Statistical Influence

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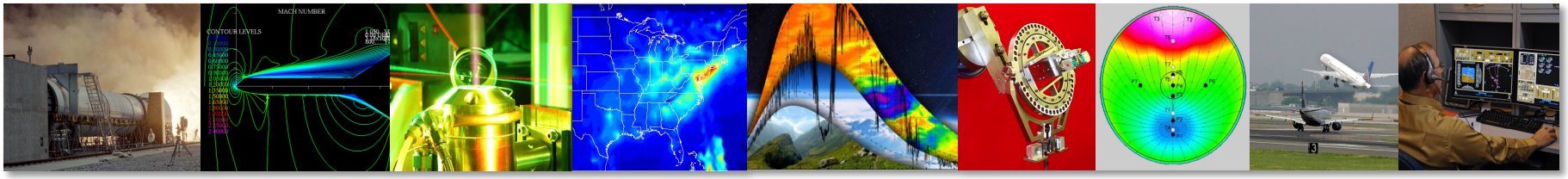
Langley Research Center

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Essence of Statistical Influence



"… influence denotes power whose operation is invisible and known only by its effects, or a power whose cause and operation are unseen." Webster (1828)

- **Statistical influence advances the spread and practice of statistics and enhances an organization's ability to successfully achieve their mission**
- **Statistical concepts become more widely known and engrained primarily through demonstration and impact**
- **Statistical influence at NASA is presented as a case study**

Webster, Noah (1828) American Dictionary of the English Language, United States, Editorium.

Maybe a more descriptive title

Organizational and Individual Statistical Influence



Maybe an even more descriptive title with a necessary qualifier

Positive Organizational and Individual Statistical Influence

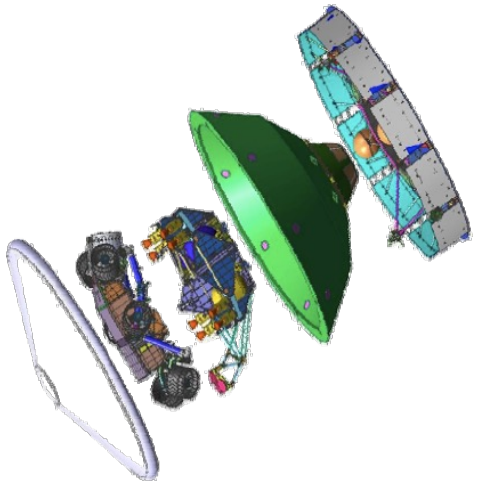
Within your organization:

Are statistical methods desired or feared?

Are they sought after or run from?

Are they the first or last consideration?

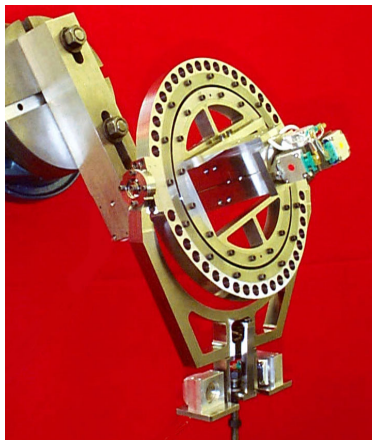
Opportunities for Statistical Influence



Mars Entry Measurements

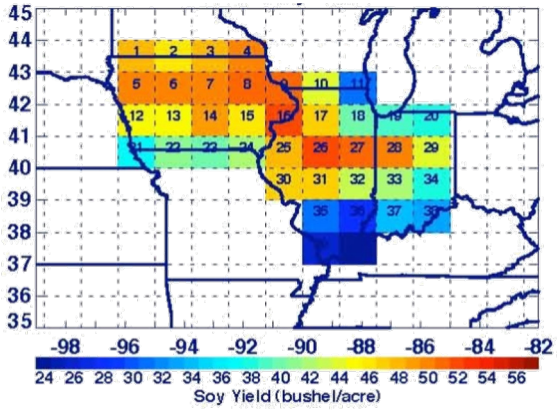


Rocket Characterization



Improving Instrumentation





Informing Crop Yields



Helicopter Capability

Statistical Influence on Decisions, or Not



The value of statistical methods is to extract insights and knowledge from data to empower decisions.

…many types of decisions throughout the organization

Decisions based on statistics and about statistics influence the spread of statistical practice

Statistical Influence in Collaboration



Consultation

Helping others understand a pre-defined problem in a larger system

Cooperation

Dividing a task among team members, where each person is responsible for a portion of the problem solving

Collaboration => Most Influence

Mutual engagement to identify and solve a problem together with a common goal

Communication is a critical skill for collaboration and influence

Anderson-Cook, Lu, Parker (2018) "Effective Interdisciplinary collaboration between statisticians and other subject matter experts," *Quality Engineering*.

Evidence of Statistical Influence



- **Broad awareness and appreciation of statistical concepts**
- **Becoming common language in project planning and execution**
- **Ubiquitous practice**
- **Motivating applied statistical research**
- **Academic collaboration and infusion**
- **Influencing other organizations and communities of practice**

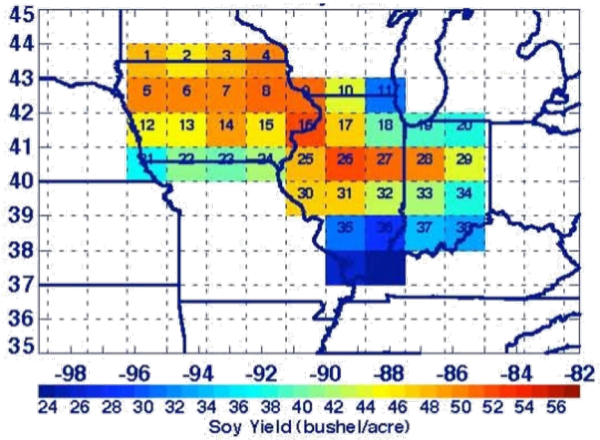
Examples of Statistical Influence



Rocket motor performance characterization

Restricted randomization, five-factor, second-order inverse prediction response models

Statistical Influence: An experiment starts with research questions, not data acquisition



Satellite models for agricultural decision support

Multiple data scale and fidelity modeling, multiple linear regression, spatial, temporal, and seasonal correlation structures

Statistical Influence: A model that captures more than pairwise correlation

Subtle, Long-Term Impact by Changing Thinking and Practice

Fishman, et al. (2006), "An Investigation of Widespread Ozone Damage to the Soybean Crop in the Upper Midwest Determined from Ground-Based and Satellite Measurements," *Atmospheric Environment*, 44, pp. 2248-2256.

Objective(s) of Statistical Influence

Defining what success looks like depends on the objective

Organizational Practice

Broad awareness, acceptance, practice, and impact. Achieves the longest, broadest impact of statistical thinking and practice

Team of Experts

Necessary and supportive, but it can be in opposition to broad organizational impact

Personal Career Goals

Important, motivating, but if the sole objective, it can limit organizational influence

Concluding Remarks

- **Illustrated aspects of statistical influence at NASA**
- **Broad, long-term influence is built on impactful demonstrations, some seemingly inconsequential**
- **Influence is evidenced by awareness, practice, research, education, and influence on other organizations**
- **Recognizing competing organizational and individual objectives is vital to realizing sustained influence.**

Advancing the spread and practice of statistics occurs through statistical influence, a strategy known only by its effects.