Item Response Theory (IRT) and Applied Statistics

Good Research Topics in Educational Statistics and Measurement

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**Paper Presented at the 2003 American Educational
Research Association (AERA) annual meeting in
Chicago, Illinois**

What is a good research topic? Two perspectives that I will draw out in a cartoon-like way.

- **Pragmatic Perspective**
  - **"A good thesis is a done thesis" – before we worry about the grandness of the topic, you need to be able to get finished in a timely manner.**
  - **Some problems are closed or no longer interesting so work on the topics that presently have the spotlight on them.**
  - **Work on a practical problem that has immediate application. Look toward institutions to find practical problems to solve.**

- **Not-so-Pragmatic Perspective**
  - **The timing of the completion is not important. The important part is the "significance" of the topic and you get done when you get done.**
  - **No problem is closed, it is just that some problems do not have the spotlight on them right now.**
  - **Pick a topic based on your personal curiosity and/or has significance to the foundations of the discipline.**

- I believe you need to pick and choose aspects of the "pragmatic" and "not-so-pragmatic" approaches that fit your personality, ambitions, and context (including your supervisor, your skills, your ambitions, etc.)

- One of the most important aspects is for you to find a topic that will keep you motivated and interested for at least 10 months to a year.

- Before I turn to a list of interesting topics, let me summarize some relevant findings from a relatively recent survey of potential employers of recent graduates for jobs in measurement and statistics (Zumbo, Hubley, & Davidson, 2000).

- You will see that the thesis topic is not rated as important so that one needs to find an interesting problem that allows you to develop some key skills of interest. The topic, per se, is less relevant.

Some results from Zumbo, Hubley, & Davidson (2000). We surveyed potential employers world-wide. The thesis topic did not come up as a determining factor in hiring or recruitment of <u>entry-level</u> people. The top 4 or 5 key factors appear to be:

- **For hiring professors:**
  1. **Oral communication skills (82% rated it vitally important)**
  2. **Written communication skills (76% rated it v.i.)**
  3. **Mathematical and statistical knowledge (68% v.i. rating)**
  4. **Applicant's personal characteristics (personable, team-player, etc.) (53% v.i. Rating)**
  5. **Publications (# and quality, 41 and 47% v.i.)**

- **For hiring professionals:**
  1. **Mathematical and statistical knowledge (88% v.i. rating)**
  2. **Oral communication skills (80% v.i. rating)**
  3. **Written communication skills (76% rated it v.i.)**
  4. **Applicant's personal characteristics (personable, team-player, etc.) (64% v.i. Rating)**
  - **No other rating was more than 18% v.i.**

Advice based on the survey results.

- **Get involved in research …. The way to learn to do research is to "do research", "do research", and "do even more research".**
- **Maybe one of these projects will turn into your dissertation. In this light, your dissertation is not your "be all and end all" of graduate school but rather what it becomes is a demonstration of your competence as a scholar.**
- **In doing research, work to develop the following:**
  - **Develop your team-working skills. Document that you can work in teams and collaboratively sharing and supporting others on the team.**
  - **Develop your oral and written communication skills. Make it so that your dissertation is not the first time you write and present something.**
- **Study and learn psychometric and statistical models …. Both the theory and applications.**

Here are some topics I see a lot of in my editorial and reviewer work I do for testing and for statistics journals. These are <u>just examples</u> … there are lots of others.

- **Applied Statistics:**
  - **Robustness and resistant methods; violating assumptions such as normality, homoscedasticity, etc..**
  - **Working with complex data … multi-level modeling (MLM)**
  - **Sampling theory alternatives to MLM**
  - **Variable-ordering**
- **IRT and intersection of IRT and Applied Stat:**
  - **Estimation theory with smaller samples; including Bayesian methods, Bayesian networks, Markov Chain Monte Carlo (MCMC)**
  - **Resistant/Robust linking methods, violations of assumptions**
  - **How to analyse data sets (like TIMMS, PISA, etc.) when the "theta" score or some plausible value is in the data set.**
  - **Blending IRT and SEM**
  - **IRT and complex survey data …. Relevant in large-scale data sets …. Wonderfully challenging estimation problems**