

# Effect of Plus-Minus Grades on Graduation with Academic Distinction for Engineering Students at Wichita State University



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# Presentation Outline

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- Background on grade inflation and plus-minus grading
- Methodology used in this study
- University-wide results of graduation with distinction
- Grade distribution for courses university-wide under whole-letter grade system
- Grade distribution for engineering courses under whole-letter and plus-minus grading systems
- Results of graduation with distinction by discipline
- Summary & future work

# Background on Grade Inflation

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- Stuart Rojstaczer ([www.gradeinflation.com](http://www.gradeinflation.com)) has collected grade inflation trend over the last 50 years
  - Dataset includes 170 schools
- **Grade of C** was most common grade until the Vietnam war (draft deferment effect thereafter)
- **Grade of A** is now the most common grade

# Background on Trend toward Adopting Plus-minus Grading System

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- Whole-letter grade (A, B, C, D, F) system was prevalent before grade inflation began
- Many universities since the 1990s have implemented plus-minus (+/-) grading system (with A, A-, B+, etc.)
  - Number of schools using +/- grading system\*: 36% in 1992, 56% in 2002, and 63% in 2014
- Key motivator: a belief that +/- system will reverse grade inflation and student performance will be better differentiated\*\*
- Publicly available grade information is not easily accessible, but grade inflation is also present at Wichita State Univ (WSU)\*\*\*
  - Registrar stated in 2004 that A is most prevalent grade

References: \*AACRAO (Registrars Assoc); \*\*Morgan *et al*, 2007; \*\*\*WSU registrar, 2004

# Background on Effect of Plus-minus Grades on GPA / Motivation

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- Reports in literature about the effect of +/- grading on GPA are somewhat mixed
    - Many report no difference in mean overall GPA
    - Hypothesized explanation: grades with pluses probably cancel minuses over the course of a student's academic career
  - Most reports recognize that there would be a small deflationary effect on students in the top A grade bracket
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- This leads to a two-fold motivation for the present study:
    - 1) How does +/- grading affect the top A-level students?
    - 2) Are there differences by discipline, from effect of +/- grading?

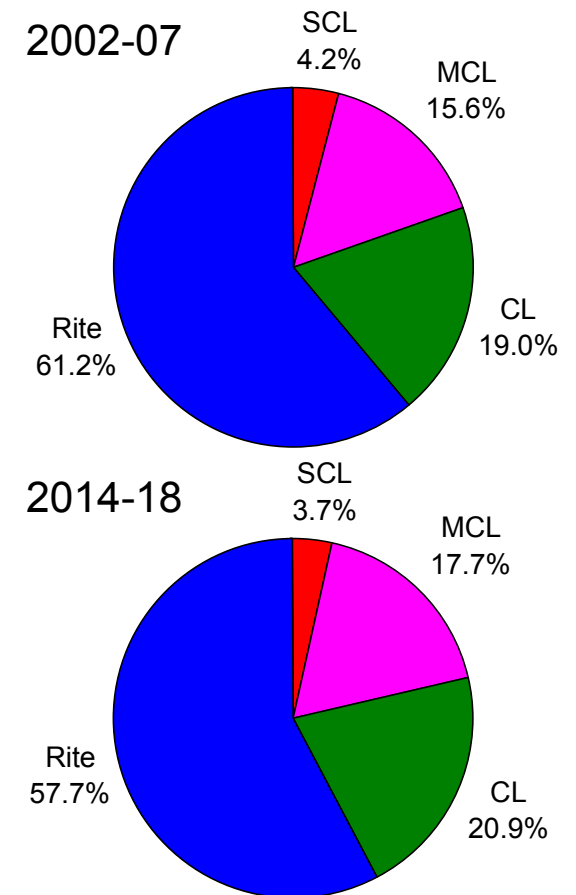
# Further Background & Methodology

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- Plus-minus grading implemented at WSU since the fall of 2009
- Graduation with honors has remained the same under +/- grading
  - Summa Cum Laude (SCL) honors require a GPA of 3.90
  - Magna Cum Laude (MCL) honors require a GPA of 3.55
  - Cum Laude (CL) honors require a GPA of 3.25
- Although wide in GPA range, the number of honors graduates in each category is a proxy for distribution of student GPAs
  - Publicly available commencement brochures were used to determine the number of graduates in each honors category
  - Five year periods before +/- grades (fall 2002 to spring 07) and after +/- grades (spring 2014 to fall 18) were considered

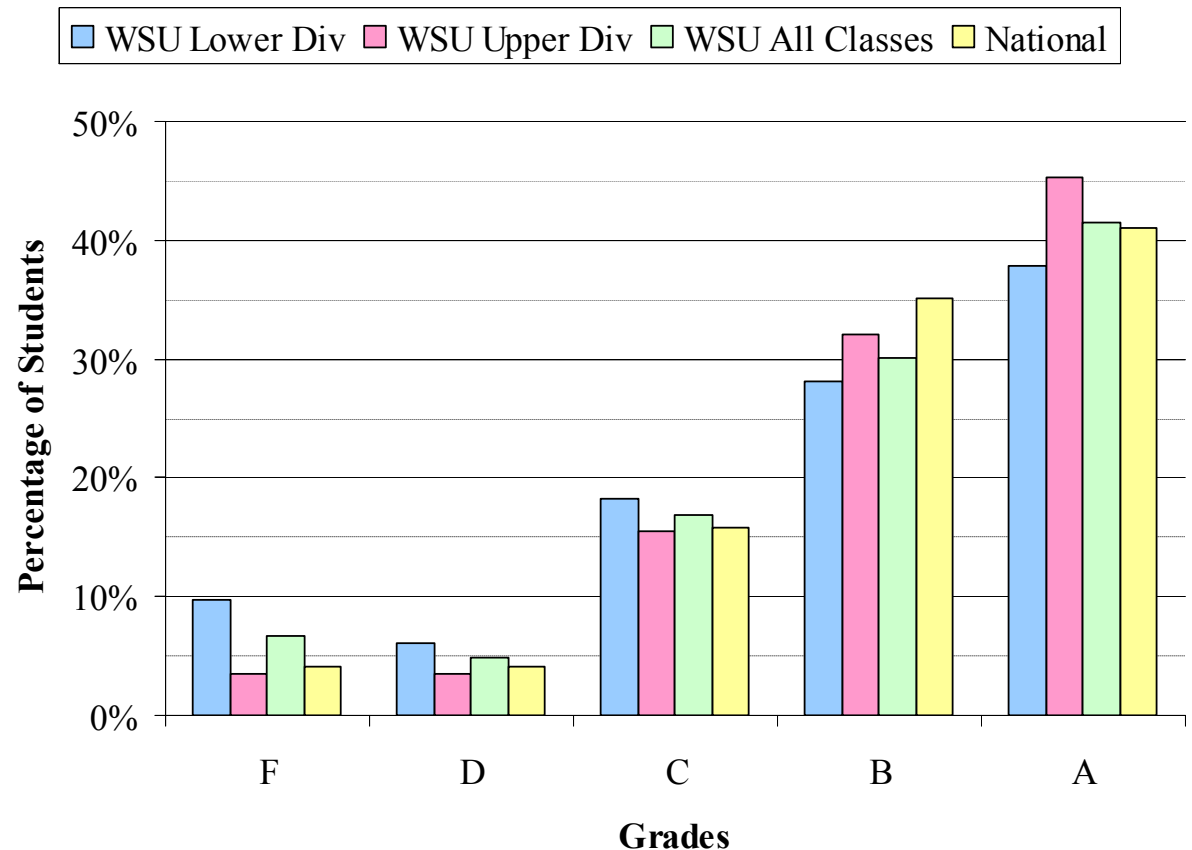
# University-wide Results of Graduation with Academic Distinction

- Whole-letter grades (2002-07)
  - Summa Cum Laude (**SCL**): 4.2%
  - Magna Cum Laude (**MCL**): 15.6%
  - Cum Laude (**CL**): 19.0%
  - Others (**Rite**): 61.2%
- After +/- grades (2014-18)
  - Change: **SCL** ↓0.5%, **MCL** ↑2.1%, **CL** ↑1.9%
  - For **SCL**, 0.5% is actually reduction of 12%  
 $\leftrightarrow (3.7\% - 4.2\%) / 4.2\% = -12\%$
  - **MCLs** & **CLs** grew more than **SCL** reduction
- Insufficient data to determine if increase in **MCL/CLs** was due to grade inflation or the change to +/- grading



# Grade Distribution in Classes with Whole-letter Grades

- Distribution of grades for individual classes at WSU (fall 2003)
  - Lower Division with 2.78 GPA
  - Upper Division with 3.12 GPA
  - Average of two (→ 2.95 GPA)
- **National average\***
- WSU ave is similar to National ave

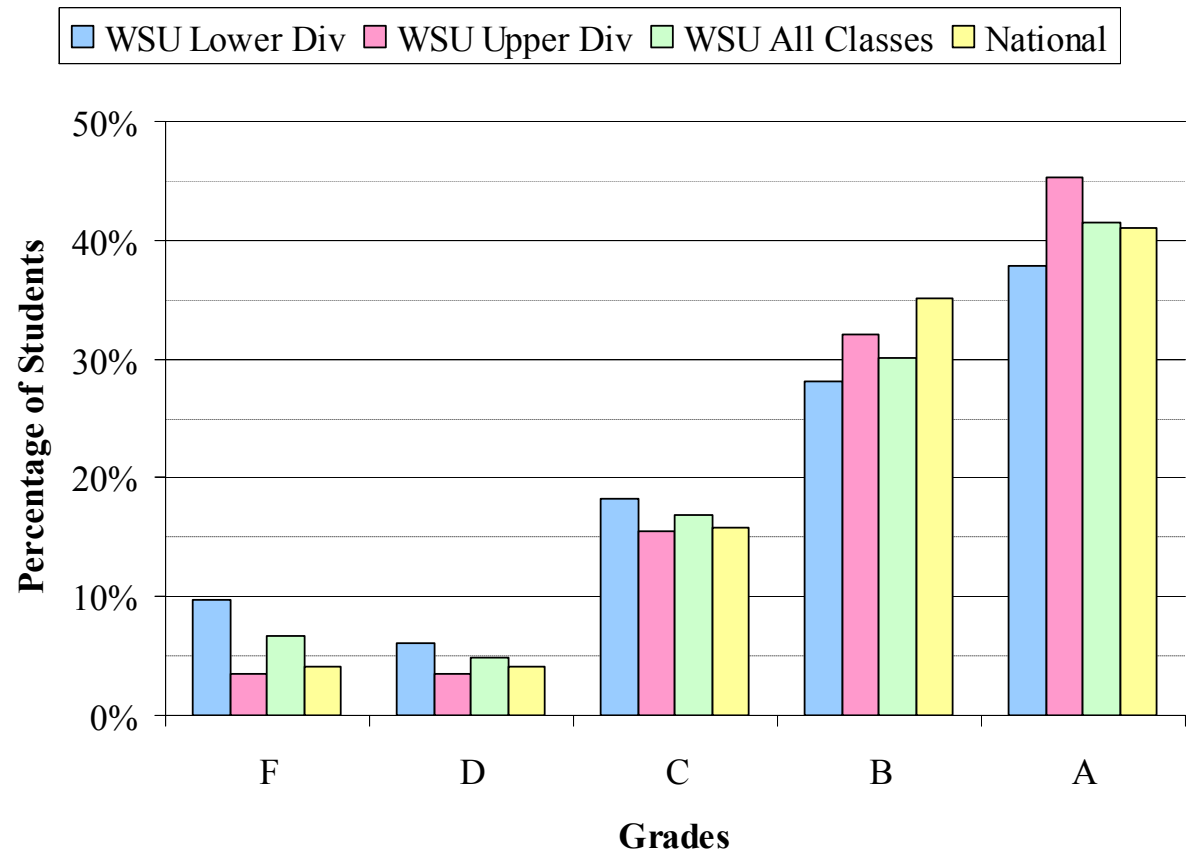


\*Reference: Rojstaczer  
[www.gradeinflation.com](http://www.gradeinflation.com)



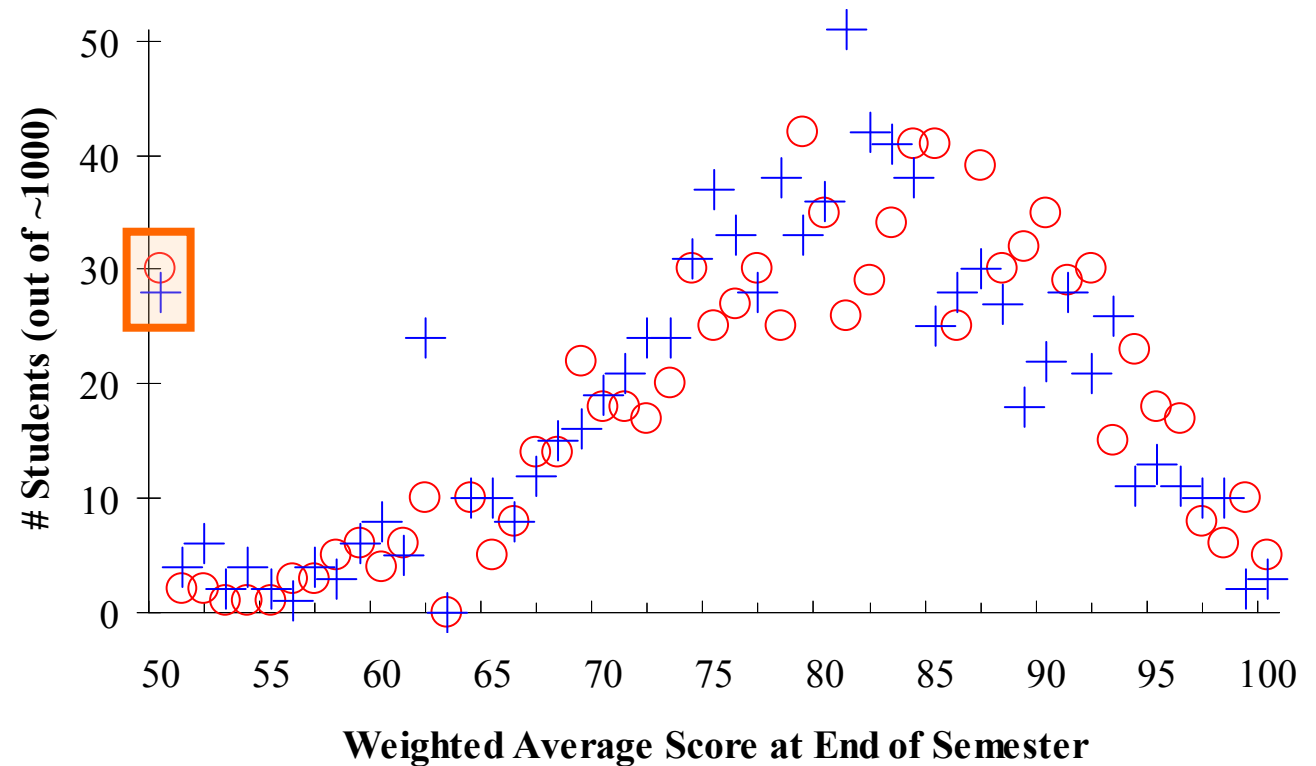
# Grade Distribution in Classes with Whole-letter Grades

- Higher GPA with more A's & B's for upper div than for lower div
- Distribution is not symmetric "Bell" shaped (Gaussian)
  - Mean shifted right
  - Left tail does not diminish – number of F's > D's
- Distribution with +/- grades not available → look at **actual** distribution for 1st author's classes



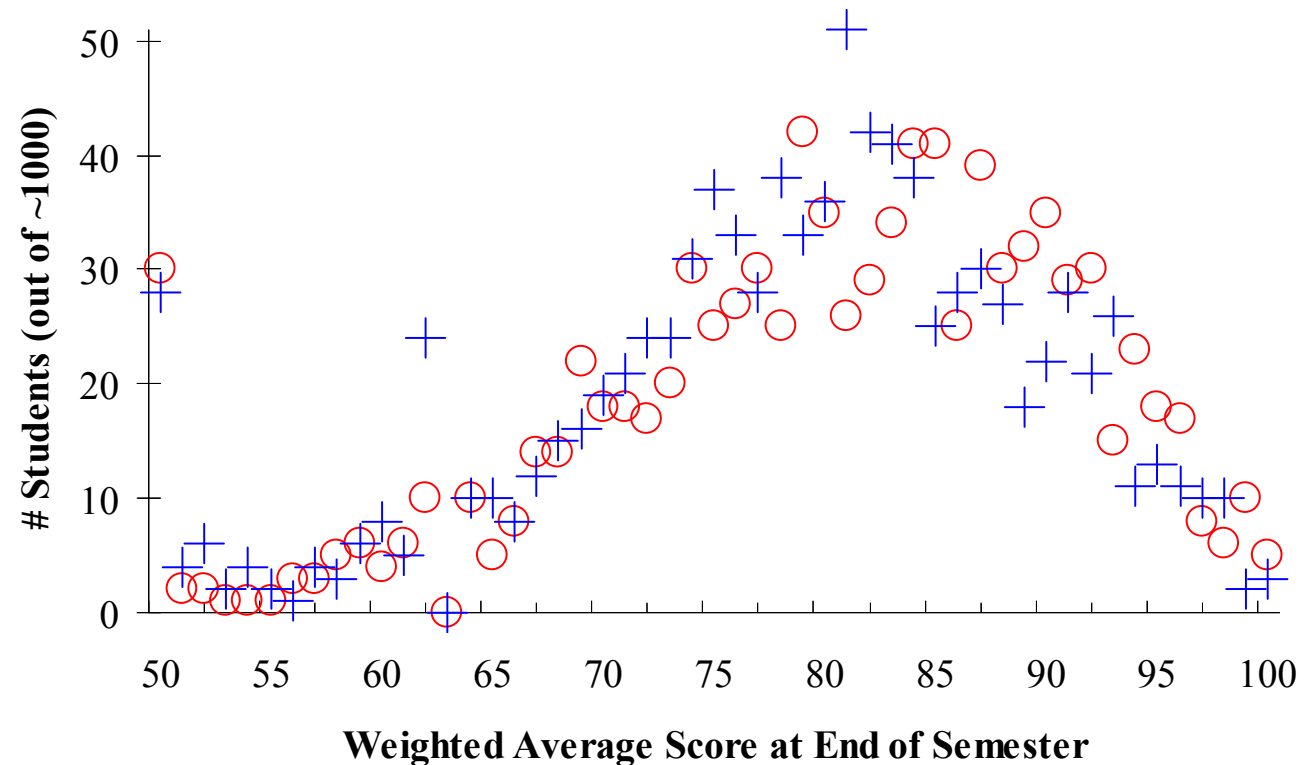
# Score Distribution of 1<sup>st</sup> Author's Aerospace Engineering Courses

- Two groups:
  - **Whole-letter** grade (2002-09) with ○, N=1000 students
  - **Plus-minus** grade (2009-14) with +, N=1020 students
- Score data (○ & +) in 1 pt bins
- **All scores < 50** are included in a single bin located at the 50 pt score bin



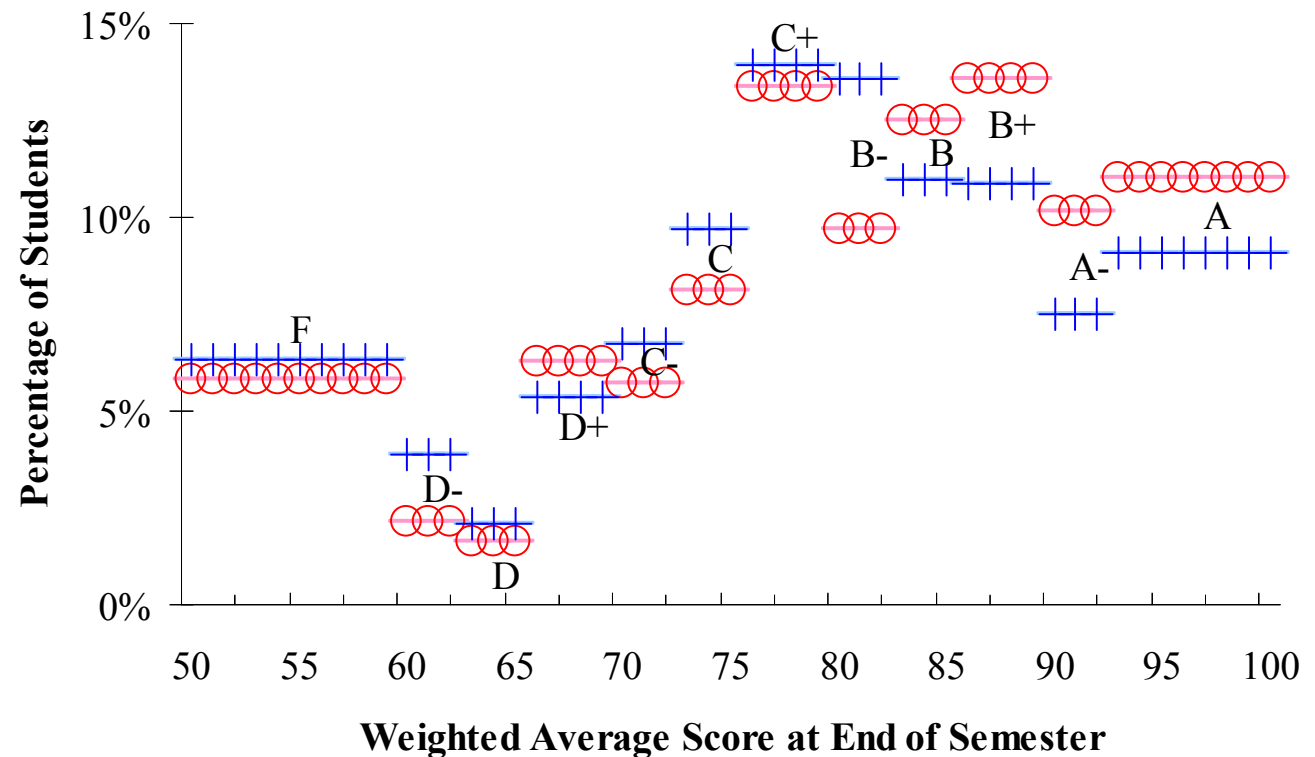
# Score Distribution of 1<sup>st</sup> Author's Aerospace Engineering Courses

- For each group of ~1000 students:
  - 1) ~500 students in sophomore year courses
  - 2) ~500 students in junior year courses
- Observations:
  - 1) Not smooth "bell" shaped (Gaussian)
  - 2) Has a lot of scatter
  - 3) Peak (and average) is in 80's
  - 4) Difficult to make further observations due to large volume of data shown



# Grade Distribution of 1<sup>st</sup> Author's Aerospace Engineering Courses

- Red ○ is whole-letter grade data (2002-09), but separated into +/- grade bins
- Plus-minus grade (2009-14) data shown as blue +
- First glance: there appears to be **fewer** A's & B's (more C's & D's) with +/- grading → requires further investigation



# Discussion of Score & GPA for Engineering Courses by 1<sup>st</sup> Author

- Statistics for courses under **whole-letter grades** (2002-09)

Category	# Students	# per class	Ave Score & S.D.	GPA
Sophomore Year	471	36	79 $\pm$ 17	2.51
Junior Year	529	44	80 $\pm$ 13	2.85
Overall Average	1000	40	80 $\pm$ 14	2.70

- Statistics for courses under **+/- grading** (2009-14)

Category	# Students	# per class	Ave Score & S.D.	GPA
Sophomore Year	471	47	76 $\pm$ 15	2.23
Junior Year	549	61	81 $\pm$ 11	2.68
Overall Average	1020	54	79 $\pm$ 13	2.48

# Discussion of Score & GPA for Engineering Courses by 1<sup>st</sup> Author

- Lower level class GPA < upper level class GPA

Category	# Students	# per class	Ave Score & S.D.	GPA
Sophomore Year	471	36	79 ± 17	2.51
Junior Year	529	44	80 ± 13	2.85
Overall Average	1000	40	80 ± 14	2.70

for both **whole-letter grade** and **+/- grade**, respectively

Category	# Students	# per class	Ave Score & S.D.	GPA
Sophomore Year	471	47	76 ± 15	2.23
Junior Year	549	61	81 ± 11	2.68
Overall Average	1020	54	79 ± 13	2.48

# Discussion of Score & GPA for Engineering Courses by 1<sup>st</sup> Author

- Whole-letter grade GPA > GPA for +/- grades, by ~.25 grd pts

Category	# Students	# per class	Ave Score & S.D.	GPA
Sophomore Year	471	36	79 ± 17	2.51
Junior Year	529	44	80 ± 13	2.85
Overall Average	1000	40	80 ± 14	2.70

for lower level, upper level, and overall average

Category	# Students	# per class	Ave Score & S.D.	GPA
Sophomore Year	471	47	76 ± 15	2.23
Junior Year	549	61	81 ± 11	2.68
Overall Average	1020	54	79 ± 13	2.48

# Discussion of Score & GPA for Engineering Courses by 1<sup>st</sup> Author

- Lower level score average is different, but others are similar

Category	# Students	# per class	Ave Score & S.D.	GPA
Sophomore Year	471	36	79 ± 17	2.51
Junior Year	529	44	80 ± 13	2.85
Overall Average	1000	40	80 ± 14	2.70

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# Discussion of Score & GPA for Engineering Courses by 1<sup>st</sup> Author

- **Standard deviation** narrows for +/- grades – possible cause?

Category	# Students	# per class	Ave Score & S.D.	GPA
Sophomore Year	471	36	79 ± 17	2.51
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# Discussion of Score & GPA for Engineering Courses by 1<sup>st</sup> Author

- Could change to +/- grades cause this difference?

Category	# Students	# per class	Ave Score & S.D.	GPA
Sophomore Year	471	36	79 $\pm$ 17	2.51
Junior Year	529	44	80 $\pm$ 13	2.85
Overall Average	1000	40	80 $\pm$ 14	2.70

Convert to whole-letter grades & **re-calculate GPAs** → no change

Category	# Students	# per class	Ave Score & S.D.	GPA
Sophomore Year	471	47	76 $\pm$ 15 <b>2.22</b>	← 2.23
Junior Year	549	61	81 $\pm$ 11 <b>2.69</b>	← 2.68
Overall Average	1020	54	79 $\pm$ 13 <b>2.48</b>	← 2.48

# Discussion of Score & GPA for Engineering Courses by 1<sup>st</sup> Author

- Recent (+/- grade) class size larger → likely cause of GPA ↓

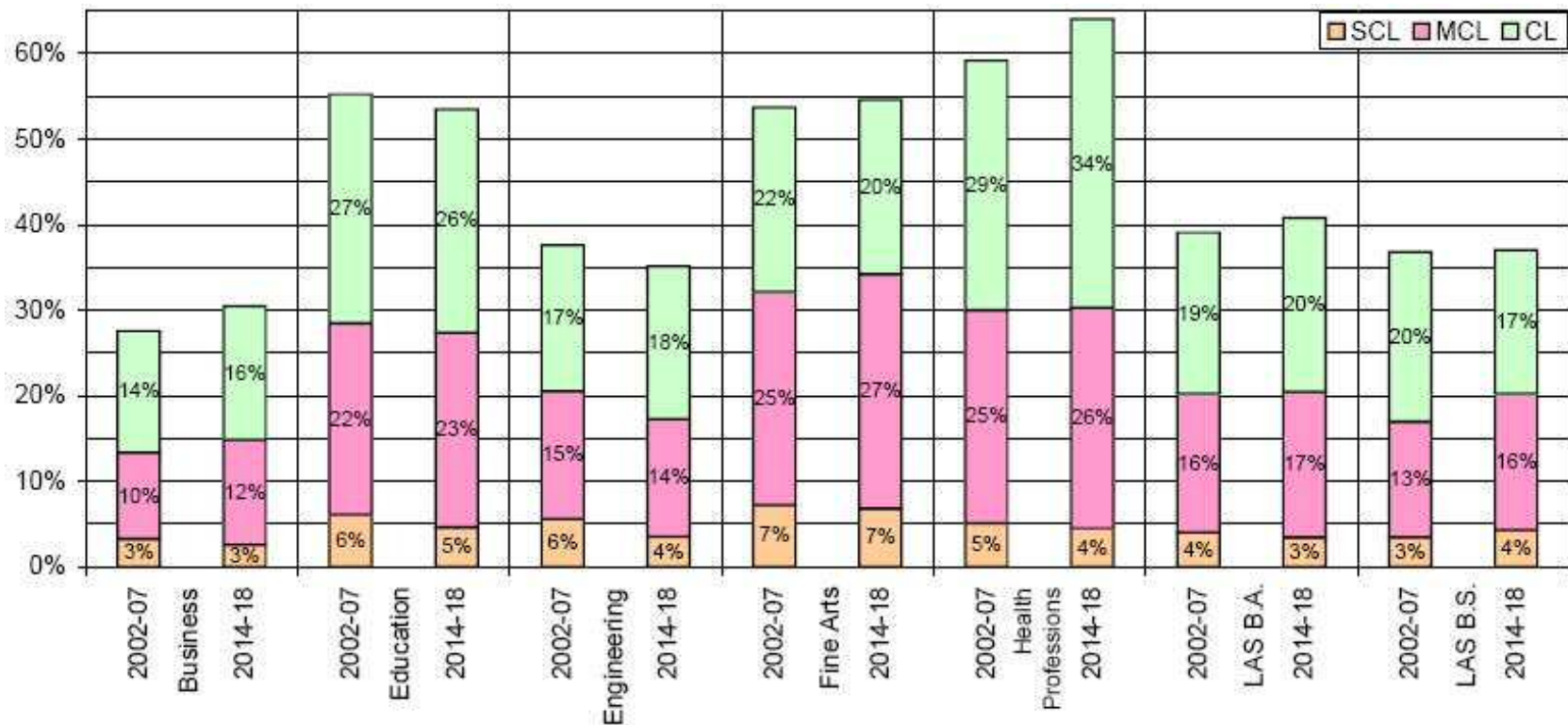
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Overall Average	1000	40	80 ± 14	2.70

- o Topic for future paper

Category	# Students	# per class	Ave Score & S.D.	GPA
Sophomore Year	471	47	76 ± 15	2.23
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Overall Average	1020	54	79 ± 13	2.48

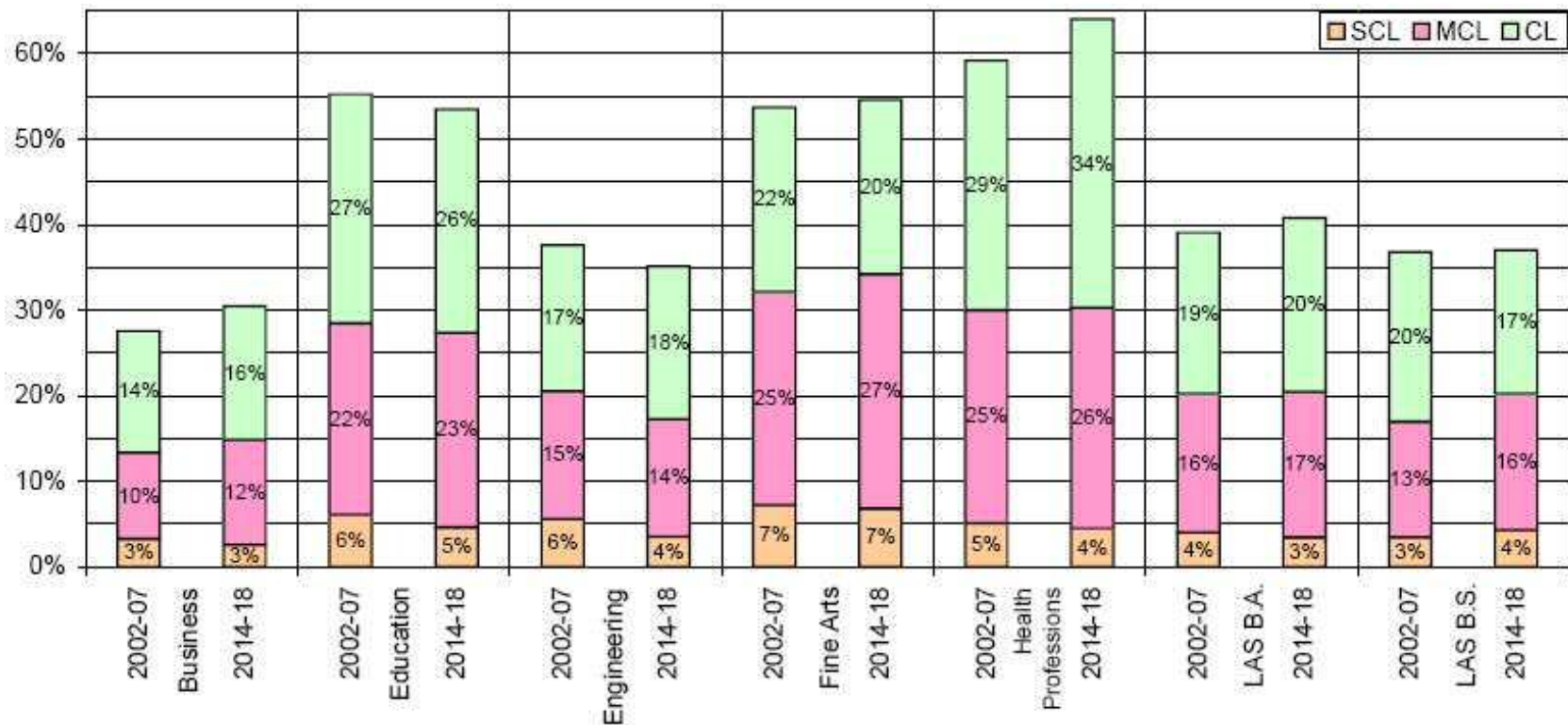
# Results of Graduation with Academic Distinction by Discipline

- Results by discipline: whole-letter grade on left & +/- grade on right
- SCL = orange (bottom), MCL = pink (middle), CL = green (top)



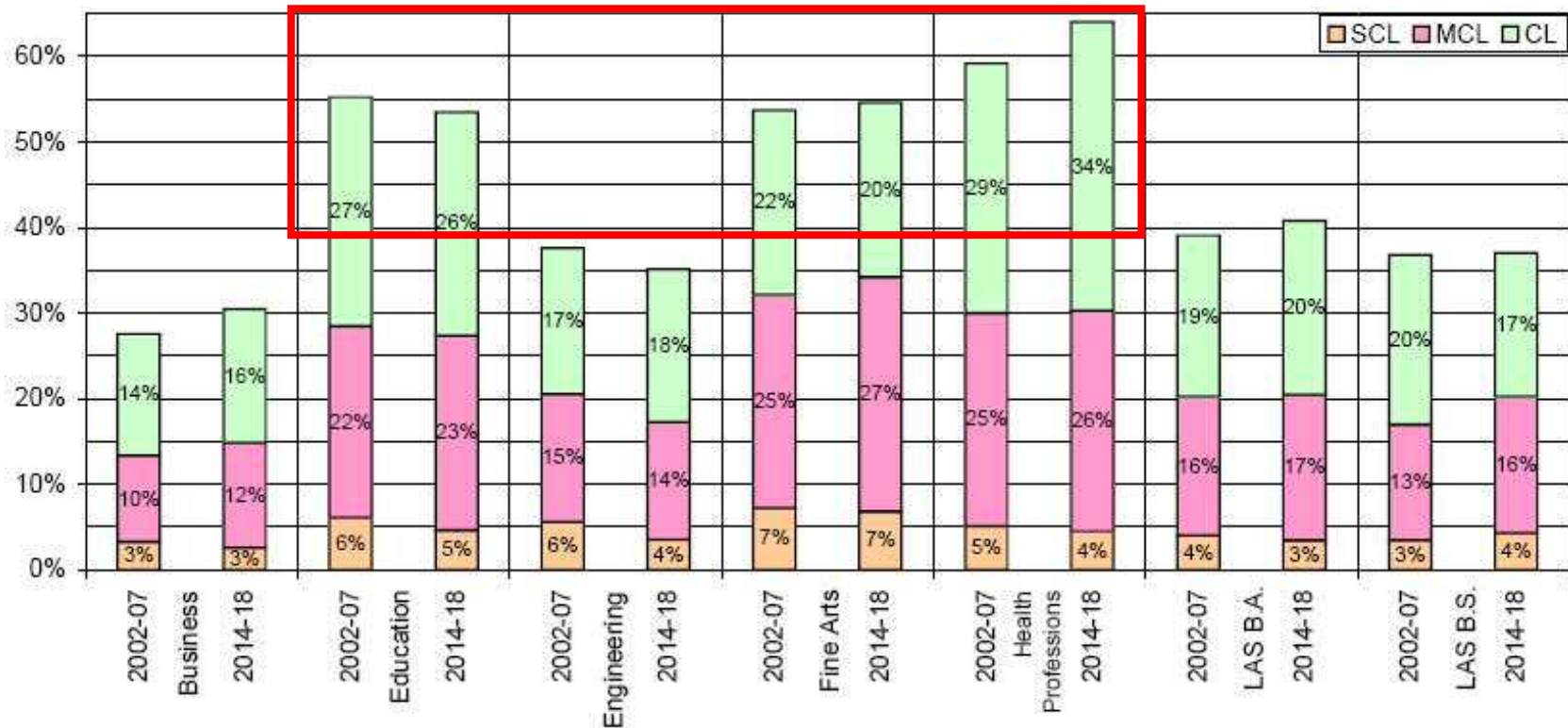
# Results of Graduation with Academic Distinction by Discipline

- Comparing across disciplines is not meaningful because of differing requirements



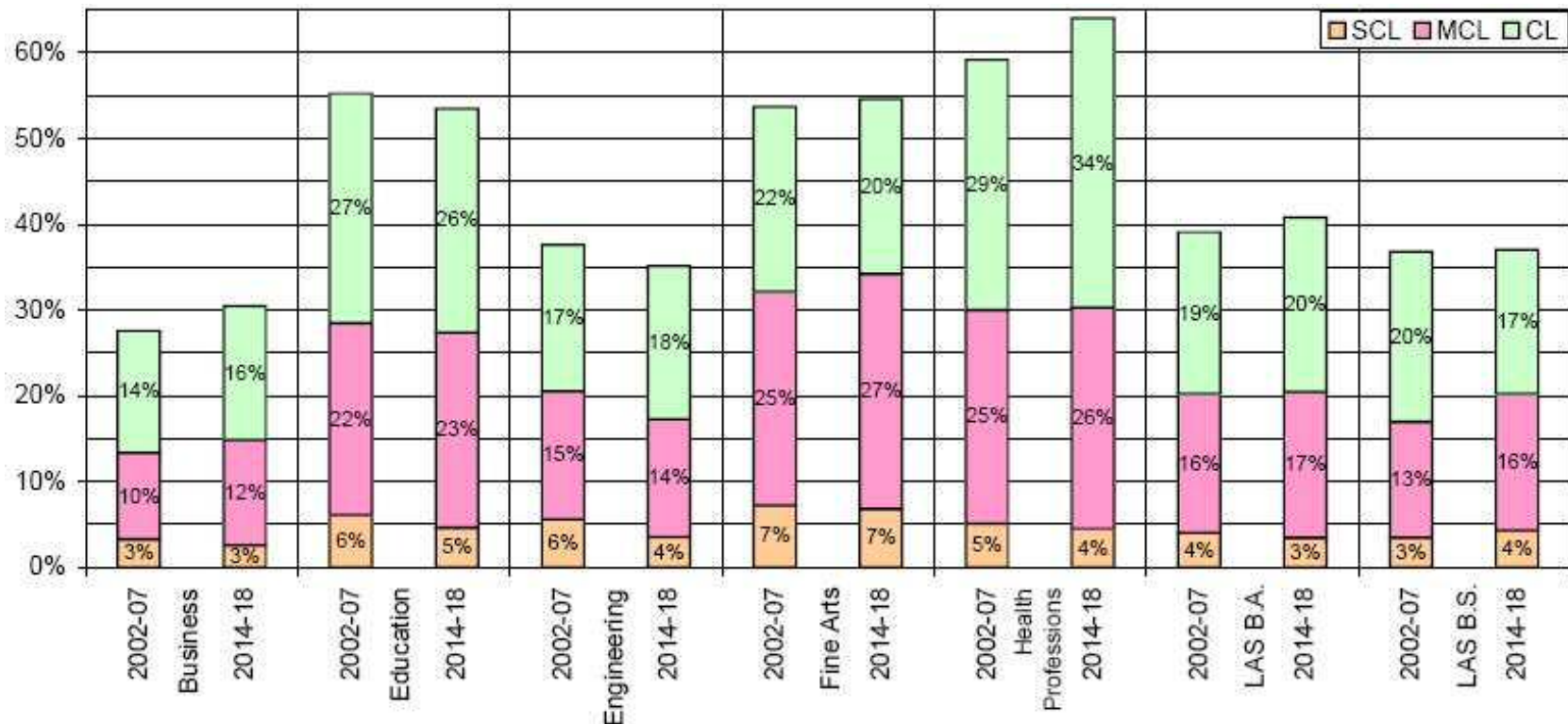
# Results of Graduation with Academic Distinction by Discipline

- o Example 1: Education & Health Professions requires GPA $\geq$ 2.5
- o Example 2: Fine Arts requires passing sophomore review



# Results of Graduation with Academic Distinction by Discipline

- Most disciplines increased number of graduates with distinction
- Finer details & observations easier to see from tabular results



# Change in Number of Graduates with Academic Distinction by Discipline

- Table gives amount of change: those under whole-letter grade minus those under +/-

Discipline	SCL	MCL	CL	SCL+MCL+CL
Business	-0.7%	+2.2%	+1.4%	+2.9%
Education (now Applied Studies)	-1.5%	+0.3%	-0.6%	-1.8%
Engineering	-2.1%	-1.2%	+0.8%	<b>-2.9%</b>
Fine Arts	-0.4%	+2.5%	-1.2%	+0.9%
Health Professions	-0.6%	+0.9%	+4.6%	+4.9%
Liberal Arts B.A.	-0.6%	+0.9%	+1.4%	+1.7%
Liberal Arts B.S.	+0.8%	+2.4%	-3.0%	+0.2%
Entire University	-0.5%	+2.1%	+2.1%	+3.5%



# Change in Number of Graduates with Academic Distinction by Discipline

- Number of SCL decreased for almost every discipline
  - Only exception is Liberal Arts B.S.

Discipline	SCL	MCL	CL	SCL+MCL+CL
Business	-0.7%	+2.2%	+1.4%	+2.9%
Education (now Applied Studies)	-1.5%	+0.3%	-0.6%	-1.8%
Engineering	-2.1%	-1.2%	+0.8%	<b>-2.9%</b>
Fine Arts	-0.4%	+2.5%	-1.2%	+0.9%
Health Professions	-0.6%	+0.9%	+4.6%	+4.9%
Liberal Arts B.A.	-0.6%	+0.9%	+1.4%	+1.7%
Liberal Arts B.S.	+0.8%	+2.4%	-3.0%	+0.2%
Entire University	-0.5%	+2.1%	+2.1%	+3.5%

# Change in Number of Graduates with Academic Distinction by Discipline

- Sum of all graduates with distinction increased in most disciplines
  - Only exceptions are [Education and Engineering](#)

Discipline	SCL	MCL	CL	SCL+MCL+CL
Business	-0.7%	+2.2%	+1.4%	+2.9%
Education (now Applied Studies)	-1.5%	+0.3%	-0.6%	-1.8%
Engineering	-2.1%	-1.2%	+0.8%	<b>-2.9%</b>
Fine Arts	-0.4%	+2.5%	-1.2%	+0.9%
Health Professions	-0.6%	+0.9%	+4.6%	+4.9%
Liberal Arts B.A.	-0.6%	+0.9%	+1.4%	+1.7%
Liberal Arts B.S.	+0.8%	+2.4%	-3.0%	+0.2%
Entire University	-0.5%	+2.1%	+2.1%	+3.5%

# Change in Number of Graduates with Academic Distinction by Discipline

- Reduction in graduation with distinction in Engineering is **-2.9%**
  - Corresponds to reduction of **7.6%** =  $-2.9\% / (5.6\% + 14.9\% + 17.1\%)$

Discipline	SCL	MCL	CL	SCL+MCL+CL
Business	-0.7%	+2.2%	+1.4%	+2.9%
Education (now Applied Studies)	-1.5%	+0.3%	-0.6%	-1.8%
Engineering	-2.1%	-1.2%	+0.8%	<b>-2.9%</b>
Fine Arts	-0.4%	+2.5%	-1.2%	+0.9%
Health Professions	-0.6%	+0.9%	+4.6%	+4.9%
Liberal Arts B.A.	-0.6%	+0.9%	+1.4%	+1.7%
Liberal Arts B.S.	+0.8%	+2.4%	-3.0%	+0.2%
Entire University	-0.5%	+2.1%	+2.1%	+3.5%

# Summary

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- Effect of +/- grading system on graduation with academic distinction was considered
  - Data sets consisted of five-year periods when whole-letter grades were used and for a similar period under +/- grading
- Overall, the number of *summa cum laudes* decreased with +/- grading while the number of graduates in other distinction categories increased
- In engineering, there was a decrease in *summa* and *magna cum laudes* without a corresponding increase in *cum laudes*
- Actual grade distributions in Engineering classes were also considered
  - Increased class size appeared to affect student performance
  - This is a topic for future study