

Opportunities for Statistical Collaboration with NASA: Some Personal Reflections

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Outline

- Some Personal Background
- My Background with NASA
 - LaRC
 - NESC
- Reflections
- Opportunities

Some Personal Background

- University of Florida
 - Typical Academic Career
 - Large Amount of Consulting
 - Through the University
 - Outside the University
 - Gates Aerospace Batteries: LEO – ISS Batteries

Some Personal Background

- Virginia Tech
 - Department Head
 - “Seven years of college down the drain.”
 - Corporate Partners Program
 - Consulting as a Full Professor
 - Pratt & Whitney
 - NASA LaRC
 - NESC
 - DoD
 - Mostly, Design of Experiments

My Background with NASA

- LaRC
 - Dr. Parker Was My Ph.D. Student
 - First Collaborations Were with the Atmospheric Sciences
 - Recently, Working on Calibration
 - ARES
 - AirSTAR
 - Force Measurement Systems
 - A.G. Davis System
 - Two Publications to Date

My Background with NASA

- NESC – COPV
 - Ultimate Question: Probability of Failure for a COPV at Use Conditions at Specific Time in Future
 - Design of Experiments for Reliability Data
 - DOE People Rarely Understand Lifetime Data
 - Reliability Experts Rarely Understand the Nuances of DOE
 - Initial Work: Testing “Strands”
 - Some Preliminary Work: Vessels

Reflections

- My Primary Involvement: Technical Expert
 - Some Work Helping to Define the Problem
 - Usually, Initial Work Already Done on Problem Definition
 - My Job: Refine and Clarify as Needed
 - Project Manager
 - Supervise Graduate Students
 - Administration
 - Provide Technical Guidance – Both for VT and NASA
 - “The Right Tool for the Right Job.”
 - Major Contribution: Big Picture

Reflections

- As a Rule, NASA Under-Utilizes Statistics and Statisticians
 - NASA Employs Very Few True Statisticians
 - Most Engineers/Scientists Have Limited Command of Proper Statistical Procedures
- A Large Amount of Mathematical Modeling, but Very Little Statistical Modeling
- Combination Can Lead to Questionable Practices

Reflections

- Very Little Statistical Thinking within NASA
 - All Work Occurs in Systems of Interconnected Processes
 - Variation Exists in All Processes
 - Keys to Success: Understanding and Reducing Variation
- Many NASA Statisticians Are Pure Data Analysts, Not Scientific Collaborators/Leaders
- Strong Agency Need for True Statistical Engineering and Statistical Leadership

Reflections

- Statistical Engineering and My Involvement
 - My Work with Dr. Parker: Statistical Engineering
 - Problem Selection
 - Decisions about Tactical Deployment
 - Focus on Big Picture and Value Added
 - Otherwise: Traditional Consulting
 - One Step Below Tactical
 - Focus on Reasonable Solutions to Specific Problems
 - Teaching Graduate Students to Consult
 - “Tool” in the Nascent Statistical Engineering Effort

Reflections

- Benefits to Date: Virginia Tech
 - Teaching Graduate Students to Consult with Practicing Engineers and Scientists on Real Problems
 - Students See: Good, Bad, Ugly
 - Publishing Research Papers Based on Real Engineering and Science Problems
 - Pride in Helping a Distinguished Gov. Agency

Reflections

- Benefits: NASA
 - Technical Support Not Available within the Agency
 - Limited Number of Statisticians within the Agency
 - Academics Often are the Leading Experts in the Field
 - Pipeline for Hiring Ph.D. Statisticians
 - Already Familiar with the NASA, Its Mission and Culture
 - Real Practical Experience with Agency Problems
 - Standard Benefits from University/Agency Collaboration

Opportunities

- Can Achieve Benefits Far Above Standard University/Agency Collaboration!
- Implement on a Broader Scale True Statistical Engineering
- Biggest Initial Contributions:
 - Statistical Thinking/Clear Problem Definition
 - Sound Structured Approaches to Solving Problems
- At Least Initially, Take Advantage of Academic and Professional Expertise

Opportunities

- NASA Technical Leadership Needs to Provide the Strategic Vision
 - Set Agency – Wide Goals and Objectives
 - Recruit Appropriate Personnel from within NASA
 - Manage the Entire Process
- “NASA Statistical Engineering Group”
 - Develop Tactical Plans to Achieve Strategic Goals
 - Manage Specific Projects Selected by Leadership

Opportunities

- NASA Deals Daily with Highly Complex Problems
- A Large Portion of These Problems Have Significant Statistical Components
 - Some Cases, Understood
 - Far Too Many Cases, Not Understood!
- Statistical Engineering Provides Tactical Deployment of Sound Statistical Practices to Support the Engineering/Scientific Method

Opportunities

- Complex Problems Require Appropriate Solutions
 - Team Approach to Solutions
 - Clear and Precise Problem Definitions
 - Avoid Errors of the Third Type!
 - Systems Thinking
 - Understanding Sources of Variation
 - Appropriate Data
 - Tactical Deployment of Analytics
- Statistical Engineering Is an Appropriate Approach!

Opportunities

- Implementing Statistical Engineering Is a Journey
- Academia and the Profession Can Provide Excellent Guides
- The Process Leads to Better Science and Engineering, Which Is Core to NASA's Mission