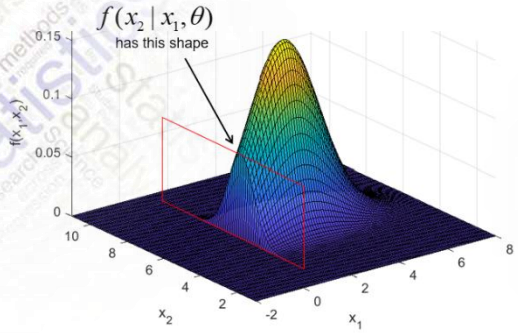
MARQUETTE UNIVERSITY

BE THE DIFFERENCE.

MATH 4790/MSSC 5790 – FALL 2025

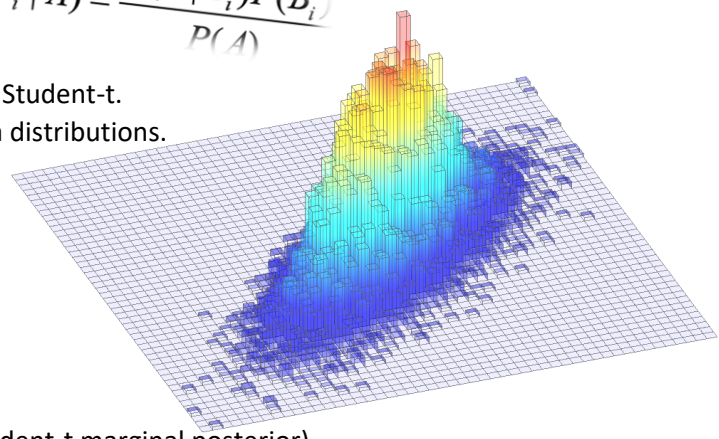
Bayesian Statistics

TuTh 3:30-4:45pm



Tentative topics:

$$P(B_i \mid A) = \frac{P(A \mid B_i)P(B_i)}{P(A)}$$



- Conditional probability and Bayes' rule.
- Discrete and continuous distributions of data;
  - binomial, beta, gamma, inverse gamma, normal and Student-t.
  - The bivariate normal and the normal-inverse gamma distributions.
- Maximum likelihood estimation.
- Conditional and marginal distributions.
- Conjugate and non-conjugate prior distributions.
- Maximum a-posteriori and marginal mean estimation.
- Bayesian binomial probability
  - (binomial likelihood, beta prior, beta posterior).
- Bayesian normal mean estimation
  - (normal likelihood, normal-inverse gamma prior, Student-t marginal posterior).
- Bayesian multiple regression
  - (normal likelihood, bivariate normal-inverse gamma prior, bivariate Student-t marginal posterior).
- LASSO (normal likelihood, Laplace-inverse gamma priors).
- Naïve Bayesian Classification
  - (normal class likelihoods, normal-inverse gamma class priors with discrete uniform prior class probabilities).
- Markov chain Monte Carlo numerical integration including
  - importance sampling, Gibbs sampling, and the Hastings algorithm.
- Sequential updating of previous Bayesian models.
- A computational flavor throughout.

$$\overbrace{f(\mu,\sigma^2}^{B} \mid \overbrace{y_1,\ldots,y_n}^{A}) = \frac{\overbrace{f(y_1,\ldots,y_n \mid \mu,\sigma^2}^{A})\overbrace{f(\mu,\sigma^2}^{B})}{\underbrace{f(y_1,\ldots,y_n)}_{A}}$$

Prerequisites/Notes:

- COSC 1010, MATH 1451, and MATH 4720 or the equivalents
- Students enrolled in MSSC 5790 will have additional assignments

For more information, email the instructor:

- Dr. Daniel Rowe (Daniel.Rowe@Marquette.Edu)