

MAY 23, 2025

SESSION 23 SUMMARY



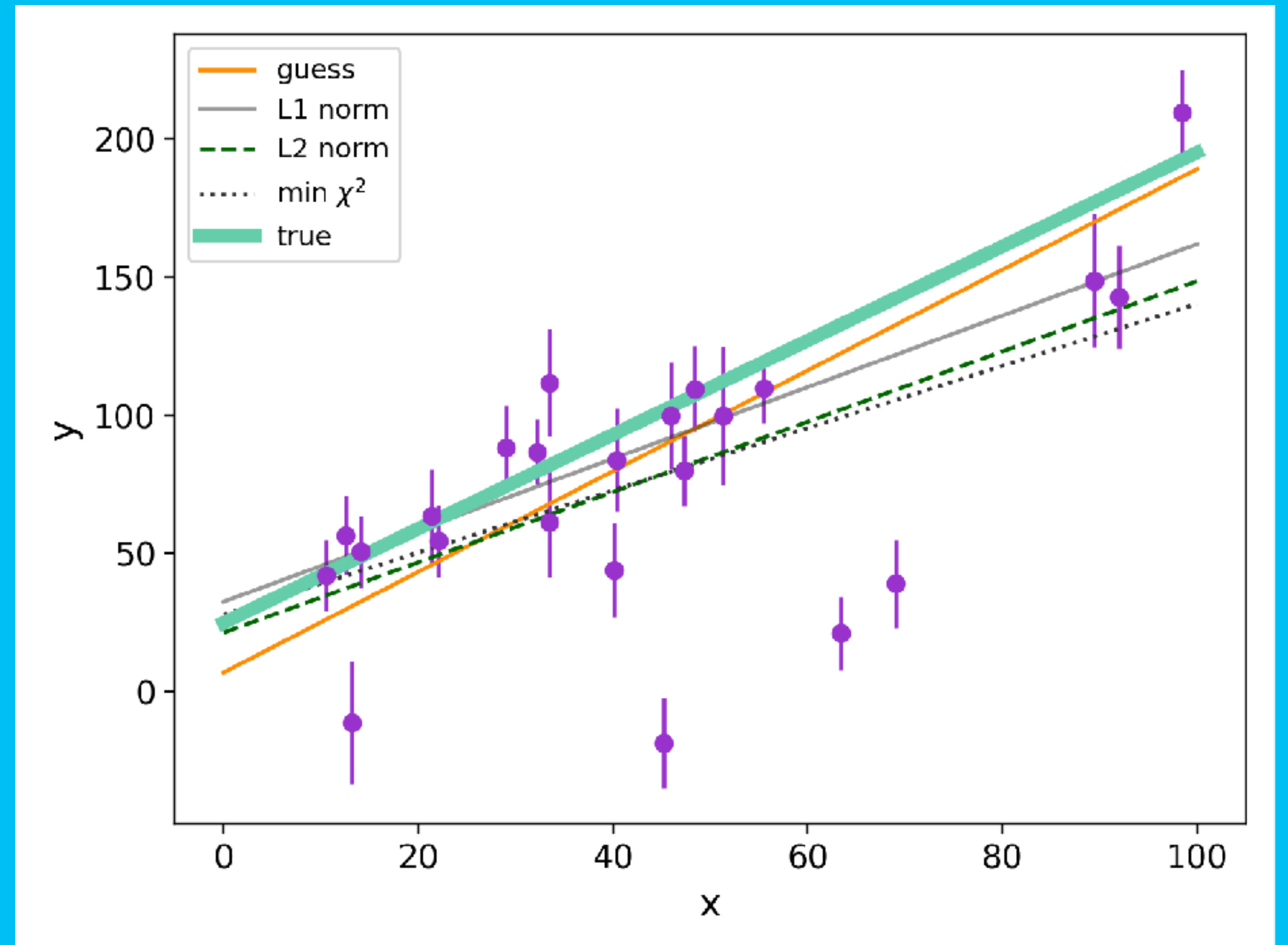
DR. ADAM MILLER

CLASSICAL INFERENCE AND METROPOLIS HASTINGS

**WE USE PROBABILITY TO DETERMINE THE MODEL
PARAMETERS THAT ARE MOST LIKELY TO HAVE
GENERATED THE OBSERVATIONS**

WE CONNECT MODELS TO DATA VIA THE LIKELIHOOD

MCMC COLLECTS SAMPLES PROPORTIONAL TO THE
POSTERIOR. THIS PRESENTS A WONDERFUL OPPORTUNITY
FOR ASTROPHYSICAL EXPERIMENTS (WHICH HAVE
DETECTORS THAT ARE DIFFICULT TO PERFECTLY
CALIBRATE) AS IT IS EASY TO QUICKLY MARGINALIZE OVER
NUISANCE PARAMETERS AND DETERMINE THE
PROBABILITY DISTRIBUTION FOR THE MODEL PARAMETERS
THAT YOU ULTIMATELY CARE ABOUT.



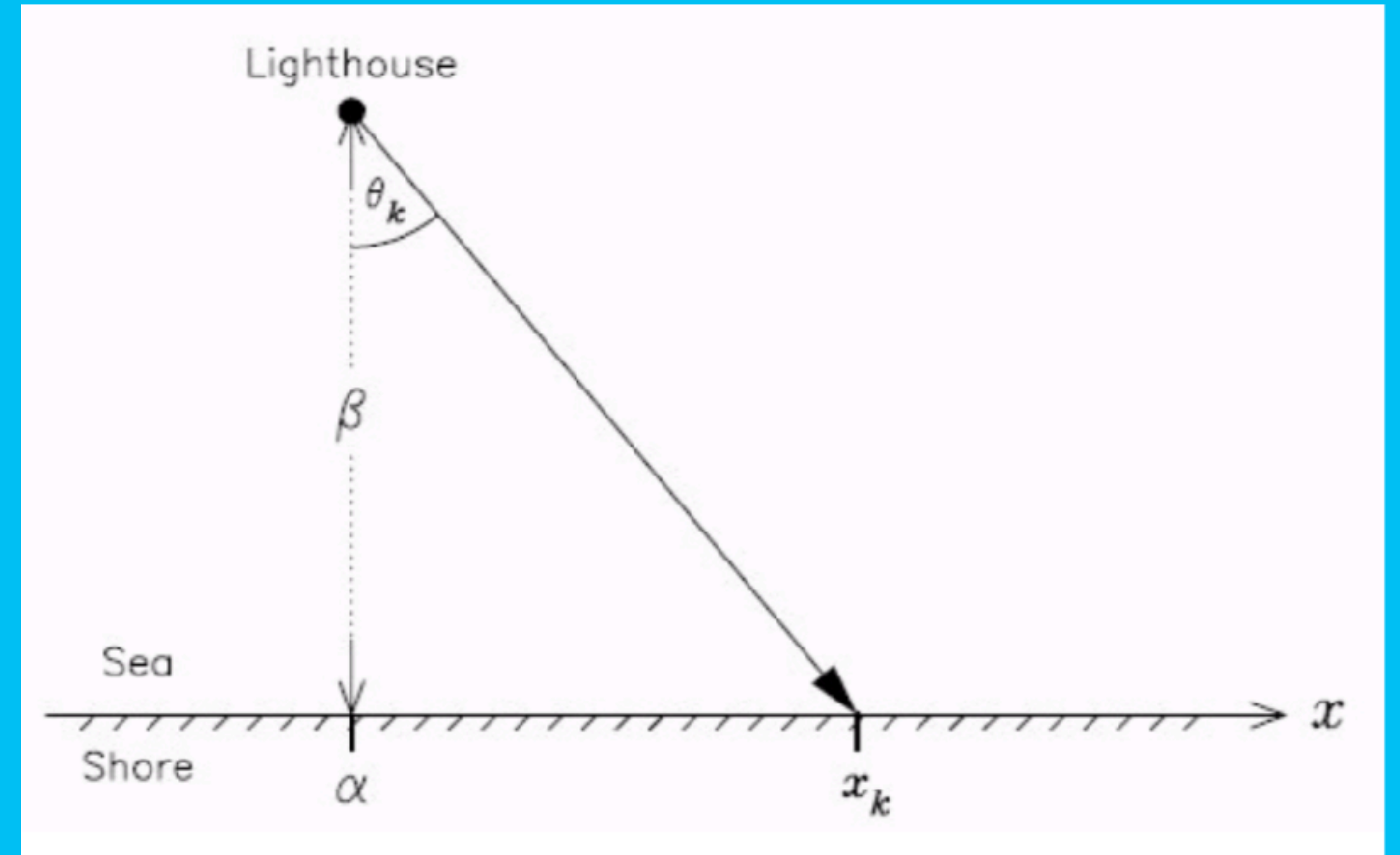
DR. BRYAN SCOTT

PROBABILITY, POSTERIORS, AND ALL THAT

PROBABILITY IS DEFINED BY AXIOMS, WITH DIFFERENT POSSIBLE INTERPRETATIONS. YOU CAN CHOOSE WHICH TO USE, BUT THE BAYESIAN ONE IS MOST COMMON IN ASTRONOMY TODAY.

HOW YOU PARAMETERIZE A PROBLEM IS IMPORTANT. YOU MAY NEED TO APPLY THE TRANSFORMATION FORMULA IF YOU CHANGE HOW YOUR PARAMETERIZATION. A FLAT PRIOR IN ONE IS NOT NECESSARILY A FLAT PRIOR IN ANOTHER.

PRIORS CAN BE CHOSEN BY ASSUMING SYMMETRIES OF A PROBLEM, LIKE SCALE, PARAMETER, OR SHIFT INVARIANCE, OR BY THE MAXIMUM ENTROPY PRINCIPLE.



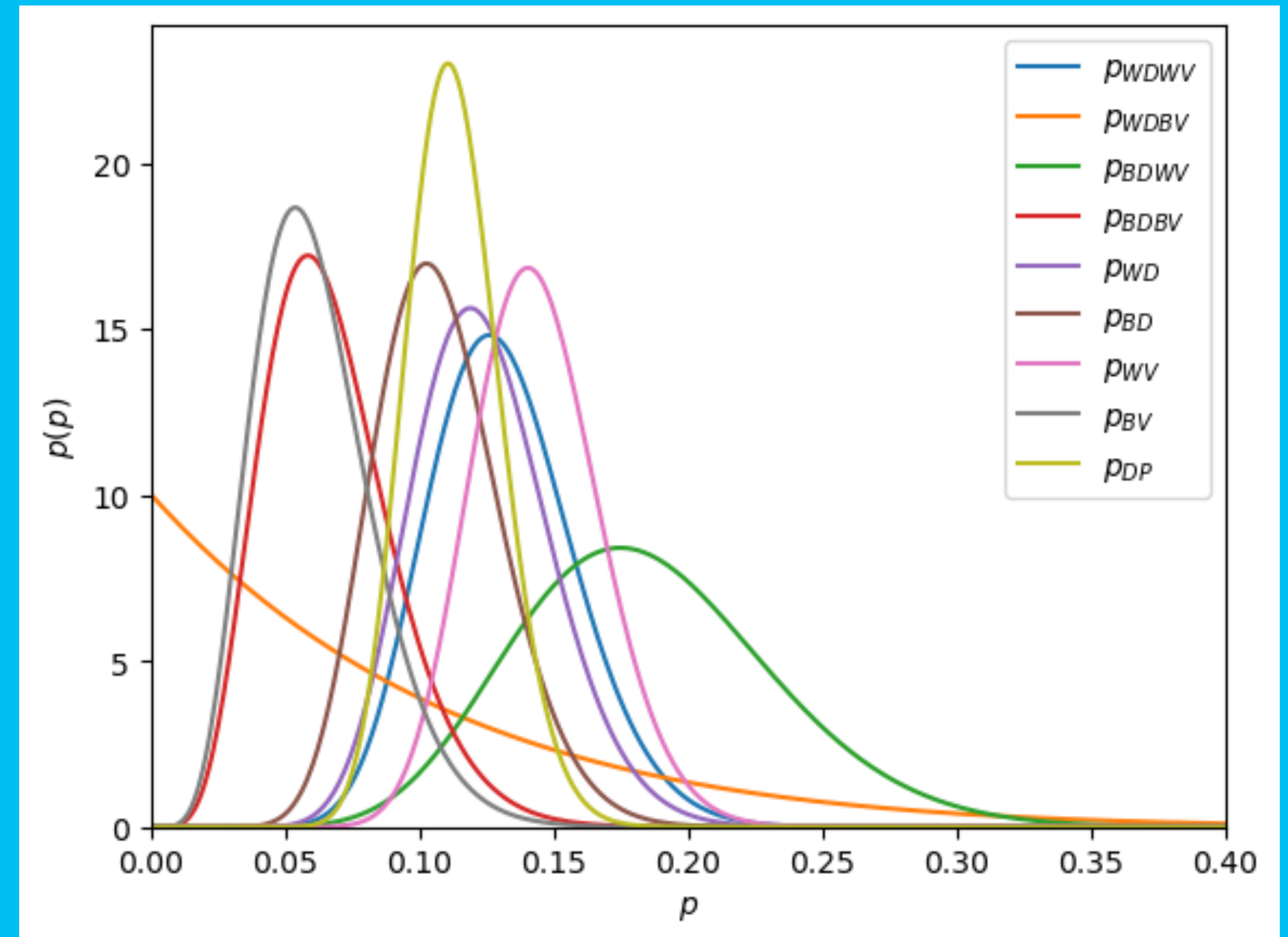
DR. SYLVIA BISCOVEANU

BAYESIAN INFERENCE AND MODEL COMPARISON

THE BAYESIAN INFERENCE FRAMEWORK ALLOWS FOR ROBUST UNCERTAINTY QUANTIFICATION AND RELIES ON UPDATING “PRIOR BELIEFS” BASED ON DATA/OBSERVATIONS.

BAYESIAN EVIDENCES ARE A POWERFUL TOOL FOR MODEL COMPARISON, BUT CARE MUST BE TAKEN WHEN CHOOSING PRIORS TO ENSURE THAT COMPARISONS ARE MEANINGFUL.

DON'T UNDERESTIMATE THE POWER OF VISUAL CHECKS FOR MODEL MISSPECIFICATION.



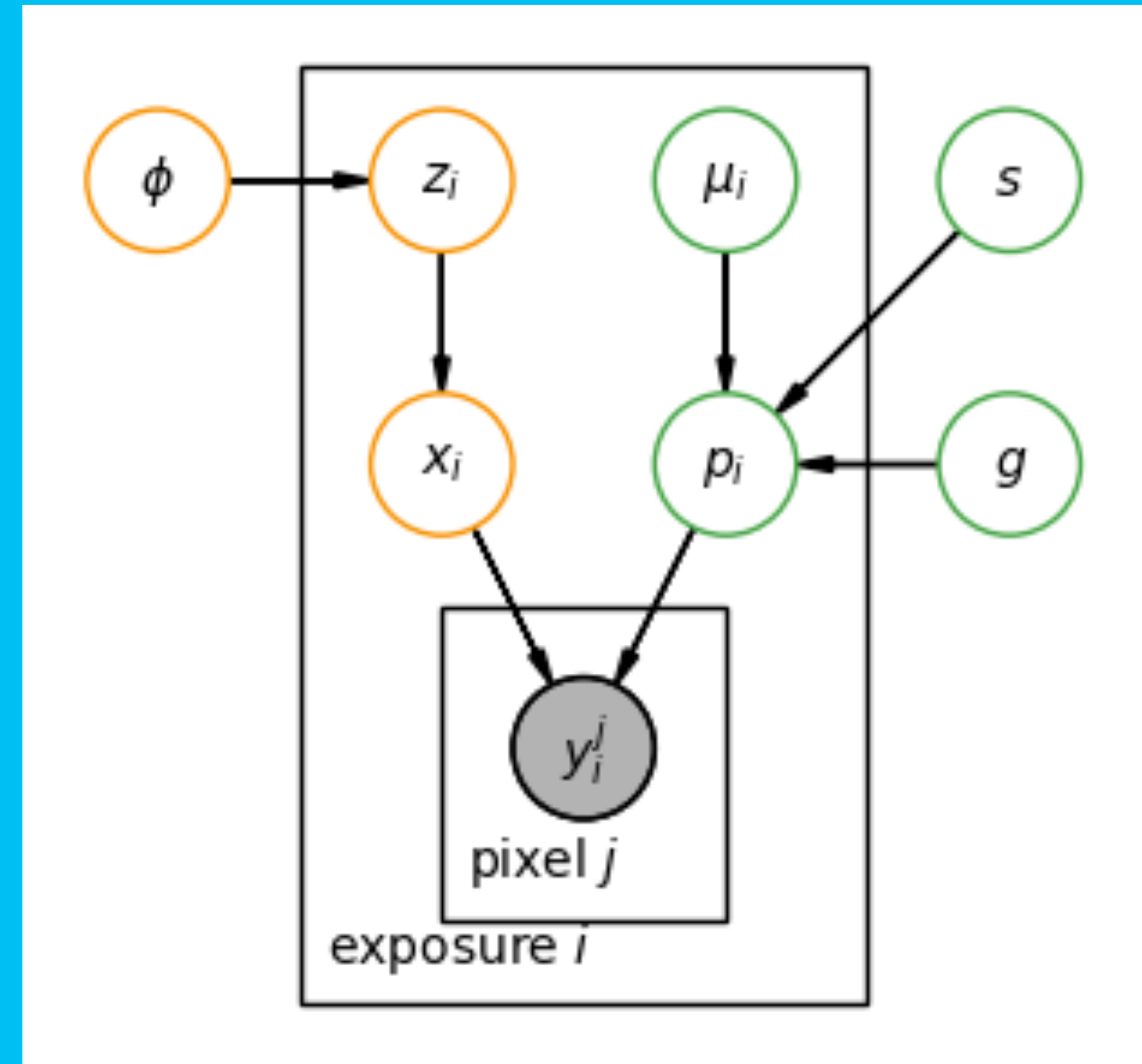
DR. CHAD SCHAFER

PROBABILISTIC GRAPHICAL MODELS

PGMS ENCODE A DECOMPOSITION OF THE JOINT DISTRIBUTION OF RANDOM VARIABLES INTO A PRODUCT OF CONDITIONAL DISTRIBUTIONS, THUS PROVIDING A WAY TO VISUALIZE THE DEPENDENCE STRUCTURE IN AN ASSUMED MODEL.

PGMS ARE ESPECIALLY USEFUL IN THE BAYESIAN FRAMEWORK FOR INFERENCE, WHEREIN MULTIPLE LAYERS OF PARAMETERIZED PRIORS CAN BE CHARACTERIZED EASILY, IN AN HIERARCHICAL MODEL.

PGMS DEPICT A GENERATIVE PROCESS FOR THE OBSERVABLE DATA, WHICH CAN THEN BE USED AS PART OF AN INFERENCE PROCEDURE, E.G., MCMC.



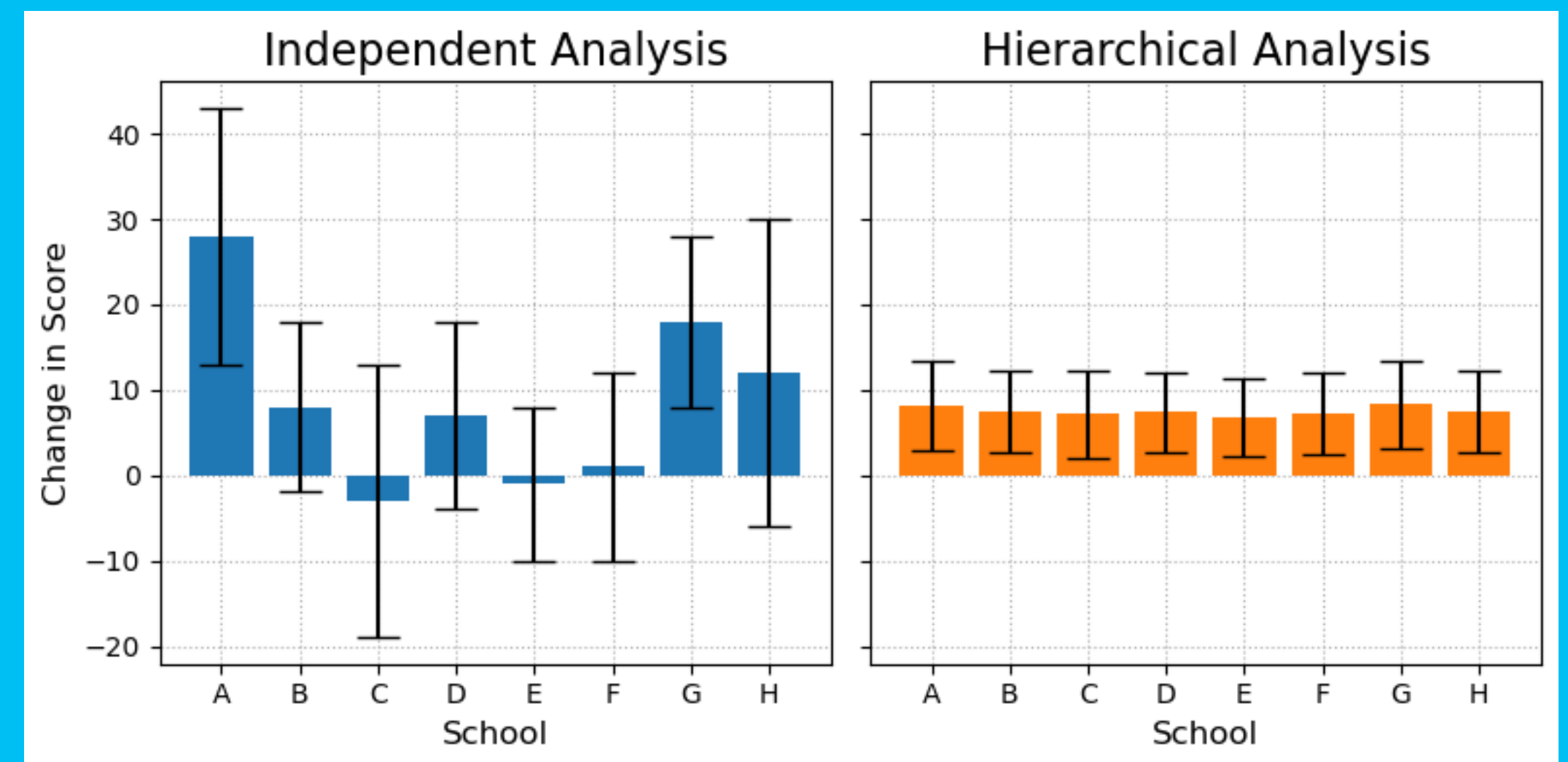
DR. GREG GILBERT

SAMPLING AND HIERARCHICAL MODELS

MODEL BUILDING IS ABOUT MAKING CHOICES.

DON'T WORRY SO MUCH ABOUT FINDING THE SINGLE "BEST" MODEL. TRY A BUNCH OF DIFFERENT THINGS (PRIORS, MODEL SPECIFICATIONS, SAMPLERS, ETC.) AND CHECK THAT YOUR RESULTS ARE QUALITATIVELY CONSISTENT. ROBUST RESULTS ARE RELATIVELY INSENSITIVE TO SPECIFIC MODELING CHOICES.

ALWAYS STATE YOUR ASSUMPTIONS CLEARLY. YOUR RESULTS ARE ALWAYS CONDITIONED ON SOME MODEL, WHICH YOU SHOULD MAKE AS EXPLICIT AS POSSIBLE.



SESSION 24: IMAGE PROCESSING FOR WIDE FIELD SURVEYS

**DATE AND LOCATION ~TBD
(BUT PROBABLY MID-LATE AUGUST)**



**SAFE, COMFORTABLE,
AND PLEASANT TRAVELS
HOME**
