THE GREAT DEBATE
BAYES vs. FREQUENTISTS

TRYING TO SHOW THAT

ONE METHOD IS ALWAYS RIGHT $\longleftrightarrow$ THE OTHER METHOD IS ALWAYS WRONG

IS COUNTER-PRODUCTIVE

EXAMPLE: THE BAYESIAN CRUSADE AGAINST CLASSICAL GOODNESS-OF-FIT

BAYES 1 NO STOPPING RULE:

FOR BAYESIANS – THE CONDITIONS UNDER WHICH AN EXPERIMENT IS PERFORMED SHOULD NOT ENTER INTO THE CALCULATION OF SIGNIFICANCE

EXAMPLE: 17 PEOPLE TAKE VITAMIN C → 13 GET BETTER; → 4 DO NOT

CLASSICAL SIGNIFICANCE DEPENDS ON STOPPING RULE

WHAT IS FIXED? 17, 13, OR 4?

BAYES 2.

THE LIKELIHOOD PRINCIPLE

- ALL RELEVANT INFORMATION IS CONTAINED IN LIKELIHOOD FUNCTION
- RESULTS CANNOT DEPEND ON DATA YOU COULD HAVE OBSERVED BUT DIDN'T

Q: IS THE SUN SHINING?
A: I DIDN'T SEE THE SUN
Q: DID YOU OPEN YOUR EYES?
A: IT DOESN'T MATTER!

BAYES 3

PRIOR PROBABILITIES

EXAMPLE: THE REINDEER IN THE ALPS.

FINNISH PHYSICIST:

"FRED, THEY LOOK LIKE REINDEER,
BUT THEY ARE NOT REINDEER,
BECAUSE THERE ARE NO REINDEER HERE."

LESSON: DON'T PUBLISH SUBJECTIVE CONCLUSIONS

PUBLISH OBSERVATIONS EVALUATED OBJECTIVELY

WHAT CAN WE USE FROM BAYESIAN STATISTICS?

PEOPLE (INCLUDING PHYSICISTS) USE BAYESIAN REASONING

- IN EVERYDAY LIFE
- IN DECISION-MAKING
- WHEN IT IS REASONABLE TO USE APRIORI BELIEFS

SUMMARY

FREQUENTIST METHODS STILL OFFER THE ONLY WAY TO PRESENT EXPERIMENTAL RESULTS OBJECTIVELY WITH THE USUAL SCIENTIFIC MEANING.

BUT

- BAYESIAN METHODS ARE GOOD FOR DECISION MAKING.
  DO PHYSICISTS MAKE DECISIONS?

- BAYESIAN METHODS ARE GOOD FOR BETTING
  DO PHYSICISTS MAKE BETS?

- BAYESIAN METHODS ARE GOOD WHEN THERE IS A PRIOR PROBABILITY OR PHASE SPACE
  MAXIMUM ENTROPY METHOD

- BAYESIAN METHODS ARE A GOOD WAY TO COMBINE NEW KNOWLEDGE WITH PRIOR BELIEFS.
  DO WE DO THIS?

WHAT I WOULD LIKE TO SEE:

1. PHYSICISTS LEARN THE VOCABULARY OF STATISTICS

2. ASSUMPTIONS, METHODS, APPROXIMATIONS CLEARLY SPECIFIED IN PUBLICATIONS

3. FELDMAN/COUSINS IN ALL SEARCHES

4. BAYESIAN DECISION THEORY IN POLICY DECISIONS