Statistical Analysis and the Illusion of Objectivity

Thesis: To show that objective data needs subjective input to reach sensible conclusions.

Two reasons for subjectivity:
1) Bayesian analysis yield answers which are much easier to understand, less likely to have misinterpretation.
2) Standard Statistical methods depends on the intentions of the investigator (the subjective input arises from the producer rather than the consumer of the data)

Setting up the “Experiment”

Study: to find the effectiveness of Vitamin C in treating the common cold
Null Hypothesis (H): Vitamin C has no effect on the common cold
Subjects: 17 matched pairs
Results: 13 pairs (C) was better than (P)
(C) Vitamin C ; (P) Placebo

Caution:
♦ What were the motives of the investigators?
♦ How do people interpret these p-values?

Solution:
♦ Bayesian statistics produce “final probabilities” that can be compared.

Standard Statistical Methods

1) Identify null-hypothesis and derive probability distribution
2) Let $R$ denote the set of possible observations that cast as much or more doubt on $H$
3) Calculate the P-value (observed significance level)

Bayesian Approach

1) Choose initial probability (.01 to .09)
2) Calculate final probability (complex equation)
Uneasiness

*Standard:* P-value hides choices (subjectivity) of investigator  

*Bayesian:* depends on subjectivity of consumer, expert, or your personal beliefs

*Standard:* P-values change based on observations  

*Bayesian:* greater flexibility; not based on observations

Bayesian Method & Subjectivity

**Advantages**

- Probabilities can be calculated and reported any time
- Experimental plans can be modified at any time (with no lose in drawing valid statistical conclusions)
- Experiments can be evaluated and planned on the basis of current probabilities, maximizing the amount of information to be gained at a fixed cost
- Different experiments can be combined to arrive at a final probability.
- Many problems arising in fields can be vitally important to involve the subjective information possessed by the decision-maker

Conclusion

*Note:* Bayesian gives similar results in most situations

**Two Main situations:**
- Testing of precise hypothesis
- Accumulating data (clinic trials)