Software Metris and Quality Engineering

CSE 8314 — Fall 2019

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Module V: Recent Development and Advanced Topics

- New Metrics and Applications
- New Models and ESE Guidelines
- Data Collection/Extraction/Mining
- Hypothesis Testing

New Metrics and Applications

- New (internal) metrics might be needed:
  - ▷ new language/technology
  - ▷ new application domain
  - ▷ new vs. adapted/adopted metrics

- New language/technology
  - ▷ CK metriics for OO
  - ▷ Other new languages/technologies

- New application domains (+technologies):
  – e.g., Web, net-centric, SOA, Cloud, IoT, etc.

New Metrics/Work at SMU

- NCSS complexity metrics (SDPS slides)
  - ▷ new application domain: NCSS
  - ▷ existing basis: Tian/Zelkowitz/etc.
  - ▷ more specs intead of specific metrics

- Usability metrics
  - ▷ Usability improvement work: Geng-Tian
  - ▷ U-metrics: success rate and performance (# steps, time spent)

- Testing metrics
  - ▷ Improved Markov OP: Karami-Tian
  - ▷ Markov OP accuracy metrics: node, link, and probability differences
  - ▷ Testing metrics: coverage and waste
  - ▷ Related reliability metrics: qualitative comparison (only partially quantified)

New Models and ESE

- *Empirical Research in S/w Eng. (ESE):* 2002 paper by Kitchenham, Pfleeger, Pickard, Jones, Hoaglin, Emam, Rosenberg (TSE 28(8):721-734).

- Why a guideline?
  - ▷ More ESE research activities
  - ▷ Maturing of SE and ESE
  - ▷ Practical concerns:
    - reader/students
    - researchers/meta-analyst
    - reviewers/editors
    - journals/conferences etc

- More details in CSE 8340

ESE Guideline: Basis

- Internal basis for the guideline:
  - ▷ Research experience in ESE
  - ▷ Researcher experience in ESE
  - ▷ from both author/reviewer perspectives
  - ▷ Other CS/SE work
- External basis for the guideline:
  - ▷ Scientific method
  - ▷ Implicit guidelines used for emp. studies in other mature disciplines (most natural science)
  - ▷ (Explicit) guidelines for emp. studies in other disciplines (e.g., medical)
  - ▷ External experts as co-authors
- Result: *Preliminary* guidelines.

ESE Guideline: Sources

- Authors as information sources:
  - ▷ Diverse background
  - ▷ Experience in SE/ESE/statistics/others

- Other important sources:
  - ▷ Similar guidelines for medical journals
  - ▷ Meta-analysis studies
    (studies of empirical studies and results)
  - ▷ Papers about statistical applications:
    – positive (guide, "what should be done")
    – negative ("what was wrong/to avoid")
  - ▷ Other "soft" sciences
  - ▷ List of specific references in paper

ESE Guideline: Topic Areas

1. Experimental context
2. Experimental design
3. Conduct experiment and data collection
4. Analysis
5. Presentation of result
6. Interpretation of result

Data Collection/Extraction/Mining

- Data collection
  - ▷ Data source identification
  - ▷ Data collection procedures
  - ▷ Tools: computing vs extracting
  - ▷ IBM data: complexity/defect/activity/etc.

- Data extraction:
  - ▷ Tapping into pre-existing data sources
  - ▷ Web measurement example (paper in Blackboard)

- Data mining:
  - ▷ (unstructured/big) data source
  - ▷ mining/extensive processing necessary
  - ▷ AutoODC work at SMU (paper in Blackboard)

Validation and Hypothesis Testing

- Hypothesis: An assumption or concession made for the sake of argument.
  - ▷ Simple hypothesis: One value of the population parameter ($\mu = 115$).
  - ▷ Composite hypothesis: A range of values that the population parameter may assume ($\mu \neq 115$).
  - ▷ Null Hypothesis (H_0): Status quo.
  - ▷ Alternative Hypothesis (H_a): Believed to be true.
  - ▷ Both H_0 and H_a can be simple or composite.

- Hypothesis Testing: Choose between two competing hypotheses about the value of a population parameter using the knowledge obtained from a sample.
  – Example HT: slides online (pp.45-48)

HT and Taylored Metrics

- Another HT example
  - ▷ Part of OS/SRE work
  - ▷ SEDE'2017 paper by Y. Tian, J. Tian, and N. Li
  - ▷ experience factore captured and HT applied
  - ▷ result comparison with HT applied too
  - ▷ see paper and slides on Canvas

- An example of taylored metrics
  - ▷ Part of accurate Markov OP work at SMU
  - ▷ SERA'2017/Springer book chapter by G. Karami and J. Tian
  - ▷ impact of accurate Markov OP on
    - – test coverage and efficiency (waste)
    - – reliability
  - ▷ metrics on the above
  - ▷ see paper and slides on Canvas