

# Statistical Consulting 0000.00

Bertram Price, PhD

- Education
- Career Path (A Winding Road)
- Engaging Consulting Engagements
  - The Anthrax Letters
  - Future Claims Estimation in Toxic Tort Cases
  - Apportion Risk among Multiple Causal Risk Factors
- A Few Suggestions from the Consultant's Handbook
  - Mind your p-values and confidence intervals
  - Plausibility Review (avoid unintended LOL inferences)
  - Risk Communication (Can you explain the results of your analyses?)



## Education

- Wittenberg (1957-1961) BA Math
- Ohio State Graduate School (1962-1969) PhD Math/Statistics



# Ohio State Graduate School (1962-1969) PhD Math/Statistics

- Notable Faculty
  - Henry Mann (Algebraist; Design of Experiments)
    - Serious; no-nonsense; fearsome (however, kind and a humanist, I was told)
  - D. Ransom Whitney (Statistics)
    - Mann-Whitney U-statistic
    - Math Department Chairman; instrumental in establishing the Statistics Department
    - Founder and Director of the statistics lab (consulting function for faculty and graduate students across the university)
  - Jagdish Rustagi
    - Enthusiastic; a great sense of irony; an inspiration - made anything and everything seem possible



## Career Path

- 1969-1969 LEDERLE LABS (WYETH - PFIZER)
- 1969-1972 IBM
- 1972-1976 NEW YORK UNIVERSITY
- 1976-1979 THE CONTINENTAL GROUP
- 1979-1984 BATTELLE MEMORIAL INSTITUTE
- 1984-1987 MARSH & MCLENNAN COMPANIES
- 1987 – present: PRICE ASSOCIATES, INC.

# Battelle

- The world's largest, independent research and development organization
- Large multidisciplinary science-based projects most often sponsored by government agencies
- Joined Battelle-Columbus Labs in 1979
  - Objective: build a viable statistics group
  - Tom Bishop joined and was an invaluable partner in the development of the soon-to-be-formidable Applied Statistics Group
- Statistics at Battelle-Columbus in 1979
  - viewed as a service function;
  - statisticians not consulted until it was too late
  - project budget for statistics was an afterthought and almost always inadequate



# Emerging Philosophy of the Presumptuous Statistician in 1979

- Projects are collaborations
- Accept/take overall responsibility for study designs (more than statistical design of experiments/surveys and more than applying the “correct” statistical analysis procedures)
  - Measurement methods: address detection limits, calibration, replication, overall quality assurance
  - Data collection: randomization/probability sampling
  - Statistical sufficiency: statistical power; statistical significance versus meaningful substantive significance (e.g., biological significance)
- Requirements
  - Learn essential features of your collaborator’s science
  - Know enough for meaningful discussions about magnitudes of effects that are important



# Expansion of the Applied Statistics Group at Battelle Columbus

## Subtitle: Did the Presumptuous Statistician's Philosophy (PSP) Work?

- 1979-1981: Worked with EPA's Office of Toxic Substances (OTS) on Study Design and Statistical Analysis
  - Funded through contracts EPA had with other Battelle departments
  - OTS, the initial target of our PSP agenda, concluded that a direct contract with statisticians (especially Battelle statisticians) would be beneficial to the successful realization of EPA/OTS program objectives
- We responded to an EPA RFP for a Task Order Contract
  - \$6.8 million contract awarded to Battelle (the Applied Statistics Group)
  - Statistics at Battelle-Columbus was (remarkably) viewed in a new light
  - We continued to work on EPA projects with other Battelle departments, but with our new source of independent funding and with leverage from the sponsor (EPA/OTS) to exercise our newly-defined responsibilities
- PSP worked!



# A Career Epiphany

- The 1982 Battelle Management Development Seminar in Seattle
  - “So, you won that large contact; let’s see how you’re going to do at managing it and your growing staff!”
  - WHOA! The “walk-around manager” days were gone.
- Announcement: The former Battelle-Columbus Applied Statistics Group has become the Office of Statistical Studies
  - Bert Price, now Director of the Office of Statistical Studies, which includes the Applied Statistics Group, is moving his office to Washington DC
  - Effective immediately, Tom Bishop is promoted to Manager, Applied Statistics Group, and will have day-to-day responsibility for its operations in Columbus.
- The die was cast!
  - I was on my way to forming Price Associates, Inc.
  - Tom’s epiphany? (Thomas A. Bishop & Associates)



## Price Associates Inc. (PAI)

- Small size (minimizes staff management and typical business management issues, both necessities in a large organization)
  - One principal scientist
  - Between 3 and 5 researchers
- First few years – government contracts, mostly EPA
- Starting around 1990, switch to mostly private sector clients
- Office Locations
  - K Street, Washington, DC (1987-2000)
  - North Broadway, White Plains, NY (2001-2009)
  - Mountain Ave., Bar Harbor, ME (since March 2009)

# Engaging Consulting Engagements

- The Anthrax Letters
- Future Claims Estimation in Toxic Tort Cases
- Apportion Risk among Multiple Causal Risk Factors



## The Anthrax Letters (October 2001)

- Letters containing bacillus anthracis (anthrax spores)
  - Postmarked September 18 2001 mailed to:
    - ABC News, CBS News, NBC News, and the New York Post, all in New York City
    - National Enquirer at the American New Media Building in Florida
  - Postmarked October 9 2001 mailed to Washington DC Senate Offices:
    - Senator Tom Daschle (South Dakota)
    - Senator Patrick Leahy (Vermont).
- Potentially Affected Population
  - Workers handling mail where envelopes were received
  - All postal workers at mail facilities downstream from facilities where envelopes containing anthrax spores were first processed
  - The public if received mail processed at contaminated facilities
- Cases –
  - 22 people developed anthrax infections
  - 11 were life-threatening inhalational anthrax
  - 5 deaths

## The Anthrax Letters (October 2001) continued -

- Interpreted as a Terrorist Attack
- National Response Team for Anthrax – Command Center in Washington
  - United States Postal Service (USPS)
  - Centers for Disease Control (CDC)
  - Environmental Protection Agency (EPA)
  - Occupational Safety and Health Administration (OSHA)
  - Association of Public Health Laboratories (APHL)
  - LMI Consultants
  - Environmental Engineering Contractor URS
  - US Army Corps of Engineers (USACE)



## The Anthrax Letters (October 2001) continued

- My Assignment
  - Design a sampling and analysis program to screen downstream USPS facilities for the presence of BA spores
  - Purpose: Collect surface samples to estimate loading of BA spores
- A Sample Size Problem
- Factors
  - Dose-response (probability of disease as a function of number of spores inhaled)
  - Airborne concentration of spores relative to surface loading of spores
  - Locations for sample collection within a facility
  - Collection efficiency of sampling method for surface loading of spores
  - Reliability of laboratory analysis method for BA spores
- The Sample Dilution Issue



# Future Claims Estimation in Toxic Tort Cases

- Background
  - Exposure to an environmental or occupational contaminant causes disease (e.g., radiation, PCBs, agent orange, benzene, asbestos)
  - Individuals with disease sue parties allegedly responsible for the exposures
  - Those parties (companies) want to estimate the number of future claims (law suits) for various financial planning and reporting reasons
- Example: Asbestos and Mesothelioma
  - Project future medical cases of mesothelioma over time
  - Separate into (i) background cases and (ii) those likely to have been caused by asbestos
  - Estimate and apply a “propensity-to-sue” factor (may vary with time)
  - Estimate administrative costs of managing claims including litigation costs
  - Estimate payments to settle claims and the size of damage awards if a claim is litigated and the verdict is for the plaintiff



# Apportion Risk among Multiple Causal Risk Factors

- Multiple causal risk factors – the rule, not the exception
- Apportionment Methodology: Determine the contribution of each risk factor, including interactions among factors, to the occurrence of a disease or other type of event
- Applications
  - public health objectives
  - compensate individuals fairly who have been injured or made ill by government activities
  - Determine through the legal system an equitable portion of monetary damages to be paid by each of possibly many parties responsible for a disease case's exposure to one or more causal risk factors

# A Few Suggestions from the Consultant's Handbook

- Mind your p-values and confidence intervals
- Plausibility Review (avoid unintended LOL inferences)
- Risk Communication (Can you explain your own results?)





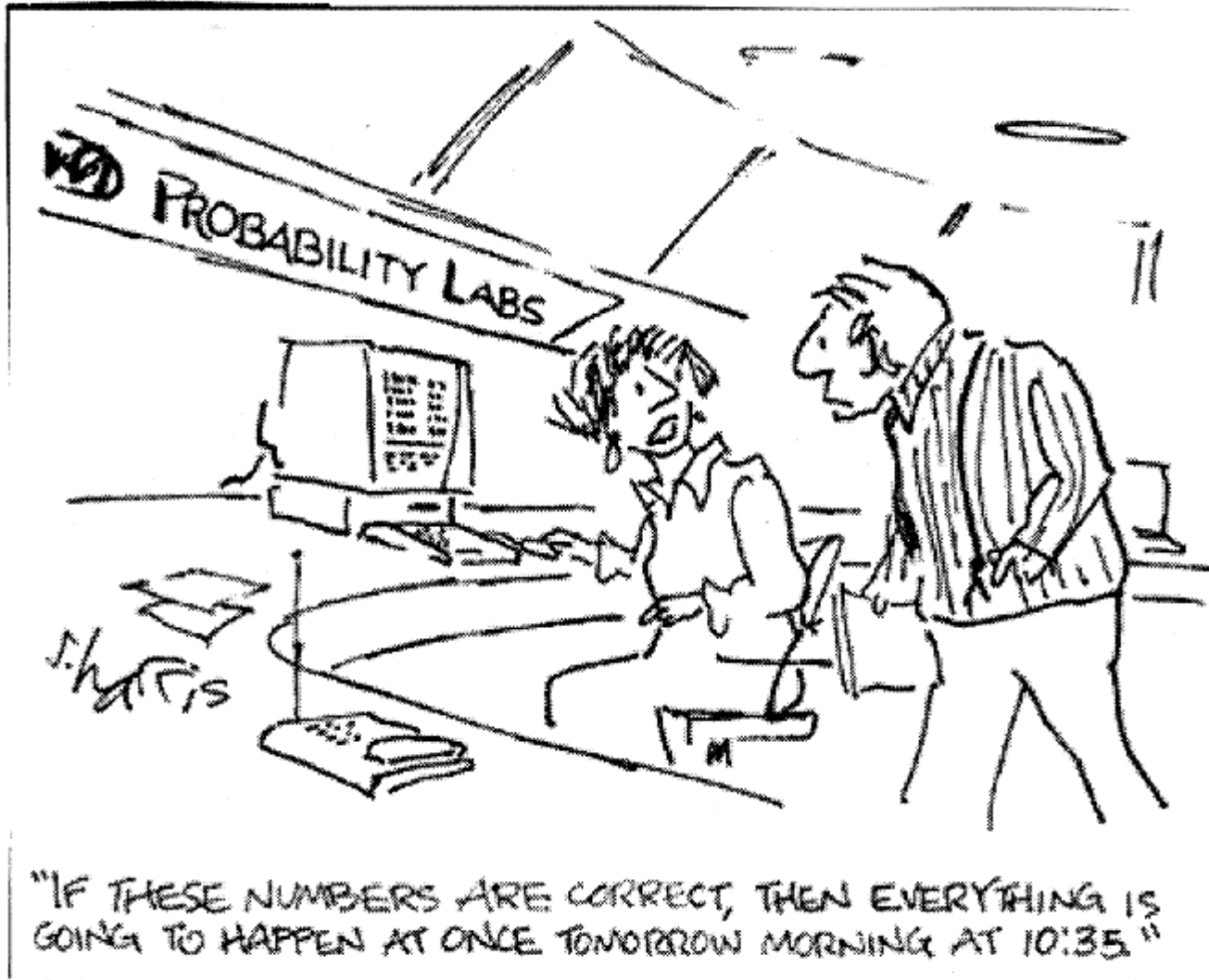
# Mind your p-values and confidence intervals

- Reference: Sander Greenland and Charles Poole, Problems in Common Interpretations of Statistics in Scientific Articles, Expert Reports, and Testimony, 51 *Jurimetrics J.* 113–129 (2011).
- P-value = 5% chance of error does not mean 95% confidence that the conclusion is correct
- How important is randomization and probability sampling?
- Carefully interpreted descriptive data are valuable, but don't tacitly overstate their "significance."



# Plausibility Review (avoid unintended LOL inferences)

Establish Your Credibility: Check/Test Your Results and Conclusions





# Plausibility Review continued -

- Ask yourself the following questions and have answers before your client asks the same questions:
  - What assumptions did you employ, what assumptions are implicit in your analysis methods, and how would your results or interpretation of those results be different if your assumptions were different?
  - What variables were not considered or averaged out?
  - Are the results consistent with results from other similar studies; if not, why not?
  - Are the results consistent with what your client expected? If not, why not?
  - Other than your interpretation of the results, how else might the results be interpreted. What unintended conclusions might be suggested by your results?
- Example: NYC skyscrapers and asbestos



## Risk Communication

What are the analyst/statistician communication responsibilities?

- Three choices
  1. Just the facts Ma'am
  2. Try to explain/interpret the facts you developed
  3. Alan Greenspan Disciple
    - “I guess I should warn you, if I turn out to be particularly clear, you've probably misunderstood what I've said.”
- Recommendation: Try to explain/interpret the facts
  - for yourself (What action would you take based on the facts you developed?)
  - Role play: Advisor (interpret results; develop scenarios and assign probabilities)
  - Role play: Decision-maker (what action, if immediate action must follow)



# Risk Communication Examples in Health Care Reform

- Health Care Reform (Tame Medical Expenses; Implement Evidence-Based Medicine)
  - Evaluate diagnostic tests (false positive rate; false negative rate; interpretation for treatment)
  - Evaluate treatments/medical procedures (effectiveness; risks)
- Examples
  - PSA test for prostate cancer
  - Endarterectomy to reduce plaque blockage in arteries



# Prostate-Specific-Antigen (PSA) Test for Prostate Cancer

- October 7 2011: The U.S. Preventive Services Task Force (USPSTF) recommends against PSA screening for prostate cancer - - "there is moderate or high certainty that the service has no net benefit or that the harms outweigh the benefits."
  - <http://www.uspreventiveservicestaskforce.org/>
- Components of this Risk Communication
  - Prob [Cancer |PSA level]
  - The screening test:
    - Blood test to measure PSA (a protein)
    - Nominal recommended normal range (established as less than 4.0 ng/ml)
  - Measure PSA
    - Measurement method sensitivity (Prob [Test > 4|True level > 4])
    - Measurement method specificity (Prob [Test < 4|True level < 4])
- Additional Risk Communication Components
  - Prob[“Cure”| treatment] for alternative treatments
  - Prob[Side effects| treatment] for alternative treatments



# Carotid Endarterectomy

- A surgical procedure to remove plaque build-up from the carotid artery and prevent stroke
- Tests: stethoscope, ultrasound, magnetic resonance angioplasty
- Recommendation
  - Recommended if blockage exceeds 50%; 60% in asymptomatic cases (i.e., primarily cases with no previous stroke and few, if any, other risk factors)
  - Strongly recommended if blockage exceed 80%
- Risk of stroke without intervention
  - Depends on risk profile (i.e., other risk factors)
  - Blockage %
- Consequences of stroke
  - Brain damage
  - Paralysis
  - Death

## Carotid Endarterectomy continued -

- Risks during surgery at the Cleveland Clinic (10 years; 2637 patients)
  - Stroke resulting in brain damage or paralysis: 1.7%
  - In-hospital deaths: 0.5%
  
- Risks during surgery at White Plains Hospital Westchester County NY, Dr. Anonymous team (3 years; 300 patients)
  - Stroke resulting in brain damage or paralysis: 1%
  - In-hospital deaths: none
  
- Risks during surgery for asymptomatic patients
  - Stroke resulting in brain damage or paralysis: ??
  - In-hospital deaths: ??





"OUR STATISTICIAN WILL DROP IN AND EXPLAIN WHY YOU HAVE NOTHING TO WORRY ABOUT."