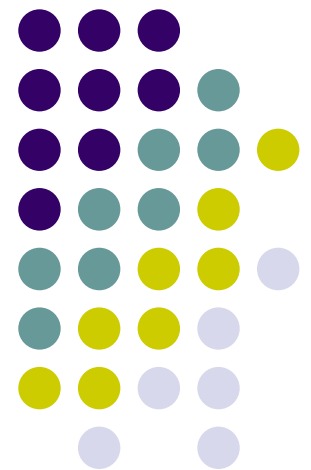# Peer Effects:
How Do First-Year Classmates Affect Students' Academic Success

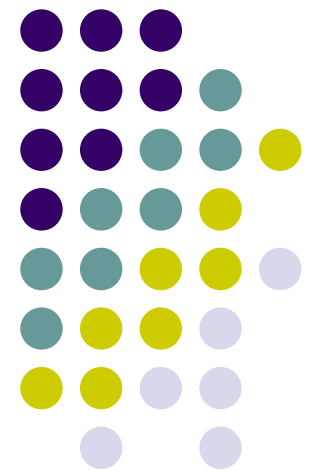Jessica Hoel, Mathematics/Economics Major, Class of 2005

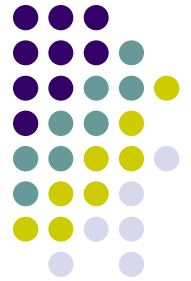Jeffrey Parker, George Hay Professor of Economics

Jon W. Rivenburg, Director of Institutional Research

Reed College

Testing the peer-effects hypothesis

How do the characteristics of Humanities 110 classmates, freshman roommate(s), and freshman dormmates affect Reed students' academic outcomes?

Student performance model
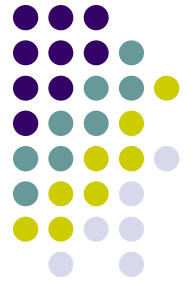
- Admission variables
    - SAT: math & verbal
    - High school GPA
    - HS rank (top 5% dummy)
    - "Reader rating"
        - 5 is perfect; 1 is awful
        - Incorporates above
        - Also considers essays, recommendations, interview, HS quality
        - We enter into model as residual from regression on other characteristics

- Other characteristics
    - Reported ethnicity, gender, financial-aid status, US citizen status
    - HS size & type
    - Year of entry
    - Major (to compensate for differences in grading)
- Controls tested
    - Hum 110 instructor
    - Time of hum conference
    - Freshman residence hall
    - Distance from home

Are admission variables collinear?
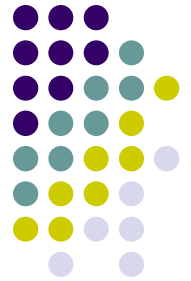
	Math SAT	Verbal SAT	Reader rating	HS GPA
Math SAT	1.00			
Verbal SAT	0.37	1.00		
Reader rating	0.36	0.37	1.00	
HS GPA	0.27	0.16	0.53	1.00

Are admission variables collinear?

- No single admission measure seems to be a satisfactory summary of student quality.

- We construct our own predicted GPA measure based on admission and demographic variables.

Research strategy

1. Estimate OLS regression model of student GPA based on student's own characteristics

2. Compute peer-effect measures based on **predicted GPA** to get best univariate measure of predicted quality

3. Test for peer effects by adding **peer averages of predicted quality** to basic GPA regression model from #1

Sample characteristics

- **3,142** students took Hum 110 as new freshmen from 1988 through 1997.
  - Some variables are unavailable for some students (esp. HS GPA and class rank).
- 10-year sample size is **1,937** for full undergraduate GPA model with no missing data.
- Residential data are only available for last 5 years (for roommate/dormmate effects).
  - Sample is about half as big for residential effects as for classmate effects.

Predicting reader rating

$$RR = -0.328 + 0.099\,SATM + 0.154\,SATV + 0.504\,HSGPA + 0.225\,TP5\%$$
$$(-2.5)\quad(7.7)\qquad\quad(12.1)\qquad\quad(17.6)\qquad\quad(10.2)$$

$$N = 1946,\quad \overline{R}^2 = 0.41,\quad \hat{\sigma} = 0.38.$$

- SATs and HS grades have strong effects (as expected)
- Males get lower ratings
- Dummy variables (not shown):
  - Financial aid students get higher ratings
  - Ethnicity variables not statistically significant
- Residual errors from this regression are "Reader-rating residual," measuring entry attributes other than SAT, high school grades, and demographics.

A basic model of student performance at Reed

How do a student's own characteristics predict his or her undergraduate GPA?
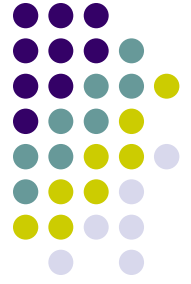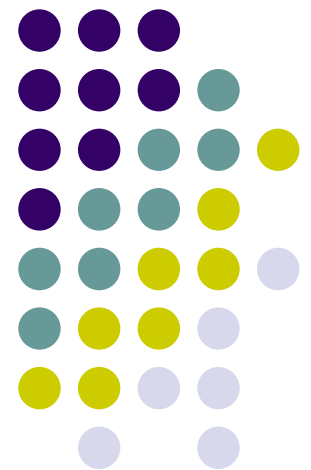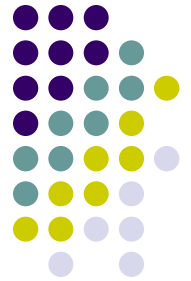
Admission variables and GPA

- Linear admission variables, *ceteris paribus*:
  - One point higher high-school GPA raises Reed GPA by 0.417.
  - Being in top 5% of high-school class raises Reed GPA by 0.155.
  - An increase of one point in reader-rating residual (holding SAT and high-school record constant) raises Reed GPA by 0.260.
- Effects of SAT scores are non-linear.

SAT scores and GPA

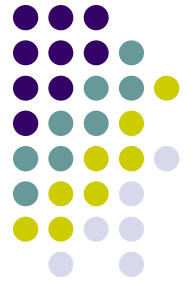Non-linear effects (other variables at means)
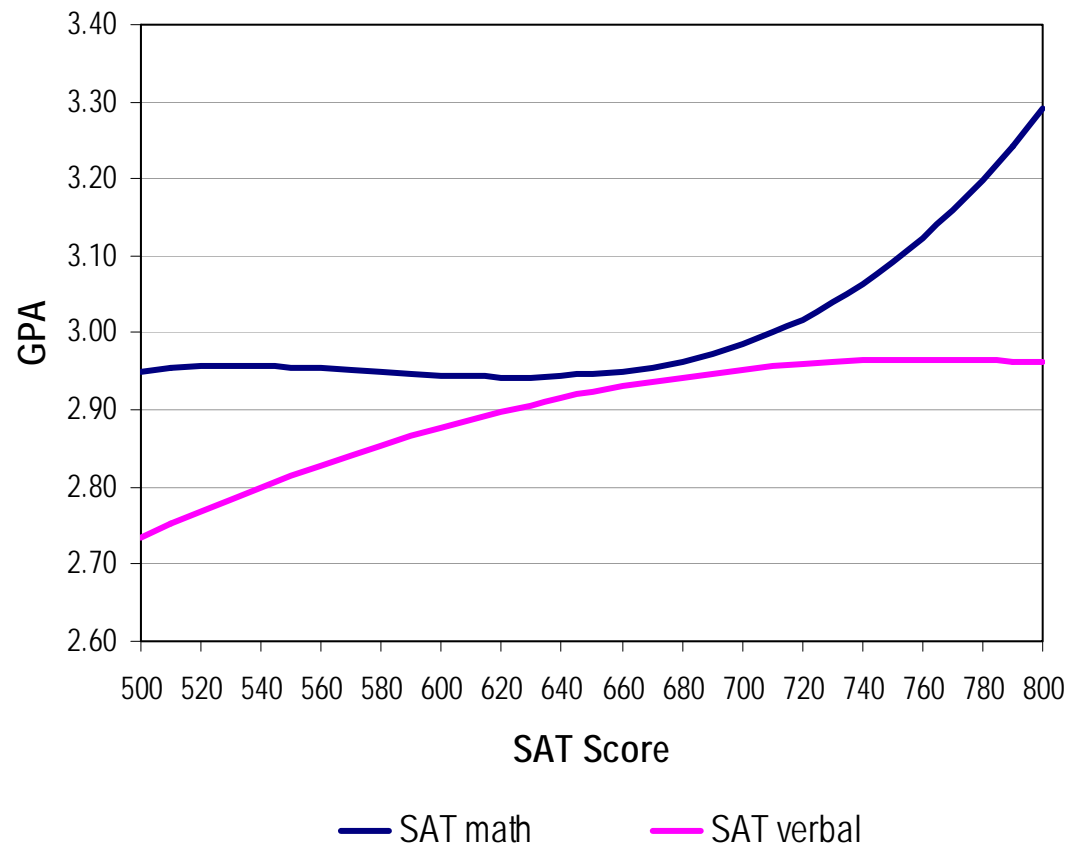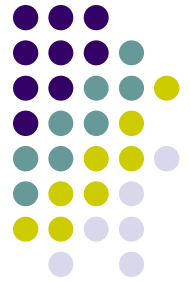
Demographics and GPA

- **Male**: lower GPA by 0.113.
- **US citizen**: lower GPA by 0.109.
- No **ethnicity variable** is significant at 0.05 level, though African-American and Asian are significant at 0.10 level (and both negative estimated coefficients).
- Full model explains just under ¼ of the variation in Reed GPA: most of variation is in residual.

Alternate GPA measures for peer effects models

- ## Undergraduate GPA without Hum 110
  - Used with classmate peer variables to avoid effect of class quality on Hum 110 "curve"
- ## First-year GPA
  - Roommate and dorm effects might be largest in first year
  - With and without Hum 110
- ## GPA in Hum-related courses, except 110
  - Hum 2XX, English, Languages, Arts, Philosophy, Religion, History, Anthropology, Political Philosophy

Peer effects on GPA

Adding peer effect variables to student performance model
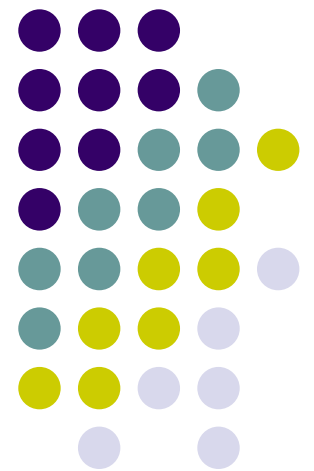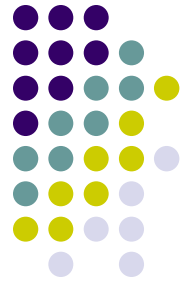
Measuring peer effects

- Calculate **average predicted GPA** of each student's peer groups (excluding self):
  - Hum 110 classmates
  - Roommate(s)
  - Dormmates
- Other peer effects:
  - Class/room/dorm **dispersion** of predicted GPA
  - Student's **position** in class/dorm distribution
- Classmate/dormmate **demographics**

Classmate-quality peer effects

- We tested a variety of specifications.

- Results did not indicate strong peer effects of average classmate quality.

- No effects of classmate variance or position in class distribution.

- But…

Interesting interaction effects
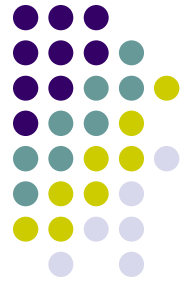
- Including both mean quality and standard deviation, along with their cross-product yields significant coefficients on all three.

- Implication: Effect of mean depends on standard deviation (and vice versa).

Non-linear GPA relationship
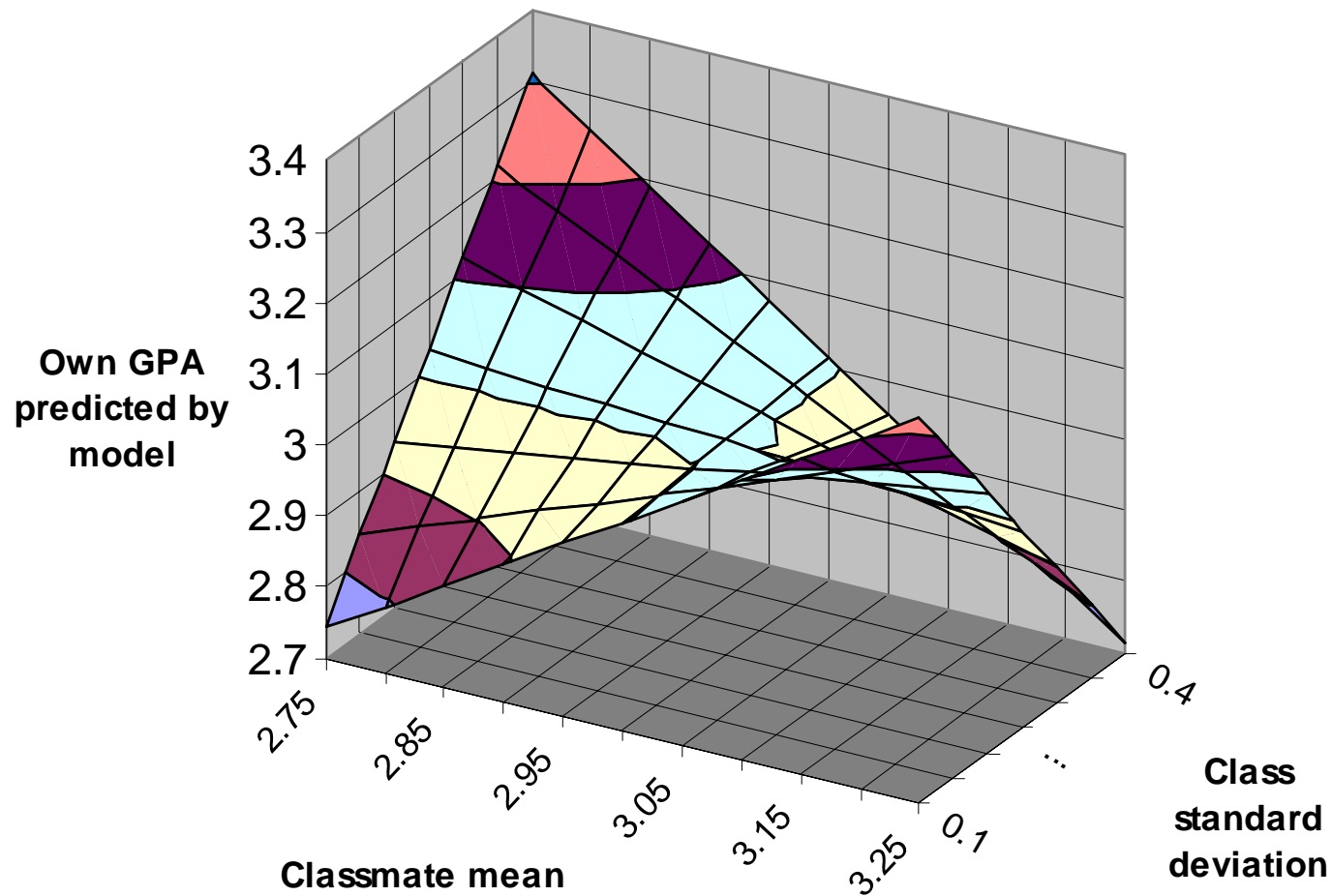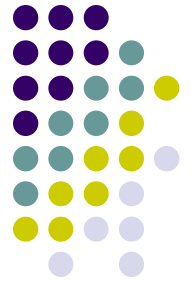
Non-linear graduation effects

Probability of graduation predicted by model
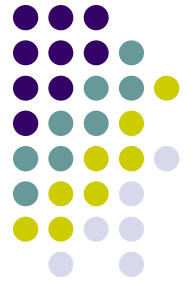
Classmate mean

Class St. Dev.
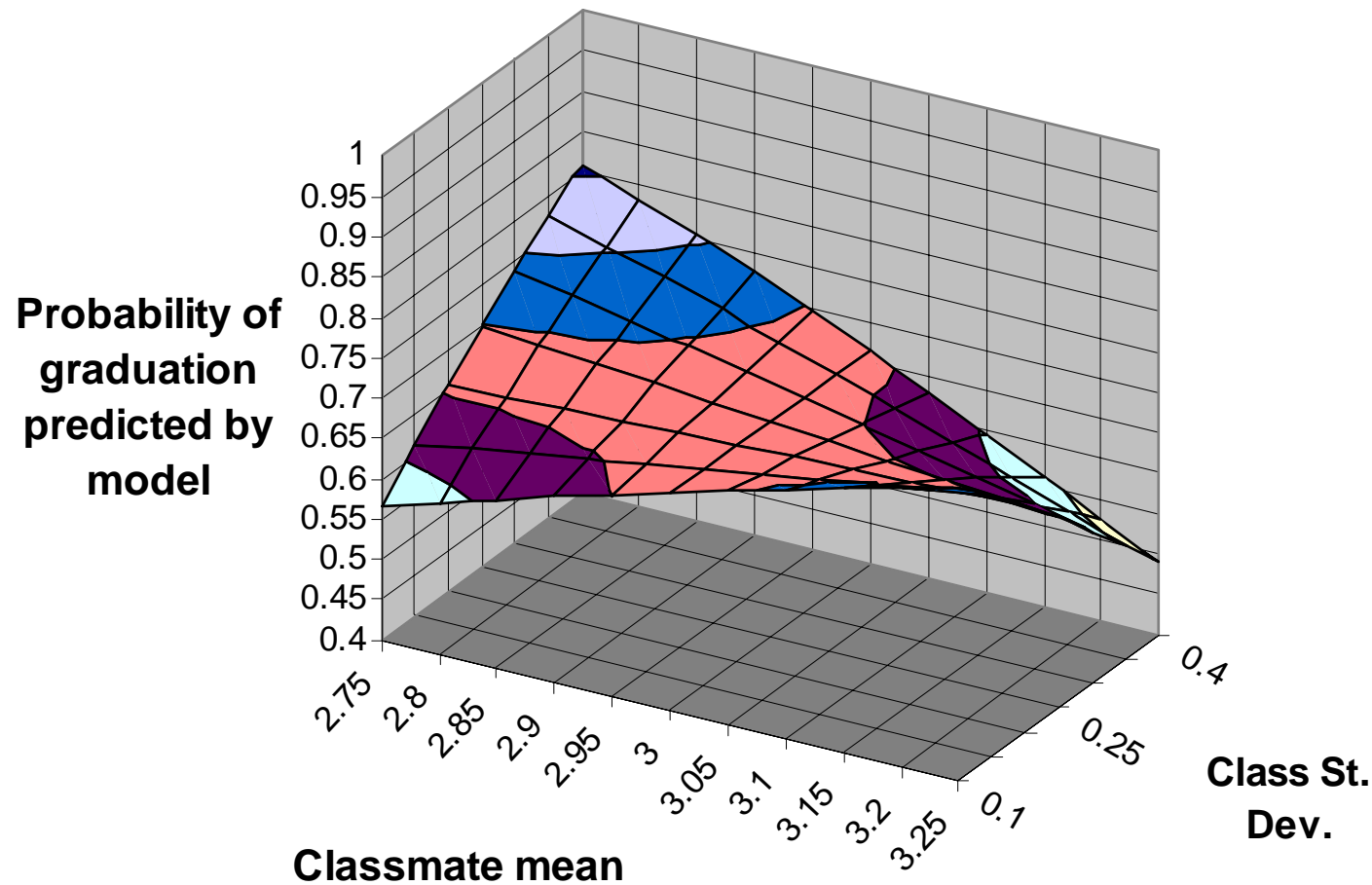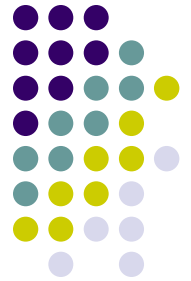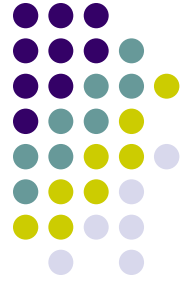
Is this result robust?

- We hope to find out be adding three years to Reed sample and replicating analysis for Whitman and Lewis & Clark samples.

Classmate-demographic peer effects

- Interesting finding for classmates:
  - More males in Hum conference has negative effect on GPA of female students.
  - Increase of 20% in male share leads to decline of 0.08 in overall GPA of a female in class (p-value = 0.075).
  - Smaller (and insignificant) negative effect of male peers on male students.
  - Male/female ratio of Hum sections seems to be important: Heavily male sections are disadvantageous, especially to females.
- No significant effects of ethnicity composition.
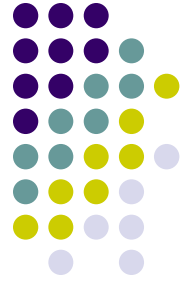
Residential peer results

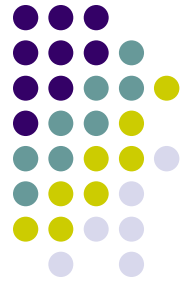- Both roommate and dormmate average predicted GPA are statistically significant for five-year sample.

- Relationship between peer average predicted GPA and outcome is nonlinear.

- Roommate effect is positive over most of sample range, but negative at extremes.

- Dormmate effect is U-shaped: best to have high or low predicted average GPA in dorm.

Roommate peer effects
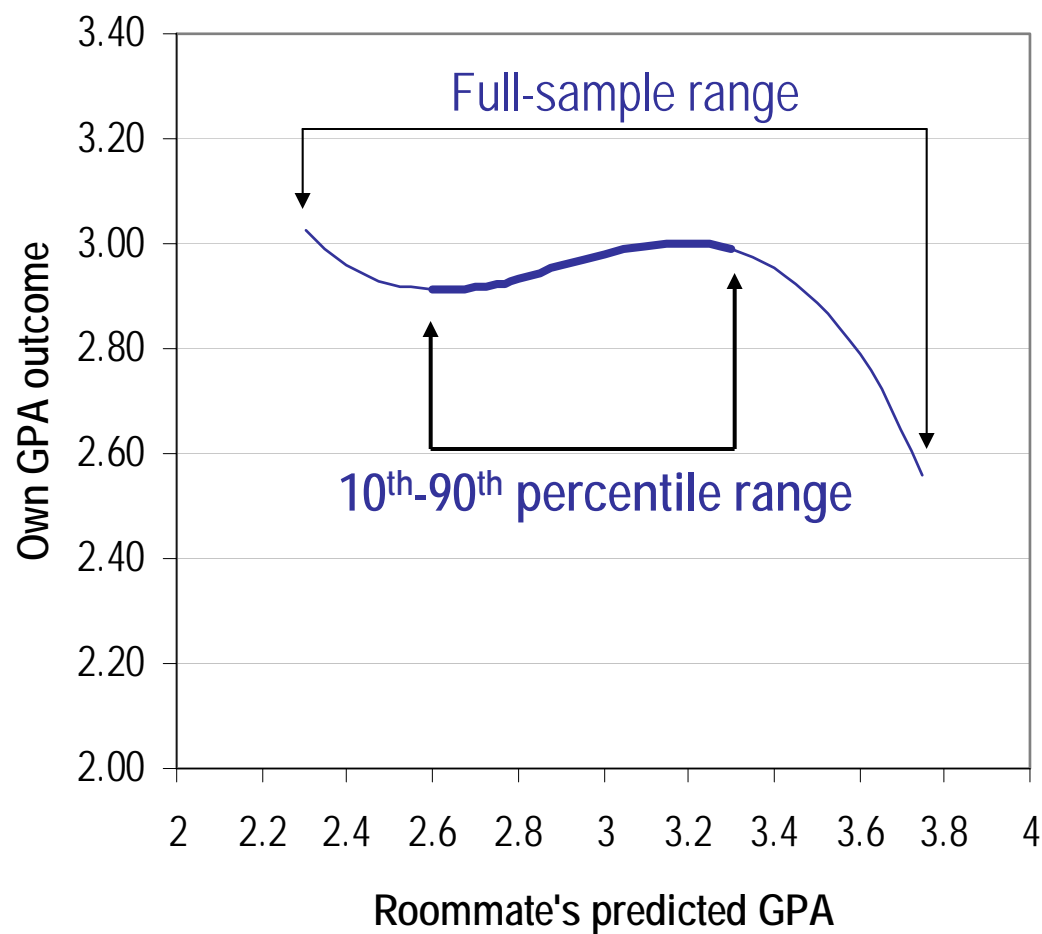
Dormmate peer effect
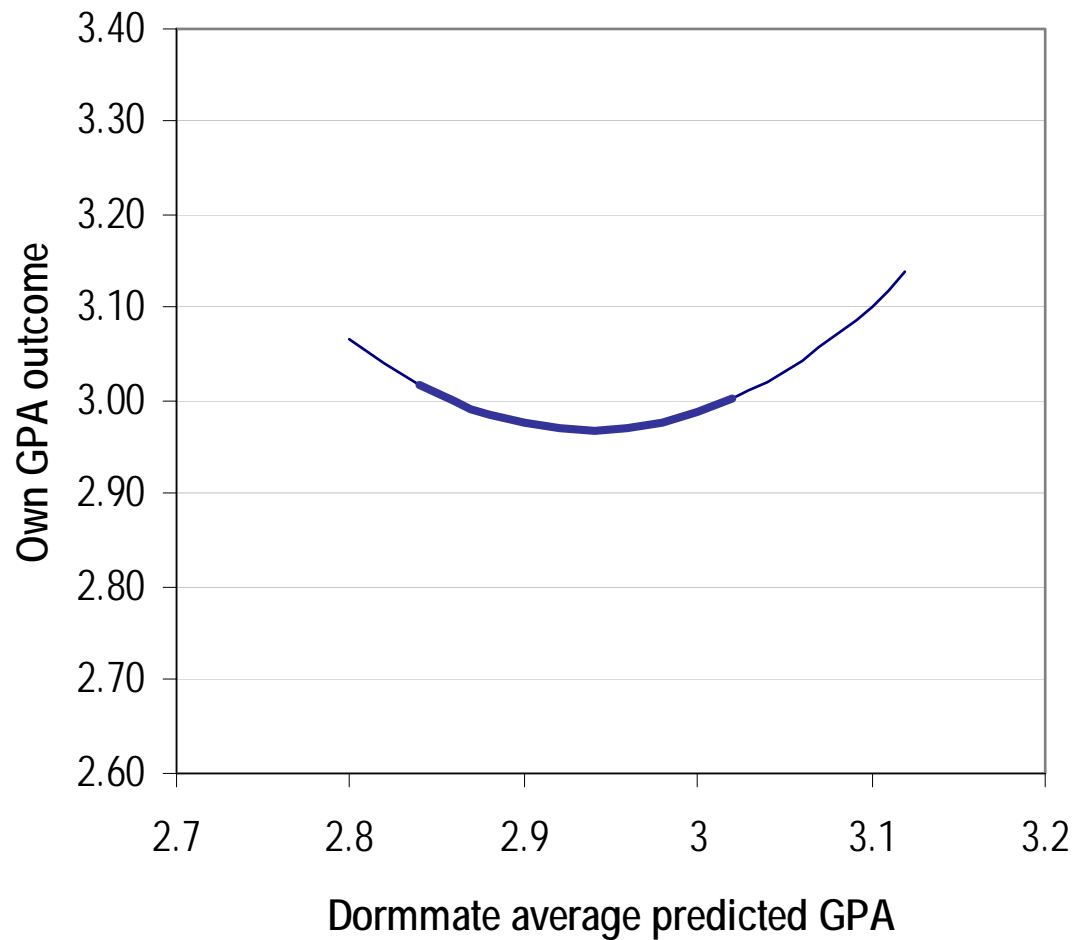
# Residential effects by gender
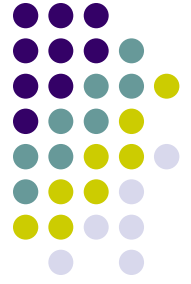
- **Female** students respond significantly to roommate predicted GPA. Male response is similar, but smaller and insignificant.

- **Male** students respond significantly to dormmate average predicted GPA. Female response is similar, but smaller and insignificant.

Conclusions

What can we conclude about the effects of students' peers on their academic success?
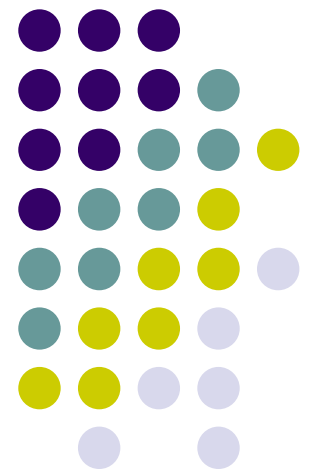
Absence of clear classmate effects

- We found ambiguous effects of the quality of students' classmates in Hum 110 on their academic performance.
- Why? …

Why weak classmate effects?

- Maybe the non-linear, interactive relationship we found is correct.

- Noisy measurement of classmate ability
  - Low R-square in predicted GPA regression

- "Ability" may not be the characteristic of a student's peers that is most relevant to his or her own success

Why weak classmate effects?

- Differences in responses of sub-groups of students may mask overall effect
  - Some evidence from studies of roommates (including ours) that responses vary across gender and quality of student
- Maybe Hum 110 classmates don't matter for other classes
  - Any peer effects may be restricted to learning in Hum 110 class.
  - One of 3 or 4 first-year classes, so peer effects of Hum classmates are diluted.
  - Classmates may not affect GPA in general.

Residential peer effects

- We find significant, nonlinear effects of roommate and dormmate quality on students' success.

- A better first-year roommate usually leads to a slight improvement in GPA.
  - Contrary behavior at extremes
    - A very strong roommate lowers one's GPA
    - A very weak roommate raises one's GPA

Gender and peer effects
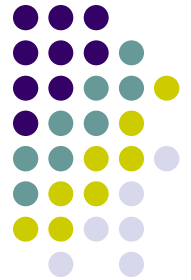
- Some of most interesting results are gender-related:
  - More females in Hum conference is good for all, especially for women.
  - Roommate effects are much stronger for females than males.
  - Dormmate effects are much weaker for females than males.
- Possible college policy implications for assignment of classmates, roommates, and dormmates.

More evidence?

- Three studies of residential peer effects in liberal-arts colleges:
  - Results are consistent, though not identical.
- Are there other opportunities to study classmate peer effects?
  - Need other "natural experiments" with random assignment to class sections.
- **This slide led us to this project!**