

### Using Baye's Theorem of Conditional Probability to Analyze Course Performance

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## Baye's Theorem

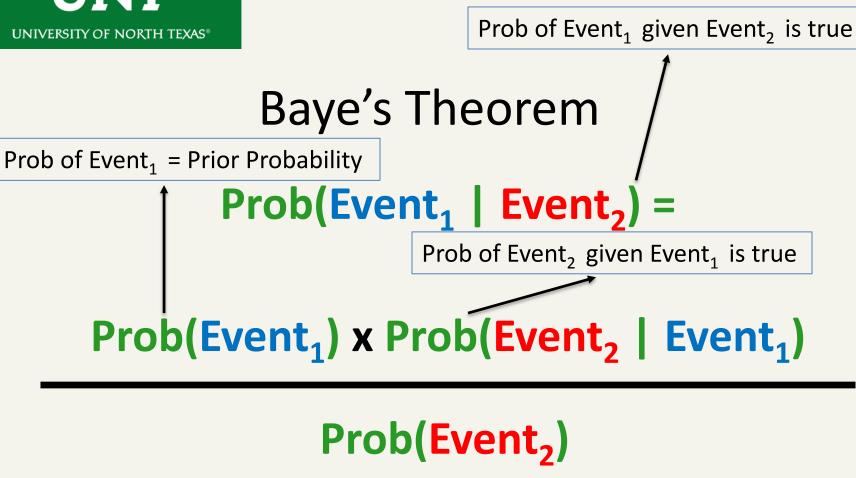
- 1. Used to update prior beliefs about the probability of an event, given new evidence
- 2. Derived from the concept of conditional probability



## Applications of Baye's Theorem

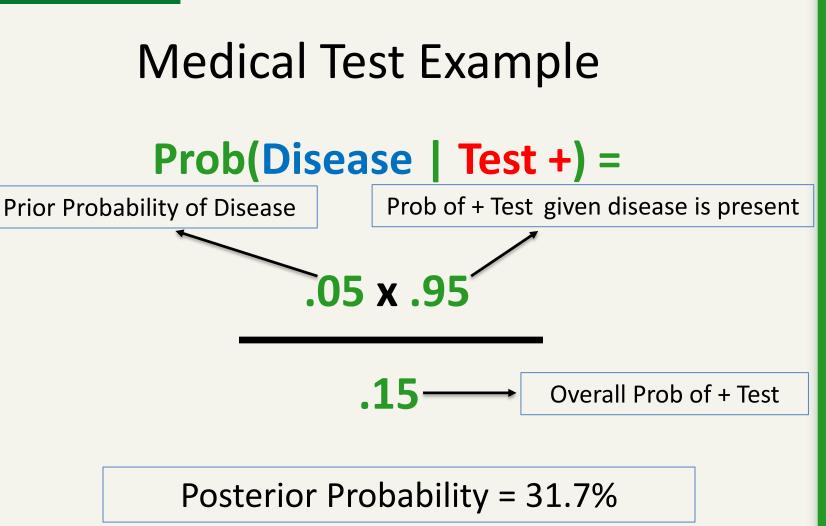
- 1. Medical Testing/Diagnosis
- 2. Operations Management/Quality Control
- 3. Spam Filtering





**Result = Posterior Probability** 







## Analyzing Sequential Courses

- 1. Examine pre-requisite / next-level course pairs
  - ENGL 1310 (Writing I) / ENGL 1320 (Writing II)
  - MATH 1710 (Calculus I) / MATH 1720 (Calculus II)
- Calculate prior probabilities for 2<sup>nd</sup> course grades
  Probability of A, B or Higher, Etc.
- 3. Use 1<sup>st</sup> course grades & Baye's theorem to update prior probabilities
- 4. Compare posterior & prior probabilities



## Population / Data Set

For each course pair...

- Select students passing first course, Fall 2013 Fall 2017
- Of the above group, limit to students taking 2<sup>nd</sup> course within the next year
- Of the above group, pare down to those completing 2<sup>nd</sup> course



## Calculus I / Calculus II Example

- 1. Total Population = 1,628 students
- Overall Probability of B or Higher in Calculus II = 52.3% (Prior Probability)
- Probability (B / Higher) in Calculus II, given
  B in Calculus I = ???? (Posterior Probability)



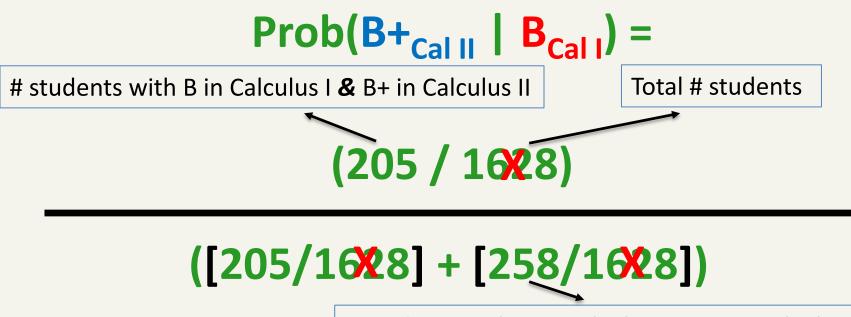
# Calculus I / Calculus II Example

Prob(B+<sub>Cal II</sub> | B<sub>Cal I</sub>) = = Prob of B in Calculus I & B+ in Calculus II Prob(B+<sub>Cal II</sub>) x Prob(B<sub>Cal I</sub> | B+<sub>Cal II</sub>) Prob(B<sub>Cal I</sub>)

= Prob of B<sub>Cal I</sub> & B+<sub>Cal II</sub> + Prob of B<sub>Cal I</sub> & <B<sub>Cal II</sub>



# Calculus I / Calculus II Example



# students with B in Calculus I & <B in Calculus II

Posterior Probability = 44.3%



### Calculus I / Calculus II: Prior vs. Updated Probabilities

Grade	Prior Probability: Cal II Grade = Grade or Higher	Posterior Probability: Given Cal I Grade = Grade
А	31.2%	63.0%
В	52.3%	44.3%
С	69.4%	42.9%
D	80.5%	49.0%



### Writing I / Writing II: Prior vs. Updated Probabilities

Grade	Prior Probability: Wri II Grade = Grade or Higher	Posterior Probability: Given Wri I Grade = Grade
А	50.7%	66.8%
В	80.2%	74.6%
С	90.9%	74.6%
D	93.4%	70.9%



### **Potential Issues**

- Skills/Concepts Not Aligned Between 1<sup>st</sup> & 2<sup>nd</sup> Course
- 2. Grade Inflation in 1<sup>st</sup> / Pre-Requisite Course
- 3. Excessively Stringent Grading in 2<sup>nd</sup> Course
- 4. Large Scale Decline in Student Effort



### 2<sup>nd</sup> Course Performance & Next-Term Persistence

2 <sup>nd</sup> Course	2 <sup>nd</sup> Course Grade vs. 1 <sup>st</sup> Course Grade	Persistence Rate
Calculus II	Equal to / Greater Than	95.1%
	Lower Than	86.5%
Writing II	Equal to / Greater Than	89.0%
	Lower Than	77.6%



Calculus I / Calculus II: Updated Probabilities by Instructor Rank (Calculus I Grade = B)

Rank	Prior Probability: Cal II Grade = B or Higher	Posterior Probability: Given Cal I Grade = B & Rank = Rank
Prof/Instructor	52.3%	68.0%
Adjunct/Other	52.3%	38.0%
Teaching Assistant	52.3%	48.4%



Calculus I / Calculus II: Updated Probabilities by Instructor Rank (Calculus I Grade = C)

Rank	Prior Probability: Cal II Grade = C or Higher	Posterior Probability: Given Cal I Grade = C & Rank = Rank
Prof/Instructor	69.4%	65.9%
Adjunct/Other	69.4%	35.9%
Teaching Assistant	69.4%	53.2%



Writing I / Writing II: Updated Probabilities by Instructor Rank (Writing I Grade = B)

Rank	Prior Probability: Wri II Grade = B or Higher	Posterior Probability: Given Wri I Grade = B & Rank = Rank
Adjunct/Other	80.2%	74.9%
Teaching Assistant	80.2%	74.5%



Writing I / Writing II: Updated Probabilities by Instructor Rank (Writing I Grade = C)

Rank	Prior Probability: Wri II Grade = C or Higher	Posterior Probability: Given Wri I Grade = C & Rank = Rank
Adjunct/Other	90.9%	75.6%
Teaching Assistant	90.9%	73.8%



## Thank You Session Evaluation Form Available via the Conference App

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