: it's a very good idea to ignore some ideas.

Motivation

"**Software costing is a quality issue.**"
- Get it wrong and everything suffers; e.g. no $$ for QA

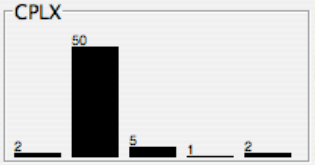
"Most software is costed like the weather." [Boehm,2000]
- Tomorrow will be like today, times some "deltas".
- Is it safe to cost new projects via extrapolation of old ones?

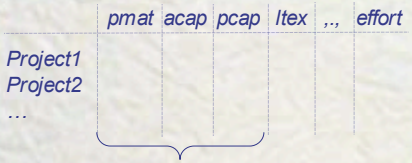
"**Stop model conflation.**"
- As time goes by, most cost models get more elaborate;
- Experience should tell us when to add or ***PRUNE*** variables.

Example

Is software complexity a useful cost driver?

- In NASA data sets, CPLX=high (usually);
- No information in this variable;
- Prune it?





prune rows? (only use data from related projects?)

widely used technique

prune columns? ← *rarely published technique* in cost estimation (exception: [Kirsopp & Shepperd, 2002])

Specialization

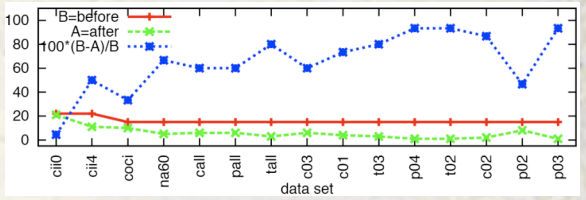
The "**wrapper**": [Kohavi & John, 1997]
1) Pick a **learner**;
   - here: LSR (not M5') on log(NUMS)
2) **Include some** more attributes;
3) Try learning with **just those** attributes;
4) If **better** then { **Stale** = 0 }
   else { if (++**Stale** > 5)
   then {**Stale=0**; forget **last 5** includes}}
5) Goto 2)

Wrapper vs (e.g.) **PCA**:
- much **slower**
- more **thorough**

[Hall, 2003]

Why specialize?

Fewer variables = smaller theories
- more explainable, easier processing.

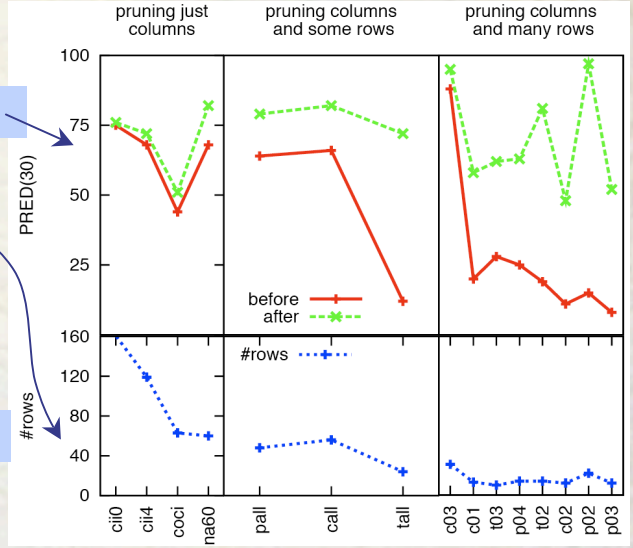


Many variables are **noisy**, **redundant**, **under-sampled** (e.g. cplx)
- they confuse, rather than clarify, the generalization process.

Lower variance
- [Miller 2002]

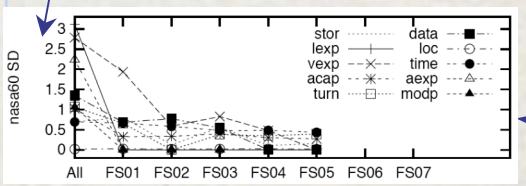
Better estimates

- Especially for small data sets.
- And small data sets are the industrial norm.



Less variation

- In the learned models.
- 30 * 90% sub-samples of the data
- Learn "effort = $\beta_0 + \beta_1 x_1 + \beta_2 x_2 + ..$ "
- Plot the β_i variance:



Wrapping **reduces** variability

Conclusion

- For generalization via LSR:

no extrapolation without prior specialization.