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Rank: **Professor**

Department: **Information Systems and Quantitative Management, College of Business Administration.**

Title of the Project: **“Using Active Learning Techniques in Quantitative Business Courses”**

Award term: **Summer 2006.**

Work completed: **Over multiple semester using MBAA 603: Introduction to Statistics as the test course. It is a continuous process as adaptation is required on an on-going basis due to changing nature of the course materials, technology for delivery, and the students. I reported my work accomplished till Spring 2008 in a CTE presentation.**

Description of actual work: **Incorporated multiple in-class activities for engaging the students, developed and administered review quizzes for each class that would encourage active problem solving by teaming with a classmate (think-pair-share techniques), and revised the overall delivery method from lecture to student oriented discovery of the concepts through simple exercise.**

Results and dissemination: **The students’ evaluation went up in the area related to teaching, the likelihood of taking the professor again shot up from 53% to 91% and a survey of the students indicated very positive attitude towards the activities and the course. The overall findings and the techniques employed were presented in CTE as well as disseminated through a poster session. I also presented some of the concepts in teaching workshops in multiple national and international conferences in our area.**

Conference presentations:

November 4-7, 2007, INFORMS Annual Meeting, Seattle, Washington.

Dec 27-30, 2007, AIMS 5th International Conference on Management, Hyderabad, India.

Incorporating Active Learning in Quantitative Business Courses

Kala C. Seal

College of Business Administration

Report on CTE Grant

Outline

- Statistics in MBA and Active Learning (Why)
- The Proposal (What)
- Active Learning Techniques (How)
- Results
- Conclusion

Why

- Teaching Quantitative Courses in MBA is a challenge.
 - Various background
 - Math phobia ☹ ☹
 - Lack of Excel skills ☹
 - Inability to connect to real world
 - “When would I ever use it” syndrome
- Active Learning can address a number of these problems.
- I tried it with Statistics Course and hoped to transfer the learning to other quantitative courses as well.

Why Not!

- Regular lecturing sure was not getting me anywhere!
- I knew Active Learning can help, but wanted to find out how.
- Quantitative Courses pose unique challenges
 - Skill based as opposed to just fact based
 - Must connect with the real world applications (math part is necessary but not sufficient)
 - More depth than breadth
 - Interdependent concepts builds on each other

Active Learning

- Definition (Wikipedia, of course! 😊):
 - **Active learning** is an umbrella term that refers to several models of instruction that focus the responsibility of learning on learners.
 - Bonwell and Eison (1991) popularized this approach to instruction. This "buzz word" of the 1980s became their 1990s report to the Association for the Study of Higher Education (ASHE). In this report they discuss a variety of methodologies for promoting "active learning."
 - According to Mayer (2004) strategies like "active learning" developed out of the work of an earlier group of theorists -- those promoting discovery learning.
 - Later further distinctions were made between behavioral active learning and cognitive active learning.
- I tried to do a mix and match of the various techniques.

What

- There are tons of materials on the web on Active Learning in Statistics (*Journal of Statistical Education* is an amazing resource).
 - Also try: http://www.ruf.rice.edu/~lane/stat_sim/index.html
- Computer and Simulation Packages open up many new possibilities.
- I developed the activities based on some of those ideas and introduced a few of my own.
- Also tried to use some of the cognitive learning cycle (Kolb, Bloom) in creating the activities and review.

List from the Web

- Go to a local grocery store and collect these data for at least 75 breakfast cereals: cereal name; grams of sugar per serving; and the shelf location (bottom, middle, or top). Group the data by shelf location and use three boxplots to compare the sugar content by shelf location. [Observational data; using boxplots to summarize data, can also be used for ANOVA test; high-sugar cereals are often at child-eye height.]
- Use computer software to simulate 1,000 flips of a fair coin. Record the fraction of the flips that were heads after 10, 100, and 1,000 flips. Repeat this experiment 100 times and then use three histograms to summarize your results. [Simulation data; using histograms to summarize data; demonstrates central limit theorem and effect of sample size on standard deviation.]
- Estimate the average number of hours that students at this school sleep each day, including both nighttime sleep and daytime naps. Also estimate the percentage who have been up all night without sleeping at least once during the current semester. [Survey data; confidence intervals for quantitative and qualitative data; students sleep less than 8 hours and many have all-nighters; if done at the beginning and end of the term, the differences are as expected.]
- The rest is in the handout.

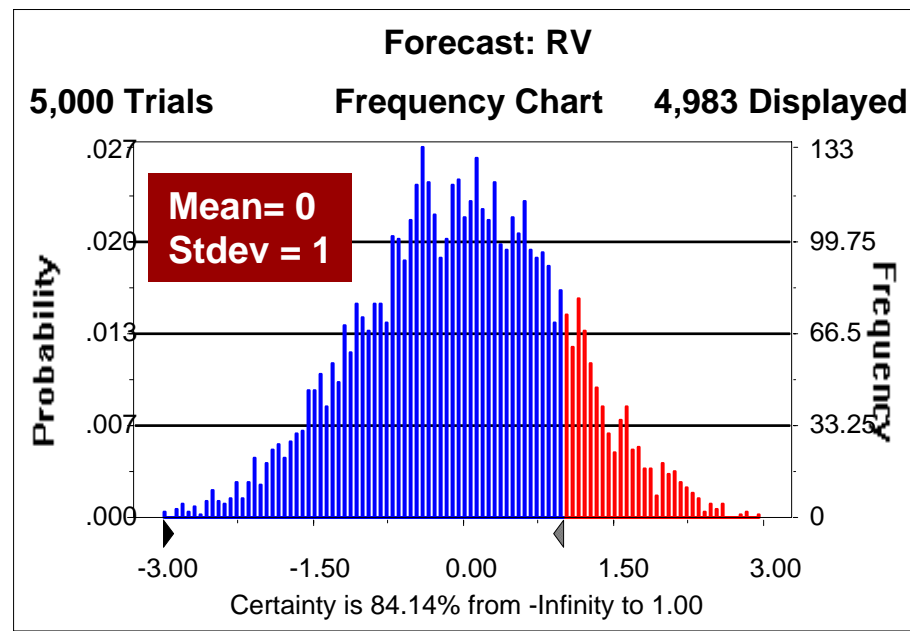
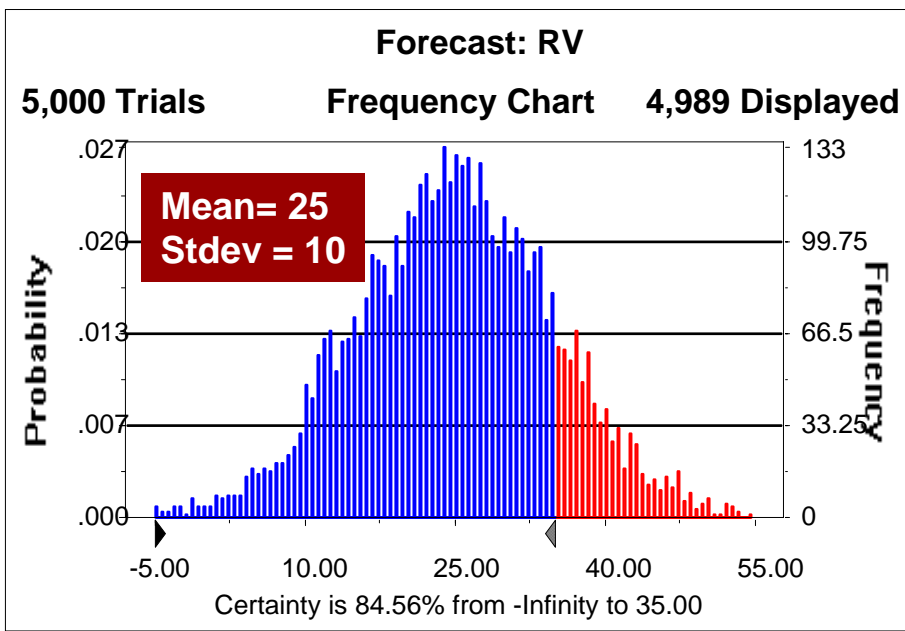
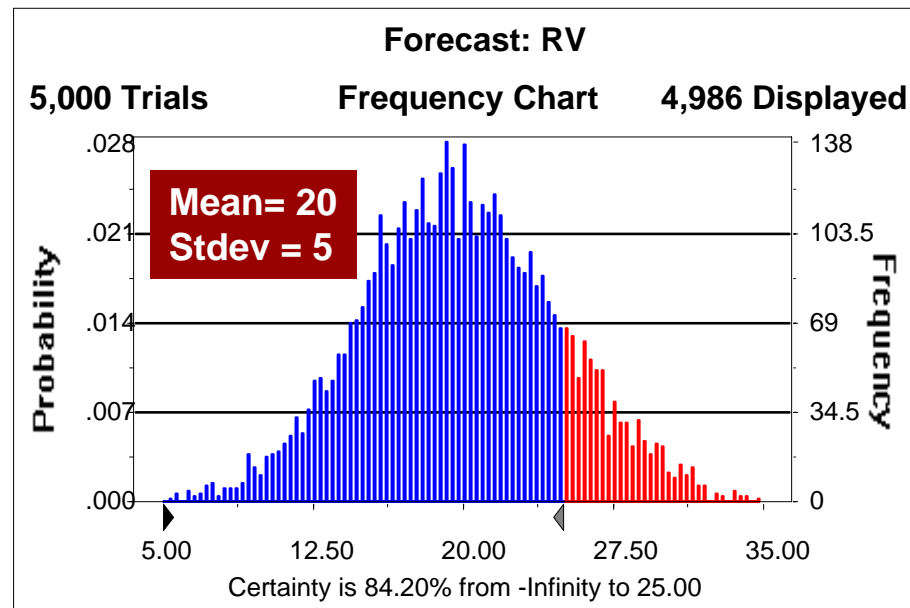
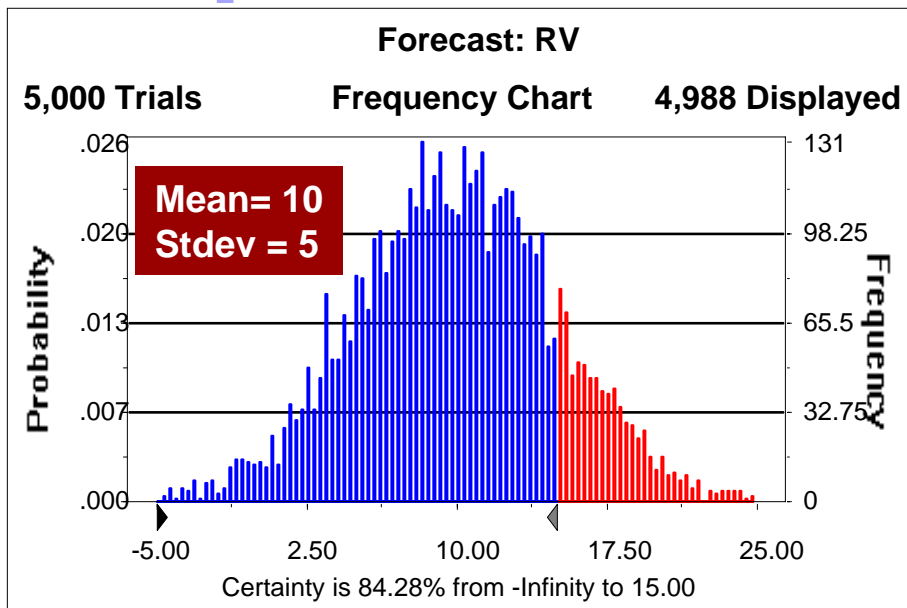
A Partial List of What

- Data collection from MLS listing
 - Idea of data sources
 - Cleaning data and coping with missing data
 - Sampling
- Using the data then for identification of outlier, pattern etc.
 - Box Plots, Histogram, etc.
- Coin tossing by various groups
 - Probability and convergence
- Crystal Ball Simulation for Normal Distributions and equivalence between them
- Crystal Ball Simulation to demonstrate the Central Limit Theorem
- Data Collection in class on “Amount Ready to Spend on First Date/Birthdays” etc. (also sometime salaries, amount of cash in the pocket, etc.)
 - Hypothesis Testing
- Developing the Linear Regression between 2 variables on a graph paper
 - Helps in understanding the concept of Intercept and Slope, Errors (residuals), Total Error and drives home the concept of Least Square Method.
- Captivate modules for Excel work (with voice)
- Most successful: Review Quiz in the beginning of each class (open book, open notes)
 - Memory Jogger (Fill in the Blanks)
 - Concept Testing (small problems, true and false statements, etc.)
 - Application (one problem from the book or from old tests)
 - Not graded, students are asked to compare the answers and discuss the differences

Selected Examples

- MLS visit for offering a price for a house.
- Coin Tossing
- Normal Distributions
- CLT
- Printout for Sampling in class
- Printout of the review quiz
- Printout of Regression Scatter Plot
- Excel Demo (Captivate)

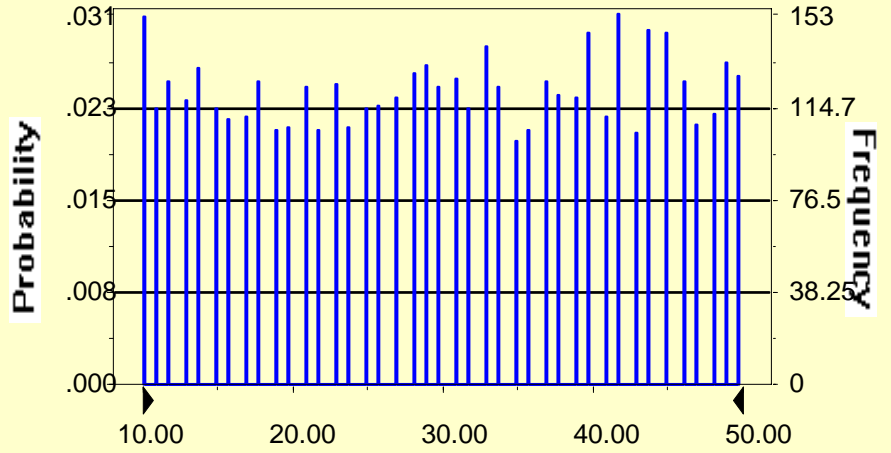
Equivalence of Normal Distributions



Simulation of Central Limit Theorem

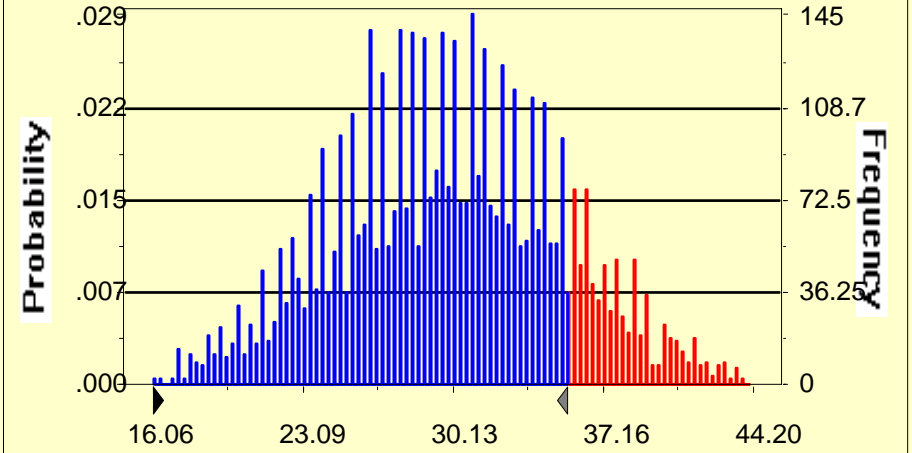
Forecast: Uniform Distribution

5,000 Trials Frequency Chart 5,000 Displayed



Forecast: Mean from 5 samples

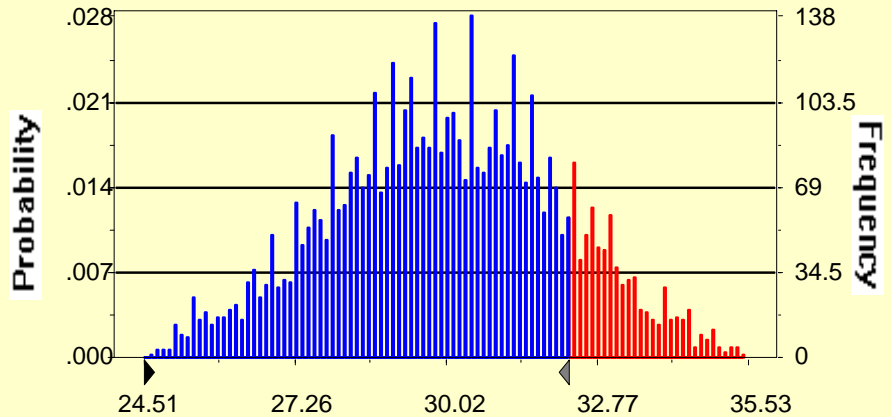
5,000 Trials Frequency Chart 4,965 Displayed



Certainty is 84.52% from -Infinity to 35.48

Forecast: Mean from 30 samples

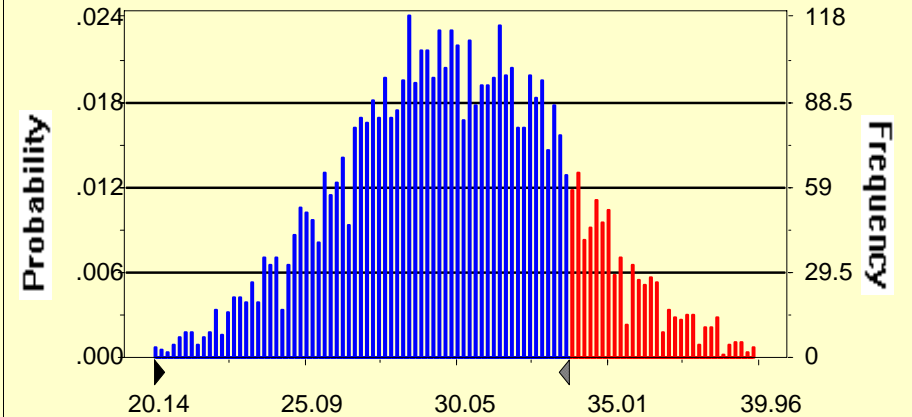
5,000 Trials Frequency Chart 4,949 Displayed



Certainty is 84.36% from -Infinity to 32.26

Forecast: Mean from 10 samples

5,000 Trials Frequency Chart 4,964 Displayed



Certainty is 84.58% from -Infinity to 33.75

Mean from
30
samples

Actual Samples or Population Points

28.37	13	16	42	36	39	19	17	18	16	44	33	17	44	32	47	36	17	31	38	36	16	48	26	35	12	47	18	20	10	28
32.00	42	24	39	25	14	18	30	49	46	19	47	42	31	25	37	39	33	25	47	48	18	33	40	49	10	34	33	17	36	10
28.93	49	11	22	45	25	39	19	22	39	30	29	12	35	36	44	20	15	21	49	17	28	43	49	34	42	21	35	14	12	11
32.57	22	41	15	42	46	36	48	14	40	49	26	36	50	32	17	36	12	37	13	23	19	48	25	37	46	36	12	47	49	23
28.90	25	12	25	49	23	26	16	31	45	33	13	42	31	13	16	28	20	50	12	45	47	11	28	24	18	29	39	29	48	39
32.30	35	44	28	24	29	22	34	19	32	15	40	13	50	15	48	49	37	39	37	27	21	47	40	46	17	43	29	45	24	20
29.47	12	45	18	21	23	16	46	16	33	23	35	24	32	17	35	46	35	31	41	36	43	12	40	24	48	32	24	12	23	41
32.17	45	18	11	20	30	34	27	34	47	50	36	20	13	25	37	48	32	31	38	14	11	31	28	46	50	37	23	39	48	42
33.90	30	49	35	15	43	30	26	45	36	42	44	12	33	34	50	13	47	38	16	30	48	38	19	44	39	25	22	31	43	40
30.93	10	12	43	34	16	49	34	49	26	30	20	29	21	44	49	24	39	42	17	38	38	27	11	34	37	16	43	37	28	31
30.57	50	10	26	25	44	11	38	50	25	48	39	37	48	18	18	47	37	19	39	28	24	41	32	24	40	32	26	18	11	12

26.60

31.13

27.30

31.37

34.83

35.63

29.23

29.97

32.00

29.97

31.00

Now we see that the data on the left are the sample means from 1000 sets of sample, each set containing 30 samples. Or the experiment is repeated 1000 times. What will be the behavior of the sample means collected from these 1000 repetitions?

Students can create histograms and compare that with the Crystal Ball output and see for themselves the Normal distribution of the sample means and can figure out the parameters.

Simulation of Central Limit Theorem

Forecast: Uniform Distribution

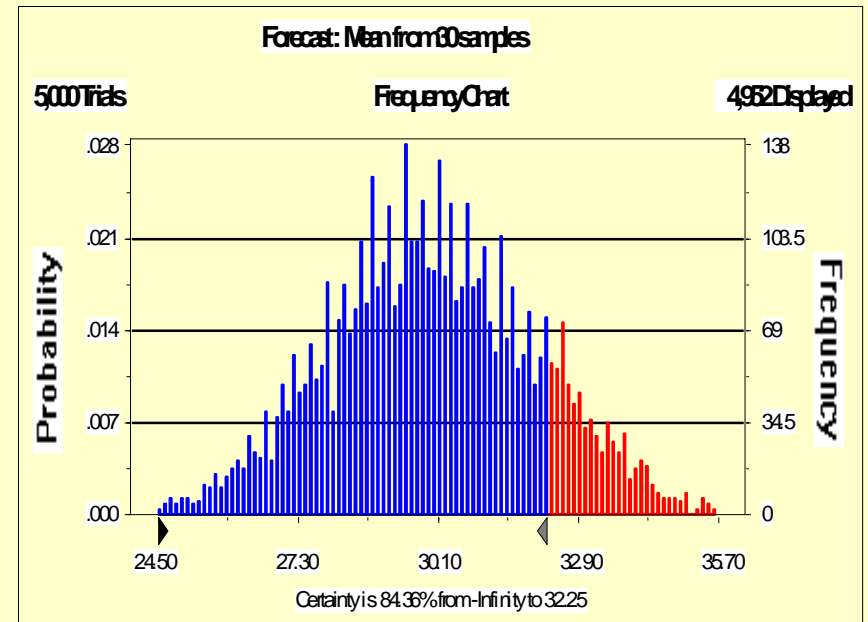
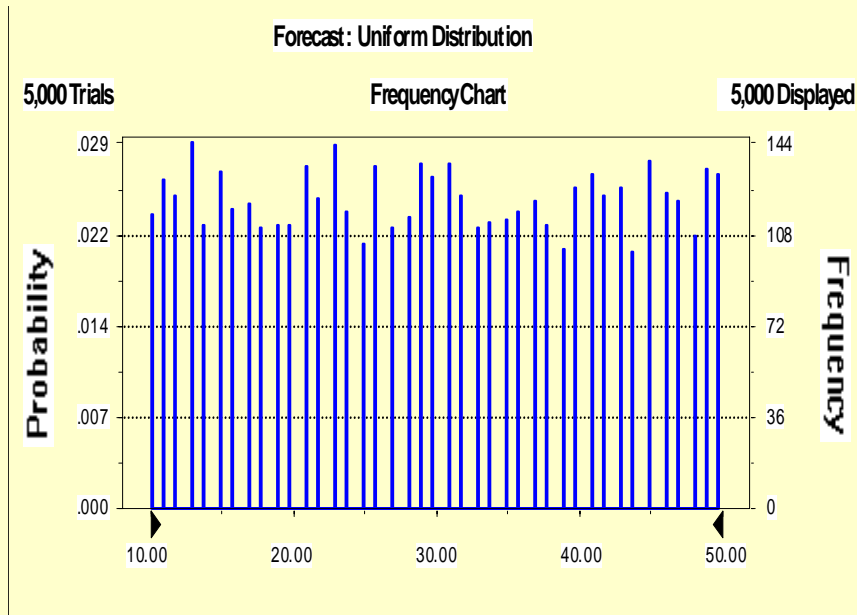
Forecast: Mean from 30 samples

Statistics:	Value
Trials	5000
Mean	29.96
Median	30.00
Mode	13.00
Standard Deviation	11.90
Variance	141.60

X or population

Statistics:	Value
Trials	5000
Mean	30.00
Median	29.97
Mode	29.57
Standard Deviation	2.14
Variance	4.60

X bar (30) or Sample Means



Results

- Collected feedback from students
 - See the printout of the feedback form
- Comparison of student evaluations
- Comparison of the grades

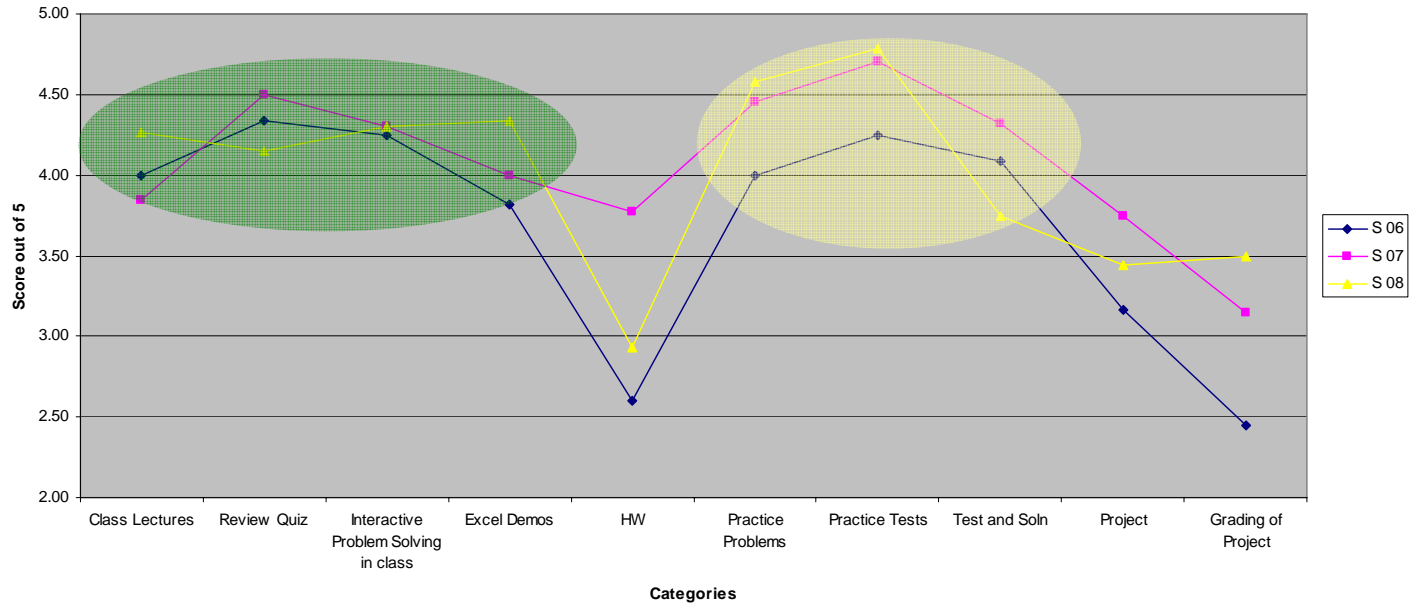
Average Survey Scores

Semester	Class Lectures	Review Quiz	Interactive Problem Solving in class	Excel Demos	HW	Practice Problems	Practice Tests	Test and Soln	Project	Grading of Project
S 06	4.00	4.33	4.25	3.82	2.60	4.00	4.25	4.08	3.17	2.44
S 07	3.84	4.50	4.30	4.00	3.77	4.45	4.70	4.32	3.75	3.15
S 08	4.27	4.15	4.30	4.33	2.93	4.58	4.79	3.75	3.44	3.50

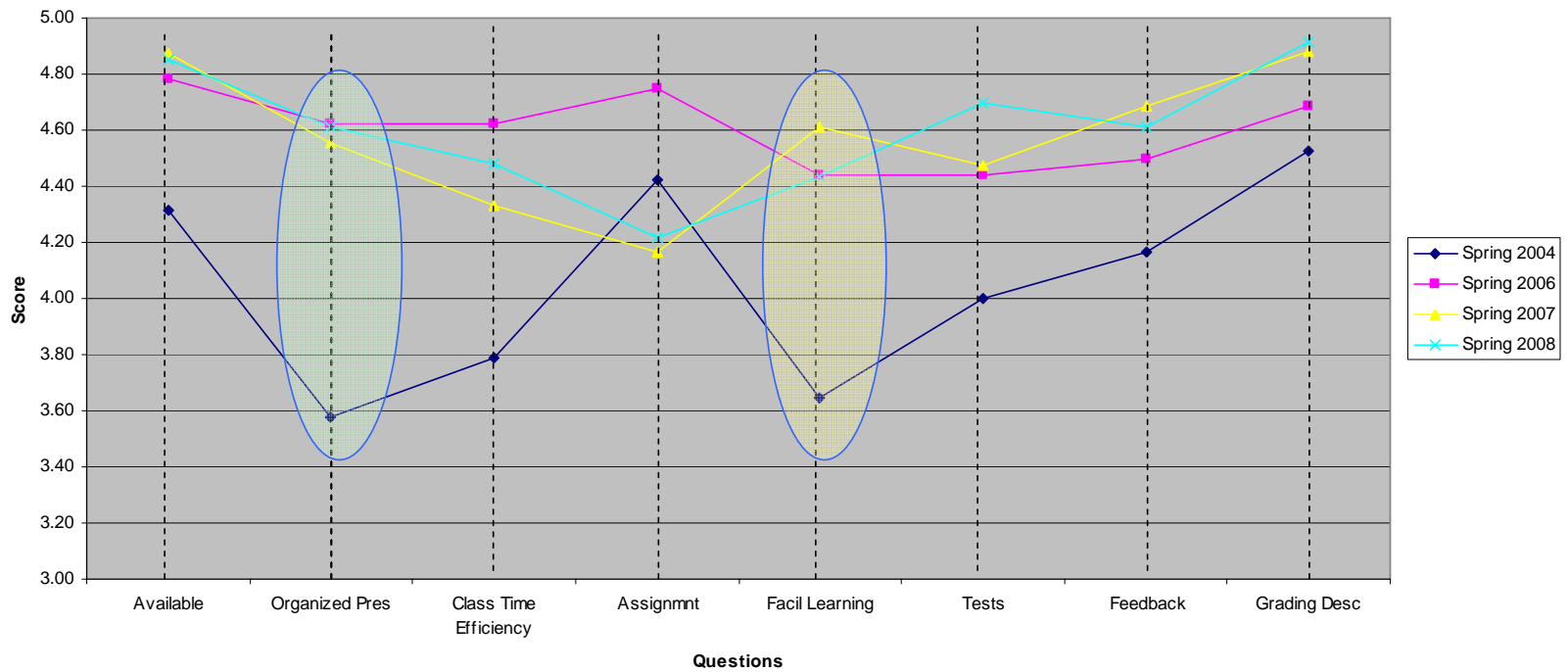
Student Evaluation

Sem	Available	Organized Pres	Class Time Efficiency	Assignmt	Fail Learning	Tests	Feedback	Take Again?
Spring 2004	432	358	379	4.42	365	4.00	4.17	53%
Spring 2006	479	463	463	4.75	444	4.44	4.50	79%
Spring 2007	488	456	433	4.17	461	4.47	4.68	71%
Spring 2008	485	461	448	4.22	443	4.70	4.61	91%

Student View of the Activities

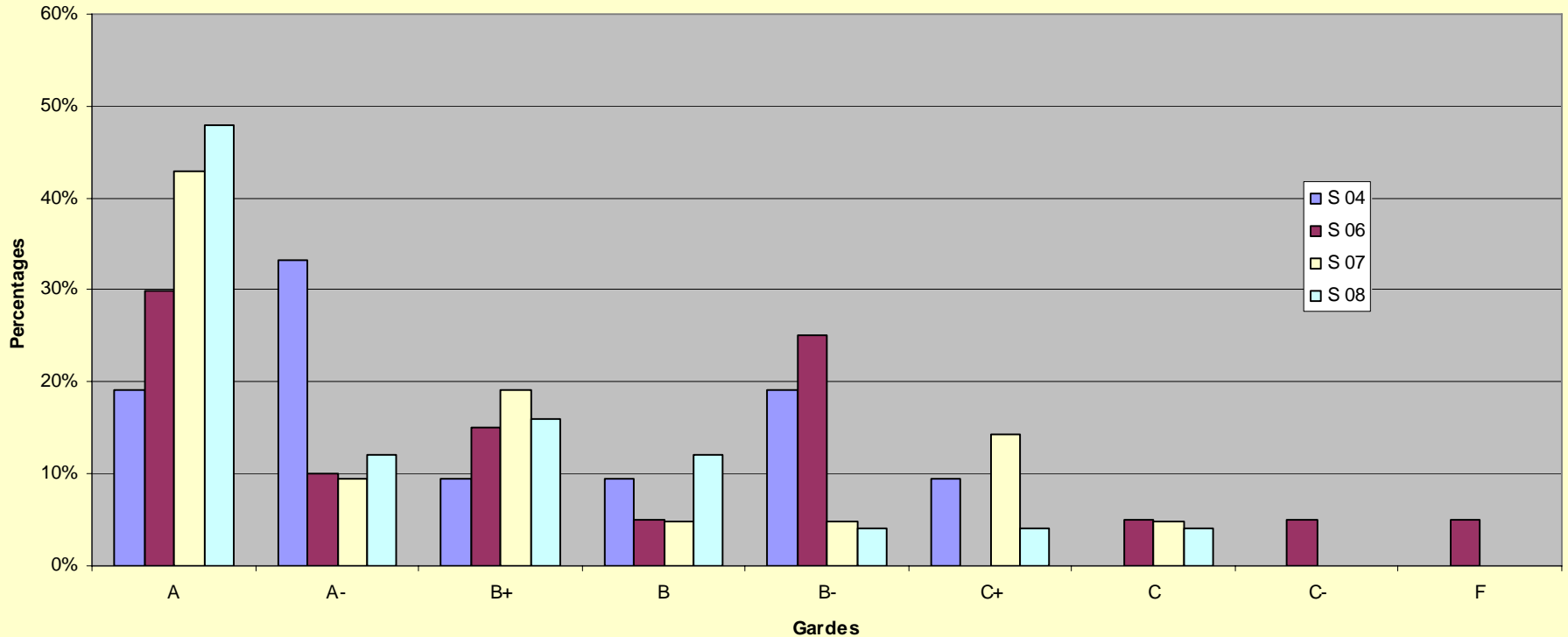


Evaluation Comparison



Student Grade Summary

Grade Distribution Over Semesters



Semester	S04	S 06	S 07	S 08
CV =	8.75	11.70	8.33	8.80
Median =	876.00	851.75	890.00	908.50
Stdev =	74.63	98.30	73.47	78.29
Average=	853.17	839.98	882.48	889.24
n =	21	20	21	25

Conclusion

- Definitely worth it, makes the class engaged (nobody can sleep)!
- Relatively easy once the initial investment is made.
- Can easily be done within the class time and you CAN cover all the materials!
 - I also believe in teaching well even if that means teaching less!
- Improves teaching.
- Do they improve learning?
 - I feel they do, but statistically it is inconclusive! There is also no easy way to measure it!
- I now have ideas to transfer this to other quantitative courses (Business Intelligence, Operations, etc.).
- Need a class with computers for a number of the ideas presented.



Thank You!