# Business Math: A Pedagogical Odyssey

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ColoMATYC, Mar. 2011
Pueblo, Colorado

## Today's Outline

- Philosophies and Books
- Calculators and TVM Problems
- Spreadsheets
- The Main Idea: Percents
- Online Homework
- The Future?

## Two Common Book Types

- Arithmetic-based: review and applications of arithmetic, emphasis on drill and process, some topics only lightly covered
- Algebra-based: introduction to algebra, emphasis on formulas and equations

## Chapters of an Algebra-Based Book

- Fractions
- Equations & Formulas
- Percents
- Banking (checking)
- Payroll
- Taxes
- Risk (insurance)
- Math of buying
- Markup
- Markdown, Inventory
- Simple interest
- Notes & discount
- Compound interest
- Annuities & sinking funds
- Loans
- Depreciation
- Financial statements
- Securities
- Business statistics

## Philosophy of the JCCC Business Math Course

- Fundamentals of Math is a prerequisite
- Algebra is not a prerequisite
- Algebra is not an objective
- Uses technology
- Problem solving emphasis

## Compound Interest & Annuities (Time Value of Money)

- Formulas: $A=\left[P+\frac{M(1+kR)}{R}\right]\left[1-(1+R)^{N}\right]-P$
- Tables: $s_{\overline{n}|r}$, $a_{\overline{n}|r}$
- Financial calculators:

## Loan Payments

- $18,000 loan, 4 years, 9% APR. Find the monthly payment.
- N = 4 x 12 = 48
- I/Y = 9
- P/Y = 12
- PV = 18000
- PMT = – 447.93
- FV = 0

## Savings

- $2,000 becomes $9,500 in 5 years with $100 monthly deposits and compounding. Rate?
- N = 5 x 12 = 60
- I/Y = 5.44%
- P/Y = 12
- PV = 2000
- PMT = + 100
- FV = – 9500

## Spreadsheets: Construction vs. Implications

Construction
- Software training
- Build formulas
- Data entry
- Analyze results

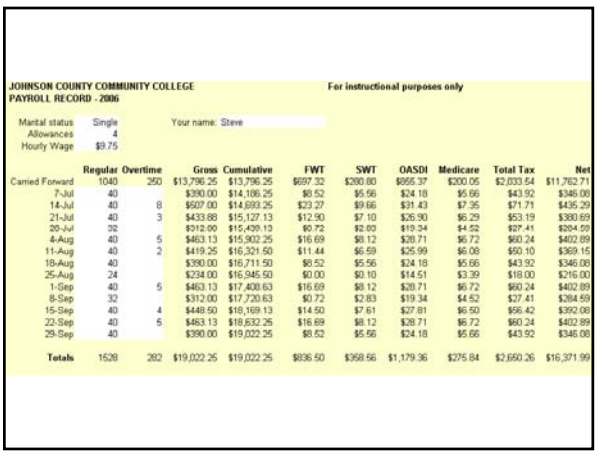
Implications
- Data entry
- Analyze results

## Spreadsheet Examples

- Payroll: student analyzes implications of withholding for FICA and income taxes
- Profitability: student tries to maximize profit given costs and unknown built-in demand
- Depreciation: student explores results of different depreciation methods

## Spreadsheet Examples

- U.S. Rule: student processes payments that vary in time and amount
- Time Value of Money: student obtains schedules showing the effect of a constant payment on a loan or for savings



JOHNSON COUNTY COMMUNITY COLLEGE — For instructional purposes only
PAYROLL RECORD - 2006

Marital status: Single
Allowances: 4
Hourly Wage: $9.75
Your name: Steve

| | Regular | Overtime | Gross | Cumulative | FWT | SWT | OASDI | Medicare | Total Tax | Net |
|---|---|---|---|---|---|---|---|---|---|---|
| Carried Forward | 1040 | 250 | $13,796.25 | $13,796.25 | $697.32 | $280.80 | $855.37 | $200.05 | $2,033.54 | $11,762.71 |
| 7-Jul | 40 | | $390.00 | $14,186.25 | $8.52 | $5.56 | $24.18 | $5.66 | $43.92 | $346.08 |
| 14-Jul | 40 | 8 | $507.00 | $14,693.25 | $23.27 | $9.66 | $31.43 | $7.35 | $71.71 | $435.29 |
| 21-Jul | 40 | 3 | $433.88 | $15,127.13 | $12.90 | $7.10 | $26.90 | $6.29 | $53.19 | $380.69 |
| 28-Jul | 32 | | $312.00 | $15,439.13 | $0.72 | $2.83 | $19.34 | $4.52 | $27.41 | $284.59 |
| 4-Aug | 40 | 5 | $463.13 | $15,902.25 | $16.69 | $8.12 | $28.71 | $6.72 | $60.24 | $402.89 |
| 11-Aug | 40 | 2 | $419.25 | $16,321.50 | $11.44 | $6.59 | $25.99 | $6.08 | $50.10 | $369.15 |
| 18-Aug | 40 | | $390.00 | $16,711.50 | $8.52 | $5.56 | $24.18 | $5.66 | $43.92 | $346.08 |
| 25-Aug | 24 | | $234.00 | $16,945.50 | $0.00 | $0.10 | $14.51 | $3.39 | $18.00 | $216.00 |
| 1-Sep | 40 | 5 | $463.13 | $17,408.63 | $16.69 | $8.12 | $28.71 | $6.72 | $60.24 | $402.89 |
| 8-Sep | 32 | | $312.00 | $17,720.63 | $0.72 | $2.83 | $19.34 | $4.52 | $27.41 | $284.59 |
| 15-Sep | 40 | 4 | $448.50 | $18,169.13 | $14.50 | $7.61 | $27.81 | $6.50 | $56.42 | $392.08 |
| 22-Sep | 40 | 5 | $463.13 | $18,632.25 | $16.69 | $8.12 | $28.71 | $6.72 | $60.24 | $402.89 |
| 29-Sep | 40 | | $390.00 | $19,022.25 | $8.52 | $5.56 | $24.18 | $5.66 | $43.92 | $346.08 |
| Totals | 1528 | 282 | $19,022.25 | $19,022.25 | $836.50 | $358.56 | $1,179.36 | $275.84 | $2,650.26 | $16,371.99 |

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**PROFITABILITY**

Your name: Steve

| | |
|---|---|
| Quantity purchased: | 100 |
| List price (each): | $59.95 |
| Shipping charge: | $75.00 |
| Trade Discount: | 70.00% |
| Cash Discount: | 2.00% |
| Shrinkage: | 4.00% |
| Op. expenses: | 65.00% as percent of net cost |
| Net cost (total): | $1,837.53 |
| Net cost (each): | $18.38 |
| Adjusted net cost (each): | $19.14 |
| Breakeven (each): | $31.58 |

| | 1st PRICE | 2nd PRICE | 3rd PRICE | 4th PRICE | AVGS/TOTALS |
|---|---|---|---|---|---|
| Quantity to sell: | 96 | 72 | 46 | 24 | |
| Percent price change: | 75.00% | 25.00% | 45.00% | 65.00% | |
| Type of change: | markup-selling | markdown-total | markdown-total | markdown-total | |
| Selling Price (each): | $76.56 | $57.42 | $42.11 | $26.80 | $53.86 |
| Potential Profit (each): | $44.98 | $25.84 | $10.53 | ($4.78) | |
| Net Profit Ratio: | 58.75% | 81.82% | 33.34% | -15.14% | 34.54% |
| Number sold: | 24 | 26 | 22 | 14 | 86 |
| Sales (total): | $1,837.44 | $1,492.92 | $926.42 | $375.20 | $4,631.98 |
| Gross Profit (total): | | | | | $2,794.45 |
| Net Profit (total): | | | | | $1,600.06 |

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**DEPRECIATION**

Your name: Steve

| | |
|---|---|
| Type: | 200%-Declining |
| Part-year: | Half-Year |
| Service date: | 3/5/2006 |
| Lifetime (years): | 15 |
| Cost basis: | $50,000.00 |
| Scrap value: | $4,000.00 |

| Number | Year | Current Depreciation | Accumulated Depreciation | Book Value |
|---|---|---|---|---|
| | | | | $50,000.00 |
| 1 | 2006 | $3,333.33 | $3,333.33 | $46,666.67 |
| 2 | 2007 | $6,222.22 | $9,555.56 | $40,444.44 |
| 3 | 2008 | $5,392.59 | $14,948.15 | $35,051.85 |
| 4 | 2009 | $4,673.58 | $19,621.73 | $30,378.27 |
| 5 | 2010 | $4,050.44 | $23,672.16 | $26,327.84 |
| 6 | 2011 | $3,510.38 | $27,182.54 | $22,817.46 |
| 7 | 2012 | $3,042.33 | $30,224.87 | $19,775.13 |
| 8 | 2013 | $2,636.68 | $32,861.55 | $17,138.45 |
| 9 | 2014 | $2,285.13 | $35,146.68 | $14,853.32 |
| 10 | 2015 | $1,980.44 | $37,127.12 | $12,872.88 |
| 11 | 2016 | $1,716.38 | $38,843.51 | $11,156.49 |
| 12 | 2017 | $1,487.53 | $40,331.04 | $9,668.96 |
| 13 | 2018 | $1,289.19 | $41,620.23 | $8,379.77 |

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**U.S. RULE**

| | |
|---|---|
| Loan amount: | $50,000.00 |
| Loan date: | 3/5/2006 |
| Annual interest rate: | 8.50% |
| Exact or ordinary: | Exact |

Your name: Steve

| Number | Date | Principal | Payment | Interest | Applied to Balance | Balance | Payoff Amount |
|---|---|---|---|---|---|---|---|
| | 3/5/2006 | | | | | $50,000.00 | |
| 1 | 4/19/2006 | $50,000.00 | $5,000.00 | $523.97 | $4,476.03 | $45,523.97 | $50,523.97 |
| 2 | 5/6/2006 | $45,523.97 | $4,000.00 | $180.23 | $3,819.77 | $41,704.20 | $45,704.20 |
| 3 | 8/31/2006 | $41,704.20 | $2,500.00 | $1,136.30 | $1,363.70 | $40,340.50 | $42,840.50 |
| 4 | 9/25/2006 | $40,340.50 | $300.00 | $234.86 | $65.14 | $40,275.36 | $40,575.36 |
| 5 | | | | | | | |
| 6 | | | | | | | |
| 7 | | | | | | | |
| 8 | | | | | | | |
| 9 | | | | | | | |
| 10 | | | | | | | |

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**TIME VALUE OF MONEY**

Your name: Steve

| | |
|---|---|
| Payment type: | Loan Payments |
| Ordinary or Beginning: | Ordinary |
| Number periods per year: | 12 |

Leave blank the data entry cell you wish to find.

| | DATA ENTRY | RESULTS |
|---|---|---|
| Number of periods: | 180 | 180 |
| Annual interest rate: | 6.75% | 6.75% |
| Present Value: | $120,000.00 | $120,000.00 |
| Periodic Payment: | | -$1,061.89 |
| Future value: | $0.00 | $0.00 |

| Period | Payment | Interest | Balance |
|---|---|---|---|
| 0 | | | $120,000.00 |
| 1 | -$1,061.89 | $675.00 | $119,613.11 |
| 2 | -$1,061.89 | $672.82 | $119,224.04 |
| 3 | -$1,061.89 | $670.64 | $118,832.79 |
| 4 | -$1,061.89 | $668.43 | $118,439.33 |
| 5 | -$1,061.89 | $666.22 | $118,043.66 |
| 6 | -$1,061.89 | $664.00 | $117,645.77 |
| 7 | -$1,061.89 | $661.76 | $117,245.64 |
| 8 | -$1,061.89 | $659.51 | $116,843.26 |
| 9 | -$1,061.89 | $657.24 | $116,438.61 |

## Unhappy with Current Books …

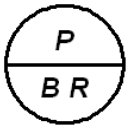
- No expectation of technology use
- Algebra formulas in a non-algebraic course
- Multiple chapters for single concepts
- Lack of a mathematical theme

## A New Book Type
## The Main Idea: Percents

- Payroll: gross pay, payroll taxes, net pay, effective tax rates
- Retailing: discounts, markups, markdowns, shrinkage, profitability, income statements
- Asset Values: inventory, depreciation, balance sheets, stocks
- Finance: simple interest, compound interest, annuities, savings, loans, bonds

## Approaches to Basic Percents

- Algebra: $P = B \times R$
- Proportion: $\frac{R}{100} = \frac{P}{B}$
- PBR diagram:




## Approaches to Percent Change

- Algebra: $P = B \times (1 \pm R)$
- Proportion: $\frac{100 \pm R}{100} = \frac{P}{B}$
- Percent change diagram:


## Percent Change Diagram

- After a 15% decrease, the price will be $79. Original price?

| | | |
|---|---|---|
| 100% | Old | $ 92.94 |
| 15% | - Change | $ 13.94 |
| 85% | New | $ 79.00 |

## Markup on Selling Price

- A 40% markup on selling price on an item that cost $175. Find the selling price.

| | | |
|---|---|---|
| 60% | Cost | $ 175.00 |
| 40% | + Markup | $ 116.67 |
| 100% | Selling | $ 291.67 |

## Adjusting for Shrinkage (with a markup on selling price)

- Dealer cost is $80 with 5% shrinkage. Find the adjusted cost.

| | | |
|---|---|---|
| 95% | Cost | $ 80.00 |
| 5% | + Markup | $ 4.21 |
| 100% | S (adj cost) | $ 84.21 |

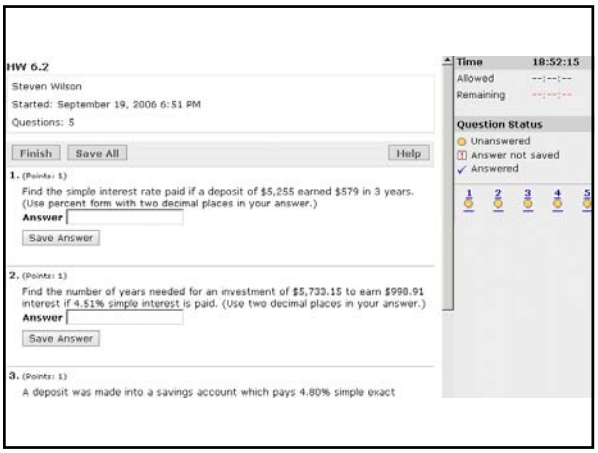
## Simple Interest

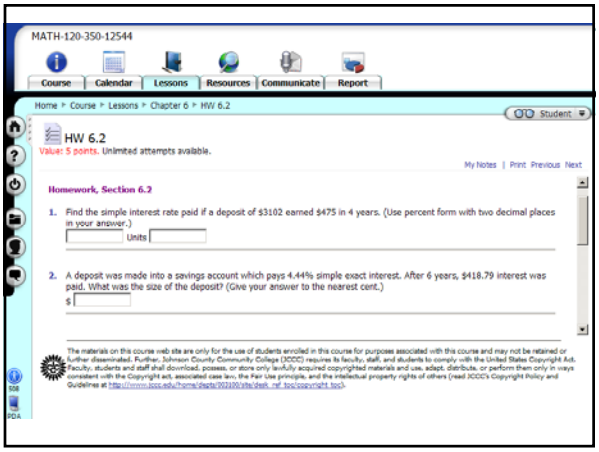
- After 3 years at 4% simple interest, the account holds $500. Original balance?

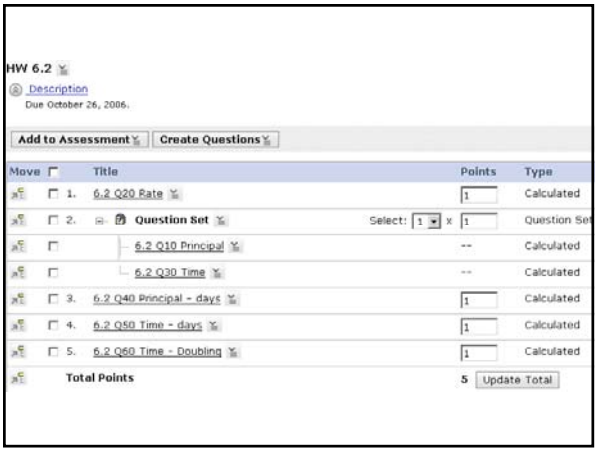
| | | |
|---|---|---|
| 100% | Old | $ 446.43 |
| 3 x 4 = 12% | + Change | $ 53.57 |
| 112% | New | $ 500.00 |

## Online Homework

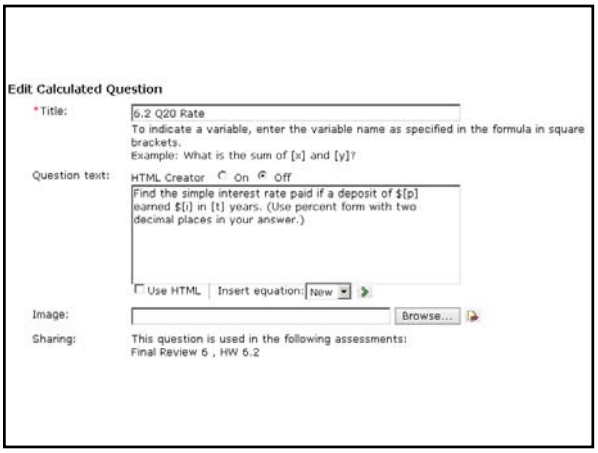
- Used WebCT & Angel (adopted by college)
- Developed own question bank
- Algorithmically-generated questions
- Five questions per section
- Most questions tolerate one-cent errors
- Unlimited practice for mastery & grade

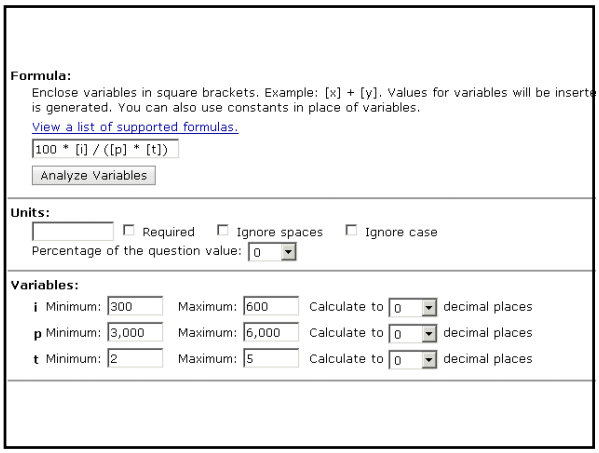


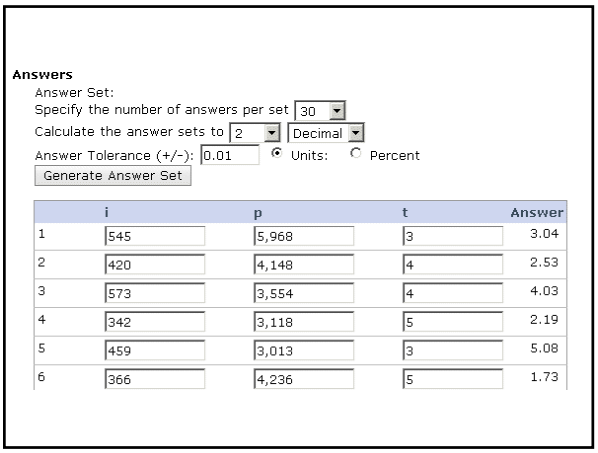



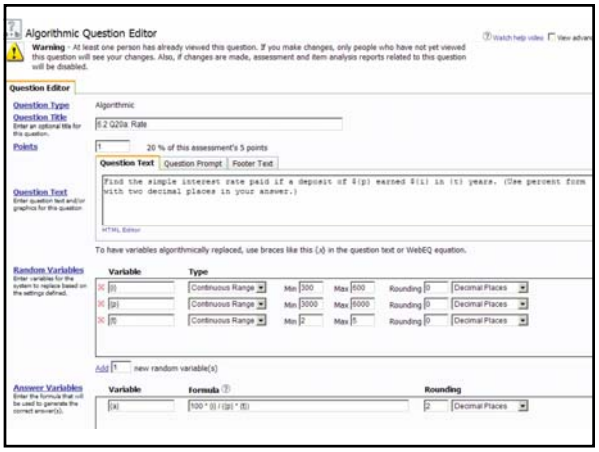



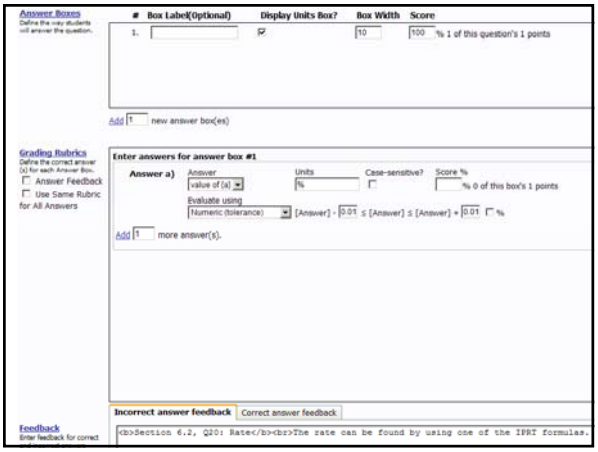


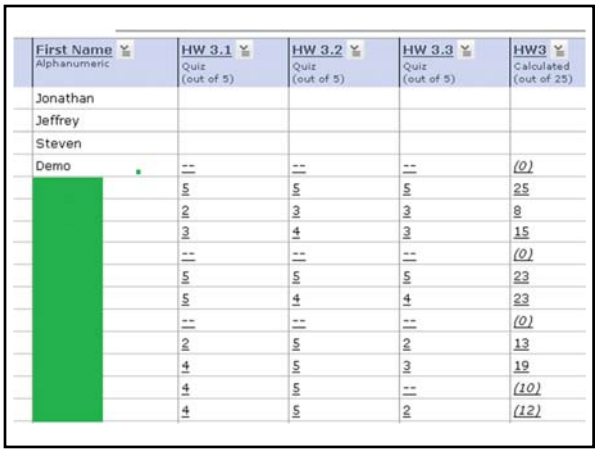


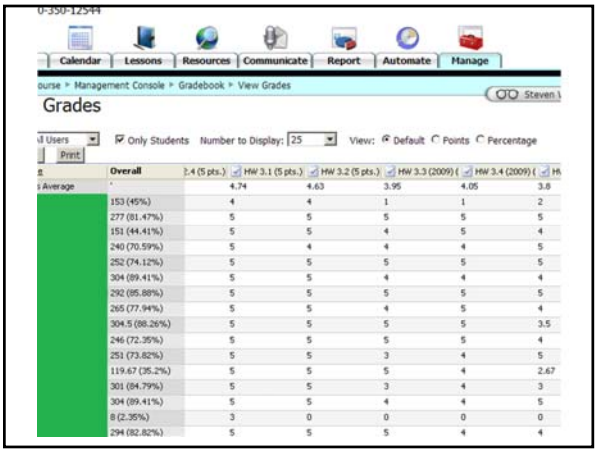

Formula:
Enclose variables in square brackets. Example: [x] + [y]. Values for variables will be inserte
is generated. You can also use constants in place of variables.
View a list of supported formulas.
100 * [i] / ([p] * [t])
Analyze Variables
Units:
Required
Ignore spaces
Ignore case
Percentage of the question value:
Variables:
i Minimum: 300 Maximum: 600 Calculate to 0 decimal places
p Minimum: 3,000 Maximum: 6,000 Calculate to 0 decimal places
t Minimum: 2 Maximum: 5 Calculate to 0 decimal places

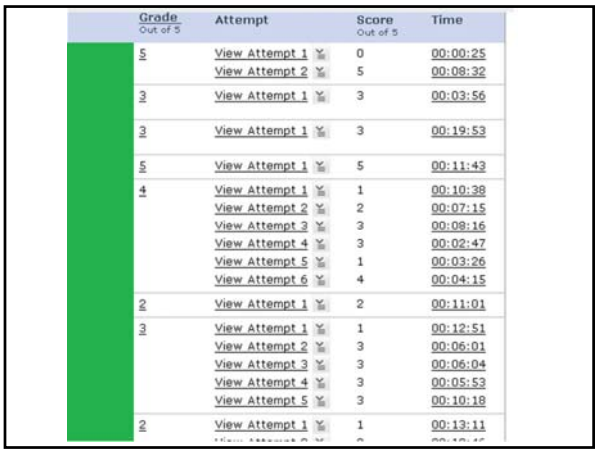

Answers
Answer Set:
Specify the number of answers per set 30
Calculate the answer sets to 2 Decimal
Answer Tolerance (+/-): 0.01 Units: Percent
Generate Answer Set
i p t Answer
1 545 5,968 3 3.04
2 420 4,148 4 2.53
3 573 3,554 4 4.03
4 342 3,118 5 2.19
5 459 3,013 3 5.08
6 366 4,236 5 1.73


Algorithmic Question Editor
Warning
Question Editor
Question Type
Question Title
Points
Question Text
Random Variables
Answer Variables
Variable
Type
Formula
Rounding

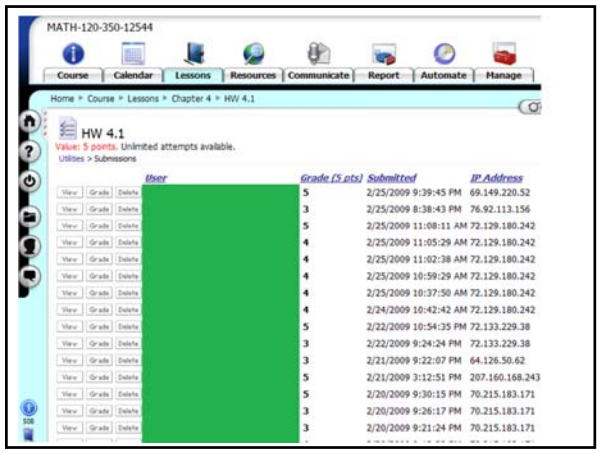

Answer Boxes
# Box Label(Optional)
Display Units Box?
Box Width
Score
Grading Rubrics
Enter answers for answer box #1
Answer a)
Incorrect answer feedback
Correct answer feedback
Feedback


First Name
Alphanumeric
HW 3.1
Quiz
(out of 5)
HW 3.2
Quiz
(out of 5)
HW 3.3
Quiz
(out of 5)
HW3
Calculated
(out of 25)
Jonathan
Jeffrey
Steven
Demo


Calendar
Lessons
Resources
Communicate
Report
Automate
Manage
Grades
Only Students
Number to Display:
View: Default Points Percentage
Print
Overall



| Grade Out of 5 | Attempt | Score Out of 5 | Time |
|---|---|---|---|
| 5 | View Attempt 1 | 0 | 00:00:25 |
| | View Attempt 2 | 5 | 00:08:32 |
| 3 | View Attempt 1 | 3 | 00:03:56 |
| 3 | View Attempt 1 | 3 | 00:19:53 |
| 5 | View Attempt 1 | 5 | 00:11:43 |
| 4 | View Attempt 1 | 1 | 00:10:38 |
| | View Attempt 2 | 2 | 00:07:15 |
| | View Attempt 3 | 3 | 00:08:16 |
| | View Attempt 4 | 3 | 00:02:47 |
| | View Attempt 5 | 1 | 00:03:26 |
| | View Attempt 6 | 4 | 00:04:15 |
| 2 | View Attempt 1 | 2 | 00:11:01 |
| 3 | View Attempt 1 | 1 | 00:12:51 |
| | View Attempt 2 | 3 | 00:06:01 |
| | View Attempt 3 | 3 | 00:06:04 |
| | View Attempt 4 | 3 | 00:05:53 |
| | View Attempt 5 | 3 | 00:10:18 |
| 2 | View Attempt 1 | 1 | 00:13:11 |




## Before-and-After Comparison: Homework Completion

Fall 2000 (n = 32)
- 10 homework sets
- 3 problems each
- Instructor graded
- 960 expected
- total 774 problems
- 81% completion

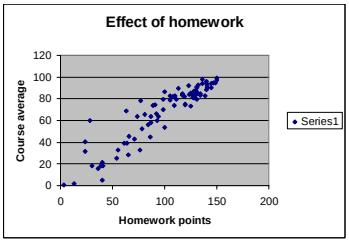
Fall 2004 (n = 33)
- 30 redo-able sets
- 5 problems each
- Computer graded
- 4950 expected
- total 12415 probs
- 1504% increase!

## Before-and-After Comparison: Course Grades

Fall 2000
- A: 16%
- B or better: 34%
- C or better: 66%
- D or better: 84%
- F: 16%

Fall 2004
- A: 27%
- B or better: 52%
- C or better: 73%
- D or better: 82%
- F: 18%

## Correlation of Homework and Grades

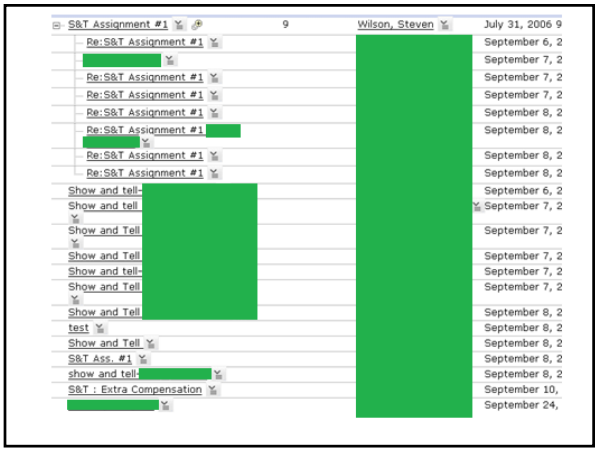



## Show-and-Tell Assignments

- Online postings to bulletin board
- Every student participates
- Two-part questions: facts, analysis
- Part 1: provide experience, collect info
- Part 2: compare, discuss why

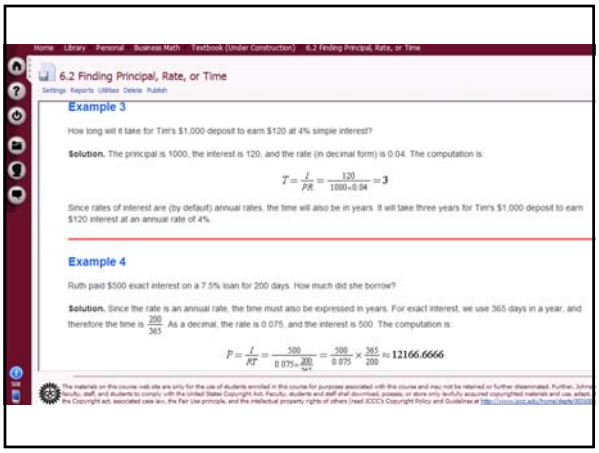
## Show-and-Tell Topics

- Compensation for extra work
- Differing prices for the same commodity
- Interest rates for savings
- Interest rates for loans
- Unusual practices


## The Future?

- Online textbook ?
- More spreadsheet use ?
- Simple spreadsheet construction ?
- More international topics ?




## Web Pages

- Business Math Corner
  **www.milefoot.edu/math/businessmath/index.htm**
- Steven J. Wilson
  **staff.jccc.edu/swilson/index.htm**