INGenIous Vision

- Ensuring that the next generation of undergraduate and graduate students view the mathematical sciences as a vibrant choice ... and not just for academic jobs

- Positioning Mathematics and Statistics departments to create a workforce ready to meet 21st century challenges
Is there really a STEM workforce problem?
Is there really a STEM workforce problem?

Yes.

- STEM is not monolithic
- Uses of math/stats are broadening
- Diversity matters …
- See the report … www.ingeniousmathstat.org
INGenIOurS Goals

- **Planning ahead for a STEM workforce**: What exists now? What’s needed?

- **Implementation**: What do stakeholders want? How best to deliver? Any low-hanging fruit?

- **Investment**: Where to target support? High- vs low-risk strategies? Who benefits?
INGenIouS Themes

Six initial themes (much more in report):
- Recruitment & Retention
- Internships
- Job Placement
- Technology & MOOCs
- Documentation & Dissemination
- Measurement & Evaluation
INGenIOUS Threads

- **Thread 1:** Bridge gaps between business, industry, & government (BIG) & academia
- **Thread 2:** Improve students’ preparation for non-academic careers
- **Thread 3:** Build public awareness of role of math & stat in STEM & non-STEM careers
- **Thread 4:** Diversify incentives, rewards, & methods of recognition in academia
- **Thread 5:** Develop new curricular pathways
- **Thread 6:** Build & sustain professional communities
INGenI OuS “Deliverable”

A written (but not “write only”) report that:

- describes way(s) forward.
- addresses implementation from different stakeholders’ perspective.
- suggests high-priority initiatives, guidelines.
- describes INGenI OuS project work.
- lists and measures projects and project ideas, with “metrics”
NSF/DMS aims to help drive positive change

- Aims to stay aware of trends in the community and take input from many directions.
- Has already funded (as of 2014) some projects aligned with the INGenI0uS recommendations.
  - Example: PIC Math award to MAA/SIAM provides math sciences faculty with tools & training to help them better prepare students for BIG careers & will provide math sciences students with opportunity to conduct research on BIG problems. $2 million over 4 years for this national scale project.
- Responds to proposal ideas. It is a good idea to talk to a program officer first.
DMS programs focused on training for math/stat students

- DMS Workforce
  - Research Training Groups (June 2015) – u, g, p
  - Unsolicited Workforce proposals – u, g, p
  - Research Experiences for Undergraduates – u
  - Enriched Doctoral Training (July 2015) – g
New (2016) NSF IUSE program focused on undergraduate STEM training

- Agency-wide, not just EHR
- 135M … up 28%
- Improve STEM learning and environments … evidence-based methods
- Broaden participation
- Build STEM workforce “for tomorrow”
Thread 1: Bridge gaps between BIG & academia

- Acknowledge & address the interests & requirements of BIG employers in educational experiences in academia.
- Forge new & strengthen existing relationships; promote collaborations among academia and BIG.
  - Connect students to BIG internship opportunities.
  - Develop opportunities for student research experiences onsite with BIG employers.
  - Disseminate information regarding the math & statistics skills & competencies needed for BIG careers.
Thread 2: Improve students’ preparation for non-academic careers

- Math sciences students need career-appropriate preparation that emphasizes the centrality of math & stat to the STEM enterprise.
- Better career prospects in math & stat can boost recruitment and retention in the short term.
- Longer term increase in number of graduates who enter the workforce well equipped with math/stat skills & expertise.
- Change will be needed in curricula & in some faculty members’ perceptions & valuation of BIG careers for their students.
Thread 3: Increase public awareness of the role of math & stat in both STEM and non-STEM careers

- Faculty, students, AND the public at large.
- Professional organizations should undertake expanded, cooperative, and coordinated programs.
- Departments should include speakers from BIG as part of regular colloquia/seminars.
- Awareness activities should be started in K-12 with the preparation of future school teachers.
Thread 4: Diversify incentives, rewards, & methods of recognition in academia

- Review & revise promotion & tenure criteria to include a broader set of professional activities.
- Build one community with diverse faculty roles.
- BIG employers encourage, recognize, & reward math scientists who engage in workforce preparation.
- Professional organizations & funding agencies recognize exemplary programs & support replication.
Thread 5: Develop alternative pathways

- **Traditional** curricula & programs
  - Dominated by upper level theory courses
  - Need more focus on apps that reflect the complexity of BIG problems
  - Need more focus on big data applications, modeling, data analysis, visualization, high performance computing, & standard BIG technology

- Need to **modernize** curricula & programs
  - Alternative entry points besides freshman algebra or beginning calculus
  - Alternative options for major; interdisciplinary minors; professional master’s
  - Alternative remedial and general education pathways
Thread 6: Build & sustain professional communities

- A national community focused on workforce development to share information, resources, & best practices:
  - Current technology tools
  - Assessment & evaluation
  - Identify internships & improve job placement

- Implementation: Virtual and in-person communication tools
  - Electronic listserv, discussion board, workshops
  - On-site, multi-day sessions for academics at BIG entities during which they join a team working on existing problems
Six threads revisited

- Thread 1: Bridge gaps between business, industry, & government (BIG) & academia
- Thread 2: Improve students’ preparation for non-academic careers
- Thread 3: Build public awareness of role of math & stat in STEM & non-STEM careers
- Thread 4: Diversify incentives, rewards, & methods of recognition in academia
- Thread 5: Develop new curricular pathways
- Thread 6: Build & sustain professional communities
Questions for discussion

- What is the low hanging fruit here (i.e., the first things that ought to be done)?

- What are the barriers to implementation of any of these strategies?

- Are there other issues related to workforce development that need to be addressed by the community?
Other efforts: e.g., TPSE
www.tpsemath.org

- support from Carnegie and Sloan foundations
- sparked by MS 2025 and PCAST reports, 2012
- “undergraduate mathematics is main barrier …”
- about math and math ed, but also STEM workforce prep
- enlarge and diversify STEM career pipeline …
TPSE recommendations:

- Remove barriers; open pathways ... calculus the only way?
- Raise prestige/rewards of teaching in departments
- Broaden undergrad. experience: math, stats, cs, modeling ...
- More graduate training in teaching, mentoring, communication ...
Other efforts: Common Vision project

- Support from NSF, societies, …
- Stay tuned … …