USING DATA TO IMPROVE CURRICULUM ... AND EQUITY

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S116 AMATYC 2017   SAN DIEGO
NOVEMBER 10, 2017
OUTLINE FOR OUR TIME ...

- USING DATA: ANECDOTES OR ANALYSIS?
- WHAT DO WE SEE?
- CLARIFYING: PREREQUISITES TO PRE-CALCULUS; TO CALCULUS
- CLARIFYING: PLACEMENT INTO PRE-CALCULUS
- EQUAL EFFECTS FOR STUDENTS: MEASURING ‘EQUITY’ IN OUR CURRICULUM
USING DATA ... ANECDOTE OR ANALYSIS?

• MUCH OF THE DATA WE SEE IS ANECDOTAL:
  
  HEY, WE DID THIS ... AND WE SAW THAT!

• ANALYSIS INVOLVES LOOKING FOR PATTERNS IN DATA

• FIND NEW QUESTIONS ABOUT THE DATA

• HYPOTHESIZE POSSIBLE CAUSE & EFFECT RELATIONSHIPS
WHAT IS DIFFERENT: DATA ANALYSIS

• DATA ANALYSIS IS OPEN-ENDED BY ITS NATURE!
• CLASSROOM RESEARCH IS NARROW IN PURPOSE
• DATA ANALYSIS ON A MATHEMATICS CURRICULUM IS PART OF A PROCESS

IMPROVE AND MAINTAIN COURSES WHICH SERVE NEEDS IDENTIFIED FOR THEM, AT REASONABLY EQUAL LEVELS FOR ALL STUDENTS
WHAT DO WE SEE?

Math121 is “pre-calculus I”
Interval Plot of Pass121 (Pre-calculus I)
95% CI for the Mean

Individual standard deviations are used to calculate the intervals.
LOOK AGAIN ... THE 2ND TREATMENT EFFECT

7 instructors have ‘significant difference from mean’
MEASURING “INSTRUCTOR EFFECT”

• WITH SIGNIFICANT DIFFERENCES ... WE NEED A MEASURE OF THE EFFECT

• EACH INSTRUCTOR HAS A PASS RATE (OVER TIME) IN EACH COURSE ... THIS IS THE ‘EXPECTED VALUE’

• LOOK AT THE ‘GAIN’ (STUDENT OUTCOME VS EXPECTED VALUE)

• EXAMPLE: HAD INSTRUCTOR WITH MEAN PASS RATE .62
  STUDENT WHO PASSED ... GAIN=+.38
  STUDENT WHO DID NOT PASS ... GAIN=-.62
A BETTER VIEW OF THE PATTERN

“Gain121” = Pass - InstructorPassRate

Interval Plot of gain121
95% CI for the Mean

Individual standard deviations are used to calculate the intervals.
PATHS TO PRE-CALCULUS

• LANSING CC OFFERS TWO COURSES AS PREREQUISITE
• MATH112 IS “INTERMEDIATE ALGEBRA” (ACT MATH 20-21)
• MATH109 IS “FAST TRACK ALGEBRA” (ACT MATH 18-19)
• ACT MATH 22 QUALIFIES FOR MATH121
UNEQUAL PATHS (AT THIS POINT)

Interval Plot of Pass121
95% CI for the Mean

Individual standard deviations are used to calculate the intervals.
CONFIRMING: “GAIN121”

Interval Plot of gain121
95% CI for the Mean

Individual standard deviations are used to calculate the intervals.
DELIVERY METHODS IN PREREQ

• MATH112 (PREREQUISITE TO MATH121) IS OFFERED:
  ➢ “LECTURE”
  ➢ “MATH LAB” (DIRECTED SELF STUDY, F2F)
  ➢ “ONLINE” (VIRTUAL; PROCTORED EXAMS)
  ➢ “COMBO” (BEGINNING & INTERMEDIATE IN ONE) … PRIOR TO THE AGE OF MATH109 (FAST TRACK)

• WITHIN EACH OF THESE … INSTRUCTOR EFFECT

• FIRST ORDER RESULTS ON NEXT PAGE
HOW DID THEY TAKE PREREQ?

Differences exist: “Online” high ... others low
PATHS TO MATH151: CALCULUS I

• LANSING CC OFFERS TWO OPTIONS FOR PREREQUISITES TO MATH151 (CALCULUS I)
  • MATH121 & MATH122 - TWO SEMESTER PRECALCULUS
  • MATH126 - ‘ACCELERATED PRECALCULUS’
PASS RATES IN CALCULUS I

Interval Plot of Pass Math151 by Prereq
95% CI for the Mean

Pass (Calculus I)

Neither  MATH121&122  MATH126

Precalc I & II  1 semester PreCalc

Individual standard deviations are used to calculate the intervals. Results exclude rows where Prereq="MATH121MATH126".
GAIN: PASS VS. EXPECTED VALUE (CALCULUS I)

Interval Plot of gain
95% CI for the Mean

Individual standard deviations are used to calculate the intervals.
Interval Plot of gain from instructor's Math151 pass rate
95% CI for the Mean

Individual standard deviations are used to calculate the intervals.
Results include rows where Prereq = "MATH121".
PLACEMENT INTO PRE-CALCULUS I

• ACT MATH ≥ 22
• SAT MATH ≥ 550 *(INSUFFICIENT ‘N’ TO SUMMARIZE)*

• ACCUPLACER CLM ≥ 55  *[COLLEGE LEVEL MATH]*

• 2.5 OR HIGHER IN MATH112 (INTERMEDIATE ALG) OR MATH109 (FAST TRACK ALGEBRA)
EVEN PLACEMENT INTO MATH121?
ACT MATH ... TRENDS

Percent Pass Math121 by ACT Math

CLM “above” in Math121
Math112 then Math121
EQUITY ISSUES

• AT FIRST GLANCE ... “HAVE THEM ALL TAKE THE PREREQUISITE ONLINE!!” (BECAUSE ONLINE PREREQ HAD BEST RESULTS IN MATH121)

• ACROSS COURSES AND INSTRUCTORS ... ARE THERE DIFFERENT OUTCOMES FOR ‘RACIAL’ GROUPS?

• DO THESE PATTERNS CHANGE OVER TIME?
MATH121 EQUITY

Math121 Pass Rates 2011 - 2016

- American Indian
- Asian
- Black or African American
- Hispanic or Latino
- Native Hawaiian
- No Response
- Two or more races
- White

Course avg.
ACROSS COURSES
ACROSS TIME ...
Even when we ‘equalize’ math background, minorities have unequal outcomes
SEX IN MATH CLASS 😊

Difference in proportions very significant: $z$-score=5.2; $p=0.000$
DISAGGREGATING ... LEVEL 2

“Risk” is highest in online: Largest outcome gap for African-American students
WHY?
FACTORS IN LOWER PASS RATES ...

• CULTURAL ... ‘CRITICAL RACE THEORY’ MIGHT HELP US UNDERSTAND THAT

• STEREOTYPE THREAT ... IS REAL, BUT IS VALIDATED ON INDIVIDUAL ASSESSMENTS (VERSUS COURSE LEVEL)

• POVERTY ... PLACES STUDENTS AT HIGHER RISK

• WE DON’T HAVE DIRECT MEASURES OF ‘POVERTY’; THE VARIABLE WE HAVE IS “PELL ELIGIBLE” (FILED FAFSA AND HAD LOW OR NO INCOME)
In each group, ‘poverty’ places students at risk ... but not equal risk across groups.
“RACE”, “SEX”, “POVERTY” INTERACTIONS

... Four large enrollment courses by category (2011-16) ...
DATA ANALYSIS TO IMPROVE CURRICULUM

• LOOKING FOR PROBLEMS ... EVEN WHERE WE DID NOT THINK WE HAD ANY

• LOOKING FOR PLEASANT SURPRISES

• SEEKING TO UNDERSTAND WHAT STUDENTS EXPERIENCE
• NOT “ONCE AND DONE”
RESOURCES NEEDED

• A GOOD DATA EXTRACTION TOOL
  WE USE “ARGOS” HTTPS://EVISIONS.COM/PRODUCTS/HIGHER-EDUCATION/ARGOS/
  DATA EXTRACTION (DATA WAREHOUSING) IS AN INSTITUTIONAL COMMITMENT

• SOFTWARE FOR COMBINING SPREADSHEETS

• SOFTWARE FOR STATISTICS  (I USE “MINITAB”)

• A STARTING LEVEL OF EXPERTISE

• SOME TIME (PROBABLY MORE THAN YOU THOUGHT BUT LESS THAN YOU WORRIED ABOUT)
FOCUS ON FLEXIBILITY

• DON’T EXPECT “THEM” TO WRITE A REPORT THAT GIVES YOU THE DATA YOU THOUGHT YOU NEEDED

• FLEXIBILITY … DATA EXTRACTED AS SPREADSHEETS WITH IDENTIFIERS ALLOWING DATASETS TO BE COMBINED

• JOINING SPREADSHEETS CAN BE DONE IN MS EXCEL … WITH CODING. EASIER IN STATISTICAL SOFTWARE
YOUR DATA ... YOUR WORK

• MY DATA HAS NOTHING TO DO WITH YOUR SITUATION

• WORK WITH YOUR IT AND INSTITUTIONAL RESEARCH OFFICE TO GET DIRECT ACCESS TO DATA

• NOBODY STARTS AS AN EXPERT

• YOU WILL NEED TO LEARN SOME STATISTICS THAT YOU MAY HAVE NEVER HEARD OF
WRAP-UP

• OTHER QUESTIONS?

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