ALGOGEN© The algorithmic document generator

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Not every teacher wants to make easy tests but every teacher wants to easily make tests.

Contents

Using algorithmic documents for teaching and learning

Being the teacher for hundreds of students each semester in an undergraduate finance class provided a pre-pandemic opportunity to design exam questions for assessing student learning. For elbow-to-elbow exam sittings the primary anti-cheating strategy for *prof-td* was to put different versions of the same problem in front of adjacent students. An algorithmic document makes it easy to create an endless stream of unique versions of the same question scenario. Each draw of an algorithmic scenario setup offers unique numbers, nouns, verbs, modifiers, whatever content that populates a spreadsheet setup. Spreadsheet cells may contain nearly any kind of object like a chart or audio file, but cells more likely contain numbers, words, formulas, phrases or sentences. Some of the formulas use random variables to choose which content displays. The document from the word processor updates by recalculating spreadsheet cell contents thus creating new versions. This means that whether in class or online, students with wandering eyes see different views of the same problem. Re-arranging

question order and calling them different versions isn't really making different versions – it just makes some students squint harder at neighboring papers.

Stopping cheating before it happens is best for all involved and using an algorithmic document helps stop it. Software wizards that write new algorithmic question scenario setups automate growing new content into the collection regardless of course or subject. An algorithmic document collection enables new options like ones described below for teacher and student alike. Students can practice solving question scenario setups to gain proficiency, even in Blackboard. Teachers can administer alternative versions of the same question setup that differ in non-substantive ways thus assuring that different versions indeed assess the same learning outcome. Teachers even can offer students multiple attempts at the same exam – only the numbers and words may change!

A. The algorithmic question scenario setup

A standard numerical algorithmic question scenario setup in finance might specify, for example, 3 numerical inputs like an interest rate, the amount of periodic interest credited to an account, and an investment horizon. The question easily could be open-ended. In the survey of finance course teaching assignment that *prof-td* directed from Fall 1994 through Summer 2016, however, the open-ended daily quiz graded at the weekly teaching team meeting gave way in 2008 to 27 online multiple-choice **A-to-E** daily quizzes. Multiple choice exams were the norm in this large lecture course long before 1994. For the 120 point 25-question exam 2 in Spring 2015 there were 531 students that walked in the auditorium (two sittings) and self-selected a seat nearly filling the auditorium leaving a smattering of empty seats. Proctors walked down each row with a stack of paper exams, 8 sheets copied on front and back stapled together. The top sheet front displays instructions and the color code, a number from 1 to 8. The backside of the top sheet displays the first 3 of the 25 questions with 8 blank lines after each for solution scratch-space. The penultimate sheet is a two-sided formula sheet. The last sheet is a blank page of scratch paper submitted with the exam. Four unique colors collated in each stack are distributed to every other row; 8 colors in total. Every sitting student receives an exam and scantron form from the proctor and shows the proctor their student ID. The proctor verifies that the student workspace is without notes, books, cellphone, or programmable calculator.

Every fourth student got the version displaying question #1 worth 5 points shown in the left panel of screenshot 1a below. The right panel tabulates student responses in an *Excel* workbook.

1.
An account was established 11 years ago with an initial deposit. Today the account is credited with annual interest of $479.54 . The interest rate is 4.3% compounded annually. No other deposits or withdrawals have been made. How much is the end-of-day balance?
a. $14,074 b. $12,795 c. $15,482 d. $10,574 e. $11,632

	J	K
2	Toptail & Lowtail means are equal; %students in tail =	1/3
3	Question :	1
4	Total %correct :	91.0%
5	%correct TopTail :	99.0%
6	%correct LowTail :	75.3%
7	T-stat(tails) :	3.17
8	KEY1212	LS7A
9	Question :	1
10	Key :	E
11	A	0
12	B	3
13	C	2
14	D	1
15	E	133
16	#responses :	139
17	Total %correct :	95.7%
18	Upper %correct:	96.0%
19	Lower %correct :	87.0%
20	T-stat :	1.53

Screenshot 1a: The standard numerical algorithm made LS7a, Exam 2 colors 1 & 2, Spring 2015

Cell **K4:K7** in the right panel shows combined results for all four versions submitted on the 531 scantrons. Cell **K4** shows that 91% of the students get the question correct. The total exam score earned on all 25 questions is used to sort each student into one of 3 terciles: upper, middle, and lower. Cell **K5** shows that 99% of students in the upper tercile get question #1 correct. Only 75% of students in the lower tercile get #1 correct (cell **K6**). A standard test statistic (3.17, cell **K7**) for the null hypothesis on the equality of mean performance levels for the two terciles is rejected at a standard significance level. A common interpretation of this statistic is that the question discriminates between students that do or don't satisfy the learning objective underlying this question.

Performance rates vary across the four versions. For the version on colors 1 and 2 (cell **J8**) the right panel (**K15** and **K16**) shows that 133 of 139 students correctly choose solution **E**. Cell **K18** shows that students in the upper tercile score correctly at a 96% rate; in the lower tercile 87% choose correctly (cell **K19**). The null hypothesis on the equality of mean performance level for the two terciles is not rejected (t-stat =1.53, cell **K20**). Nearly everyone with this version gets the question correct. This statistic signals little about the question quality but rather simply signals that the question is "easy." Some problems, thank goodness have easy solutions.

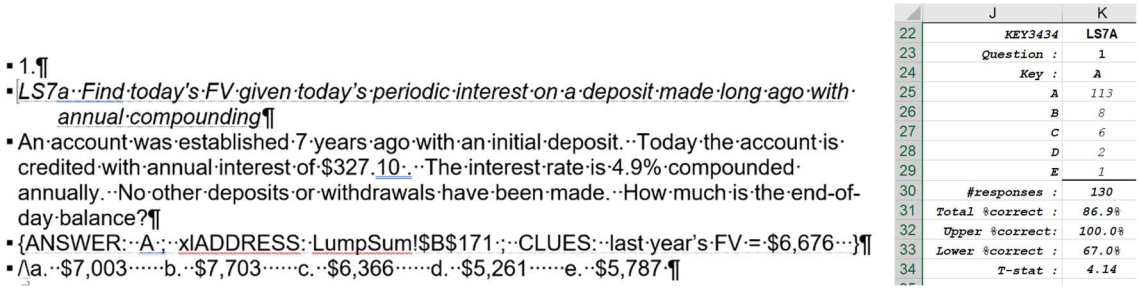
Every fourth student got the exam version shown in screenshot 1b below (colors 5 and 6). The *Word* question body of LS7a recalculates based on spreadsheet instructions and draws new numbers for 3 inputs and 5 answer choices.

▪ 1.¶
▪ *LS7a··Find·today's·FV·given·today's·periodic·interest·on·a·deposit·made·long·ago·with·annual·compounding*¶
▪ An·account·was·established·12·years·ago·with·an·initial·deposit.··Today·the·account·is·credited·with·annual·interest·of·$866.91·.··The·interest·rate·is·6.7%·compounded·annually.··No·other·deposits·or·withdrawals·have·been·made.··How·much·is·the·end-of-day·balance?¶
▪ {ANSWER:··B·;··xlADDRESS:·LumpSum!$B$171·;··CLUES:··last·year's·FV·=·$12,939···}¶
▪ /\a.··$15,186·····b.··$13,806·····c.··$11,410·····d.··$10,373·····e.··$12,551·¶

	J	K
36	KEY5656	LS7A
37	Question :	1
38	Key :	B
39	A	3
40	B	123
41	C	1
42	D	0
43	E	4
44	#responses :	131
45	Total %correct :	93.9%
46	Upper %correct:	100.0%
47	Lower %correct :	84.0%
48	T-stat :	2.71

Screenshot 1b: The standard numerical algorithm made LS7a, Exam 2 colors 5&6 #1

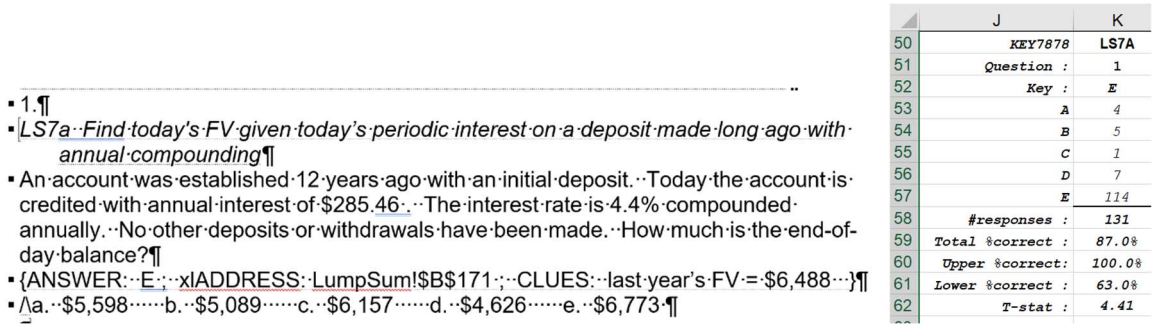
The screenshot above left displays content that is formatted in the word processor as hidden text that is not printed on the exam paper. Students do not see the paragraph that shows the "ANSWER" is **B**. Nor do they see the paragraph that begins "LS7a", a code that identifies the question scenario setup in the book, solution guides, videos, and the *Elements of Finance* algorithmic content collection. Inspection of the **A-to-E** performance profile above shows 123 students (93.9%) chose the correct answer of **B**. None of the four wrong choices attracts many. The remaining two recalculations distributed that day exhibit this same property. By far most students find the correct solution for the recalculations of LS7a shown in screenshots 1c and 1d below, submitted by 130 students and 131 students, respectively. Nonetheless, the test statistic (4.14, cell **K34**) rejects the equality of mean performance levels for the upper and lower terciles. The question discriminates between students that do or don't attain learning outcomes.



1.¶
LS7a··Find·today's·FV·given·today's·periodic·interest·on·a·deposit·made·long·ago·with· annual·compounding¶
An·account·was·established·7·years·ago·with·an·initial·deposit.··Today·the·account·is· credited·with·annual·interest·of·$327.10·.··The·interest·rate·is·4.9%·compounded· annually.··No·other·deposits·or·withdrawals·have·been·made.··How·much·is·the·end-of- day·balance?¶
{ANSWER:··A·;··xlADDRESS:·LumpSum!$B$171·;··CLUES:··last·year's·FV·=·$6,676···}¶
/\a.··$7,003·····b.··$7,703·····c.··$6,366·····d.··$5,261·····e.··$5,787·¶

	J	K
22	KEY3434	LS7A
23	Question :	1
24	Key :	A
25	A	113
26	B	8
27	C	6
28	D	2
29	E	1
30	#responses :	130
31	Total %correct :	86.9%
32	Upper %correct:	100.0%
33	Lower %correct :	67.0%
34	T-stat :	4.14

Screenshot 1c: The standard numerical algorithm made LS7a, Exam 2 colors 3&4 #1



1.¶
LS7a··Find·today's·FV·given·today's·periodic·interest·on·a·deposit·made·long·ago·with· annual·compounding¶
An·account·was·established·12·years·ago·with·an·initial·deposit.··Today·the·account·is· credited·with·annual·interest·of·$285.46·.··The·interest·rate·is·4.4%·compounded· annually.··No·other·deposits·or·withdrawals·have·been·made.··How·much·is·the·end-of- day·balance?¶
{ANSWER:··E·;··xlADDRESS:·LumpSum!$B$171·;··CLUES:··last·year's·FV·=·$6,488···}¶
/\a.··$5,598·····b.··$5,089·····c.··$6,157·····d.··$4,626·····e.··$6,773·¶

	J	K
50	KEY7878	LS7A
51	Question :	1
52	Key :	E
53	A	4
54	B	5
55	C	1
56	D	7
57	E	114
58	#responses :	131
59	Total %correct :	87.0%
60	Upper %correct:	100.0%
61	Lower %correct :	63.0%
62	T-stat :	4.41

Screenshot 1d: The standard numerical algorithm made LS7a, Exam 2 colors 7&8 #1

The process for solving this question is the same regardless of the version. Because the periodic interest, $285.46 in screenshot 1d, equals the rate (4.4%) times beginning of period balance, then the beginning of period balance equals periodic interest divided by the rate, e.g., 285.46 ÷ 0.044 = $6,488. The beginning balance plus periodic interest equals end of period balance; e.g., $6,488 + $285 = $6,773. For screenshot 1d the correct choice is **E**. The length of the investment horizon, e.g. 12 years, is not used in the solution.

Solving the four different recalculations on the eight different colors assesses the same learning outcome for each student. Nonetheless, performance by the lower tercile across different versions of LS7a range from 63% (cell **K61** above) to 87% (cell **K20**). On different recalculations the number of students in the lower tercile getting it wrong varies from 13% to 37%, a three-fold difference in a small sample statistic.

Increasing the complexity of the solution changes the performance profile of outcomes, namely, *the tails of the curve attenuate*. Questions #4 and #5 on 25-question exam 1 in Spring 2015 submitted by 561 students describes a zero-sum merger between a Target and Raider company. This multiple question scenario setup displays a common body of financial fundamentals for a stylized instantaneous merger followed by two questions. The recalculation below was submitted by 148 students getting colors 1 and 5.

The following set-up pertains to the next few questions
The balance sheet for the Raider Company shows *Total assets* of $13,100 financed by $2,900 of *Debt* and $10,200 of *Stockholders' equity*. The Raider Company has 630 common shares outstanding, their equity price-to-book ratio is 3.70, and their price-to-earnings ratio is 49.9. For the Target Company *Total assets* of $4,300 are financed by $1,100 of *Debt* and $3,200 of *Stockholders' equity*. The Target Company has 650 common shares outstanding, their equity price-to-book ratio is 0.70, and their price-to-earnings ratio is 11.5.

The Raider Company plans to takeover the Target Company. The Raider Company offers 5 share(s) of Raider stock to Target shareholders that tender 67 Target shares (the exchange ratio is 0.074627; assume fractional shares can be exchanged). Suppose tax effects and synergistic gains and losses equal zero; that is, accumulated sales, costs, and profits remain the same.

]

4.
After the Raider takes control of all Target shares, what is the market capitalization for the new conglomerated Company?
a. $30,038 b. $43,978 c. $33,041 d. $36,345 e. $39,980

]

5.
After the Raider takes control of all Target shares, what is the percentage change in Target shareholder wealth?
a. 24.9% b. 22.6% c. 27.4% d. 33.1% e. 30.1%

]

	J	N	O
3	**Question :**	**4**	**5**
4	Total %correct :	90.7%	65.6%
5	%correct TopTail :	100.0%	95.5%
6	%correct LowTail :	75.5%	37.5%
7	T-stat(tails) :	3.52	5.87
8	KEY1515	FA3J	FA3F
9	Question :	4	5
10	Key :	E	C
11	A	0	18
12	B	1	14
13	C	5	96
14	D	4	14
15	E	138	5
16	#responses :	148	147
17	Total %correct :	93.2%	64.9%
18	Upper %correct:	100.0%	88.0%
19	Lower %correct :	82.0%	47.0%
20	T-stat :	3.09	4.33
21			

Screenshot 2a: The standard numerical algorithm made FA3
Exam 1, Spring 2015, colors 1&5, questions #4 & #5

Eight blank lines usable as student written workspace between questions were deleted for the screenshot. Spreadsheet rows 4 through 7 in the right panel show the average statistic across four exam versions. Question #4, code FA3j, was solved correctly by 90.7% of all 561 students (cell **N4**). The version above was solved correctly by 93.2% of 148 students (cell **N17**). The solution is relatively easy. Pre-merger market capitalization equals the price-to-book ratio times *Stockholders equity* which for the Raider equals $37,740 (i.e., 10,200 x 3.70) and for the Target equals $2,240 (i.e., 3,200 x 0.70). For a zero-sum merger in which "the whole is the sum of the parts," an outcome consistent with long standing financial research, the post-merger market cap of the conglomerate is answer **E** ($39,980 = $37,740 + $2,240).

The student performance profiles for FA3j and LS7a discussed previously are very similar. Both are easy questions. The range of performance outcomes for FA3j across all four versions for the lower tercile (sorted by *Total exam points correct*) shown below in screenshot 2b range from 50% to 82%. Zero variation exists among 187 students in the upper tercile, however. Not one of the 187 top students miss question #4 FA3j regardless of recalculation received.

The solution for question #5 FA3f has more steps than #4. Students must figure how many shares the Target shareholders receive from the Raider treasury stock (650 x 5/67 = 48.51). Then they compute the value of Target claims on conglomerate market cap ($39,980 x 48.51/ 678.51 = $2,858). Finally, find that the percentage change in Target shareholder wealth is answer C, 27.4% (= $2,858/$2,440 -1). The upper tercile of 561 students continues to perform well with 95.3% getting FA3f correct (cell **O5**, the tercile range across 4 versions ranges from 88% to 100%). Only 37.5% in the lower

tercile get FA3f correct (cell **O6** with a range from 31% to 47%). The distribution of the lower tercile deflates, skewing student scores across an attenuated range.

	J	N	O
22	KEY2626	FA3J	FA3F
23	Question :	4	5
24	Key :	A	E
25	A	116	7
26	B	13	11
27	C	3	17
28	D	2	14
29	E	3	87
30	#responses :	137	136
31	Total %correct :	84.1%	63.0%
32	Upper %correct:	100.0%	100.0%
33	Lower %correct :	57.0%	33.0%
34	T-stat :	5.00	6.80

	J	N	O
36	KEY3737	FA3J	FA3F
37	Question :	4	5
38	Key :	A	B
39	A	130	10
40	B	4	94
41	C	5	19
42	D	0	14
43	E	1	3
44	#responses :	140	140
45	Total %correct :	92.9%	67.1%
46	Upper %correct:	100.0%	98.0%
47	Lower %correct :	83.0%	39.0%
48	T-stat :	2.89	6.09

	J	N	O
50	KEY4848	FA3J	FA3F
51	Question :	4	5
52	Key :	A	A
53	A	125	91
54	B	2	12
55	C	3	10
56	D	2	15
57	E	3	7
58	#responses :	135	135
59	Total %correct :	92.6%	67.4%
60	Upper %correct:	100.0%	96.0%
61	Lower %correct :	80.0%	31.0%
62	T-stat :	3.16	6.40

Screenshot 2b: The standard numerical algorithm made FA3
Exam 1 Spring 2015, question #4 & #5, colors 2&6, 3&7, and 4&8

Screenshot 3 below displays student performance profiles for the first 13 questions on 25 question exam 1 in Spring 2015. Upper rows reflect all 561 students while rows 8 to 20 analyze 148 student scantrons for the version on colors 1 & 5.

	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
3	Question :	1	2	3	4	5	6	7	8	9	10	11	12	13
4	Total %correct :	74.2%	68.8%	80.4%	90.7%	65.6%	75.2%	49.0%	48.3%	71.7%	54.5%	78.6%	29.6%	55.3%
5	%correct TopTail :	89.3%	91.3%	94.8%	100.0%	95.5%	91.3%	90.8%	74.5%	92.8%	65.3%	99.5%	41.0%	85.8%
6	%correct LowTail :	56.3%	42.5%	60.3%	75.5%	37.5%	58.5%	13.5%	20.5%	48.5%	43.3%	50.3%	21.3%	28.0%
7	T-stat(tails) :	3.57	5.03	4.01	3.52	5.87	3.69	7.48	5.25	4.77	2.32	5.46	2.18	5.60
8	KEY1515	FF20	FA14	FA1	FA3J	FA3F	FF5	FA15C	BA6	FF9	BE2A	BE3	BA9C	BA11A
9	Question :	1	2	3	4	5	6	7	8	9	10	11	12	13
10	Key :	E	D	B	E	C	B	B	B	C	E	D	B	C
11	A	18	7	2	0	18	0	12	34	6	6	2	22	20
12	B	9	15	117	1	14	142	63	66	4	14	14	61	21
13	C	14	16	3	5	96	1	36	22	132	11	10	35	75
14	D	4	101	3	4	14	1	29	12	0	3	116	21	19
15	E	103	9	23	138	5	4	7	12	6	114	6	9	11
16	#responses :	148	148	148	148	147	148	147	146	148	148	148	148	146
17	Total %correct :	69.6%	68.2%	79.1%	93.2%	64.9%	95.9%	42.6%	44.6%	89.2%	77.0%	78.4%	41.2%	50.7%
18	Upper %correct:	80.0%	94.0%	92.0%	100.0%	88.0%	100.0%	78.0%	69.0%	100.0%	90.0%	100.0%	45.0%	80.0%
19	Lower %correct :	57.0%	41.0%	61.0%	82.0%	47.0%	92.0%	10.0%	16.0%	76.0%	63.0%	57.0%	37.0%	31.0%
20	T-stat :	2.45	5.59	3.62	3.09	4.33	2.00	6.78	5.30	3.62	3.15	5.19	0.81	4.88

Screenshot 3: Performance profiles for questions #1 to #13 on Exam 1, Spring 2015

Screenshot row 4 shows the percentage of the total class that correctly answer the question scenario listed in each column. The maximum is 90.7% for question #4 FA3J discussed above. Apparently #4 was the easiest question. Minimum average class performance occurs with question #12 BA9c. Only 29.6% of the 561 students score correctly. For version 1, only 45.0% in the upper tercile score correctly whereas 37.0 in the lower tercile score correctly. The hypothesis that the performance rates in upper and lower terciles are equal (t-stat = 0.81, cell **V20**) is <u>not</u> rejected. Nearly everyone performs poorly on this one. Significantly, however, cell **V12** shows that 61 students select the correct answer whereas the next most selected decoy attracts 35 students – that's a powerful difference. Likely more than 50 of those 61 students put in the time to learn the content that underlies the comprehensive algorithmic scenario setup underlying BA9c.

The performance profile signals information important when creating new questions. BA9c is a challenging question that most students get wrong. The performance profile for #12 in column **V** is similar to the profile created when a question

contains a mistake, that is when no **A-to-E** multiple-choice is the correct choice. When the answer is numerical, like 15-of-25 questions on exam1, then for sure there is a closest choice. When the answer contains a word, as with 10 of the 25 exam questions, there is no closest choice for words. When such a mistake makes it into an exam sitting then likely a decoy (wrong answer) captures the most responses. Sometimes students notice and call out the mistake during the exam, it's a mess that most teachers try hard to avoid. Creating new question scenario setups based upon new ideas from class or world events and media often brings vitality to learning and teaching – the long-run gain sometimes is worth the potential pain. Packaging content from class promised for the next exam into a document collection provides an endless stream of unique draws useful for many purposes beyond the next semester.

A rule one professor held for multiple choice questions was that when more than 50% of the class get an answer wrong then the question is thrown out; i.e., everyone gets full credit. Columns **Q**, **R**, and **V** of screenshot 3 above show in row 4 that questions #7 FA15cm, #8 BA6, and #12 BA9c are so difficult that more than 50% of students get these wrong. Row 5 shows, however, that 90.8% of the upper tercile of student performers get FA15cm correct. The mode answer among the 5 **A-to-E** choices is by far the correct choice. Only 13.5% in the lower tercile get FA15cm correct. That's less than the 20% random guessing rate! For BA6 the performance profile is similar. The number of students choosing the correct answer is far greater than the number selecting any specific wrong answer. It's a challenging but doable solution for the upper tercile. Eliminating these questions from the exam because more than 50% of students get them wrong decreases the incremental information that identifies which students successfully learn difficult solutions. The tail of the upper tercile, like the lower tercile tail, attenuates as some rise to the challenge.

At the beginning of the semester all students receive a complete table of the question scenario setup codes that appear on the four 25-question course algorithmic exams. Exam 4 is the non-cumulative final with the same weight in the course grade as the other 3 exams. The item analysis of student responses shown in screenshots is not available for Blackboard submissions of question-sets. Performance profiles above come only from the analysis of scantron data from paper exam submissions. All students in the Spring 2015 distance online section receive 2 online exam submission options for each of the 4 exams. Students in classroom bound sections (traditional and hybrid) get an option on the paper exam plus one online attempt. All online submission options are available in a common *Blackboard* section containing students from all course formats (online, traditional, and hybrid/blended; 688 total registrants) from day 1 of the semester until midnight, end of the final exam period. For each exam score, like a track & field event, only the best attempt counts.

All students in the common *Blackboard* section share discussion boards, access practice quiz and exam questions, view digitized lectures and solution explanations, or submit 27 online anytime/anywhere multiple attempt quizzes. The top 15 quiz scores comprise 100% of the 10% weight for quizzes in the weighted course average. Each of the 4 exams carry a weight in the course grade of 17½% with the best of the 4 getting a 10% wild card making it worth 27½% in the weighted course average (80% is the total weight on exams). On the last day of the semester, as well as the first, each student

has the potential to put a quarter of the grade into an advantageous position. All it takes is a good performance on an assessment for which the answer to the acid test of relevance question asked by students, *is it on the test?*", the answer is a well-specified yes. Video explanations and pdf solutions exist for all question scenario setups. Even a complete 25 question draw of the algorithmic exam is available for practice online, anytime/anywhere.

43 early bird students submitted online exam 1 several days, even weeks, before the scheduled Tuesday auditorium sitting for exam 1 by paper. The upper tercile of these 43, that is 14 students that average a total score of 91.1, include 8 from a campus classroom section (avg. = 93.1) and 6 from the distance online section (avg. = 88.5). The online exams submitted early by campus students were unauthorized but accepted without penalty. Nearly all classmates of those 8 campus students intend to submit the first attempt by paper in the auditorium on Tuesday and then, about 10 days later either Thursday or Friday, 154 students attended the optional on-campus session at the 310-seat computer lab in the arts and sciences college. The course teaching team schedules and staffs the event so that any student in the learning community may submit an online attempt of an algorithmic online exam. There is no penalty for trying, only the best attempt counts. An optional online testing session after each paper exam is announced in the syllabus exam schedule at the beginning of the course.

Two students tie for highest among the 43 early bird submissions, one from the distance online section and the other in a campus section with classes. They solve 22-out-of-25 question scenario setups correctly getting 100-out-of-115 possible points (87.0%, three 5-pointers wrong). Exam 1 has 20 5-point and 5 3-point questions. Their performance earns an exam 1 score of 100.0, an A+. The online registrant lives about 200 miles from campus. 27 of the 43 early birds are registrants in the distance online section. Incremental testing costs for nearly all distance online students equal approximately $40 per submission paid to the institutionally approved vendor for proctor services from home. Some travel to test at nearby authorized sites, e.g., community colleges. Often those choices, too, incur incremental cash costs. 8 of the distance online students list a Tuscaloosa address. All online section students, including these 8, are authorized for free proctor services by scheduling time with the staff at the 60-seat on-campus testing facility in the continuing studies college. Cash strapped distance online students face disincentives submitting proctored exam attempts more costly than students in a campus section face. Proctored exams, however, are prudent for this core course required for most undergraduate degree programs in the college of business.

16 of the 43 early bird submissions are campus registrants with scheduled classes or exam times. They miscommunicated, probably clueless rather than nefarious, and got staff at the continuing studies testing facility to type the password that launched online exam 1. The campus student that scored 100 on the early bird online submission subsequently showed up in the auditorium to get 62-out-of-115 correct, 38 points worse than the first attempt. Fortunately for this student, only the best attempt at an algorithmic exam counts.

Exam 4 in Spring 2015 is the 25-question final exam submitted by 488 students. Question #8 appears below in screenshot 4.

8.
A company pursues a cost-cutting initiative that costs $26,000 to implement. Thereafter, however, the initiative reduces after-tax costs by $5,500 per year perpetually. The company relies on 53% debt financing at a 12.2% pretax interest rate. The company marginal tax rate is 36%. The company β is 1.24, short-term risk-free rate is 8.5%, and required risk premium for the market portfolio is 9.8%. Find the project's net present value.
a. $20,097 b. $16,609 c. $15,099 d. $18,270 e. $13,726

	J	R
3	Question :	8
4	Total %correct :	76.2%
5	%correct TopTail :	97.5%
6	%correct LowTail :	43.3%
7	T-stat(tails) :	5.35
8	KEY1616	CC2
9	Question :	8
10	Key :	E
11	A	5
12	B	15
13	C	3
14	D	12
15	E	91
16	#responses :	126
17	Total %correct :	72.2%
18	Upper %correct:	98.0%
19	Lower %correct :	36.0%
20	T-stat :	6.03

Screenshot 4: The standard numerical algorithm made CC2
Exam 4, Spring 2015, colors 1&6, question #8

All students knew in advance that question scenario CC2 definitely was #8 on the exam, albeit with different numbers than they may have studied. Cell **R5** shows that across the four versions of CC2 submitted, the upper tercile of student performers (sorted by total exam score) get the question correct at a 97.5% rate. Only 43.3% (cell **R6**) in the lower tercile get CC2 correct. The t-statistic for the equality of tercile means (cells **R7** and **R20**) shows that CC2 discriminates between students that do or don't attain the learning objective. That nearly every student in the upper tercile finds the correct solution for CC2, yet in the lower tercile fewer than half score correctly, raises the question: Why do the laggards lag? Since appearance of the question is not a surprise then the divergence, in the opinion of *prof-td*, is due to differences in student allocations of time. The distribution of innate talent across students plays a lesser role explaining differences in performance outcomes than motivation and time on task.

Uninformed students ultimately pursue a guessing strategy to select a multiple choice answer. Few students do not select any answer. Only 52 out of 14,025 potential responses were blank on the 561 scantrons submitted for 25-question exam 1 in Spring 2015. Of the 13,973 answer selections submitted, 13 of the 25 questions use the standard numerical algorithm which displays one number in each **A-to-E** location. Screenshot 4 above shows a version of question CC2 with the correct answer, **E**, that is the smallest number of the five choices offered. Students in the upper tercile seem well informed for finding the solution as they score correctly at a 98.0% performance rate. In the lower tercile, however, the performance rate of 36.0% for version 1 is somewhat below the tercile performance rate on the other 3 versions.

Within the 13,973 responses, there were 7,578 correct responses (54.3%) and 6,395 incorrect responses. Within the 6,395 incorrect responses, 1,136 selected **A**, 1,683 selected **B**, 1,700 selected **C**, 1,139 selected **D**, and 737 selected **E**. More than half of all wrong responses landed on **B** and **C** [52.9% = (1,683+1,700)÷6,395]!

The distribution of incorrect selections does not coincide with the distribution of correct answers. To verify this, standard numerical question CC2 was recalculated to make 300 unique versions. A tally of the **A-to-E** location and the rank of the correct

number, smallest to biggest, was recorded. Table 1 below shows the tabulation.

RANK of answer ↓	A	B	C	D	E	SUM
smallest	4.3%	3.3%	4.3%	5.3%	3.0%	20.3%
2nd smallest	4.0	3.7	5.3	4.3	4.7	22.0%
middle	2.7	3.7	3.7	3.7	3.0	16.7%
next biggest	4.7	2.7	3.7	5.0	5.3	21.3%
biggest	3.0	5.0	3.3	3.3	5.0	19.7%
SUM	18.7%	18.3%	20.3%	21.7%	21.0%	100%

Table 1: Distribution of the correct answer in the A-to-E location (columns) and by numerical rank within the five multiple choices (rows); 300 recalculations of CC2.

The question creator algorithm uses the **RANDBETWEEN(1,5)** function to assign the **A-to-E** location. An independent **RANDBETWEEN(1,5)** returns the rank of the correct number. *Excel* stipulates that **RANDBETWEEN(a,b)** returns an integer from the inclusive range **a** to **b** that is generated by a uniform distribution. The expectation, therefore, is that 20% of all answers should lie within each specific **A-to-E** location. The bottom row of the above table shows the actual percentages range from 18.3% for **B** to 21.7% for **D**; the percentage of correct answers landing on **B** and **C** is 38.6%, far below the 52.9% revealed preference of incorrect responses. With 300 draws in the sample, the hypothesis of a uniform distribution is not rejected. Similarly, the expectation is that 20% of all answers should be in each rank quintile. The rightmost row shows that the actual percentages range from 16.7% of correct numbers being in the middle of the five numbers to 22.0% being the next to smallest number. Though these diverge from 20%, the hypothesis of a uniform distribution likely cannot be rejected.

The 25 individual cells in table 1 have an expected value of 4% each (= 1/5 x 1/5). The actual likelihood, however, range from 2.3% with **A** as a number ranked in the middle of the five numbers being the correct answer to 5.3% of all correct answers being **D** and the smallest of all five choices. While these deviate from 4.0% the likelihood is that with more recalculations the results would align more closely to a unform distribution. Incorrect student responses, however, tilt toward **B** and **C**.

B. The algorithmic exam

639 students submit exam 1 performances in Spring 2015. The top row of table 2 shows the average exam 1 score equals 77.8, a C+. 243 students with an average score of 76.9 are registrants in the traditional campus section with twice weekly 75” lectures with a professor and a once-a-week 50” lab, typically with *graduate teaching assistants* from the Finance Ph.D. program. The required core undergraduate course offers a wonderful opportunity for training GTAs to teach. 94 undergraduates averaging 73.8 submit from the 150" weekly section with two 75” lectures (no lab). 260 students that average 81.7 in a campus *hybrid* section are registrants for meeting 50” weekly with a GTA. No penalties for absences and 50% absentee rates meant that effectively class

was optional. 24/7 anywhere/anytime availability to digitized learning resources means the weekly teacher facetime is substitutable to an extent that depends on student preference.

Spring 2015 Exam 1		*Registrant status by weekly classroom minutes: 50" weekly lab &/or twice weekly 75" lectures. Bonus points or penalties for attendance = 0; 0 minutes weekly indicates the online section*			
	Total # students submitting	**200** minutes / week	**150"**	**50"**	**0"**
1. Total # students submitting	639 students @77.8	243 students @76.5 avg 38% of 639	94 students @73.8 avg 15% of 639	260 students @81.7 avg 41% of 639	42 students @69.2 avg 7% of 639
2. By paper only	**407** students @79.7 avg	174 students @77.2 avg	46 students @74.2 avg	187 students @83.5 avg	0 students
3. Both paper & online exam	**154** students @77.2 avg	54 students @77.2 avg	38 students @74.7 avg	61 students @79.0 avg	0 students
2+3 Total by paper	**561** students @76.0 avg				
4. By online exam only	77 students @ 68.5 avg	14 students @68.7 avg	9 students @68.4 avg	12 students @68.0 avg	42 students @69.2 avg
5. Exam 1 Score=100	55 students @100 avg 46 By paper 9 By online 9% of 639	18 students @100 avg 14 By paper 4 By online 33% of 55	1 student @100 avg 1 By paper	35 students @100 avg 31 By paper 4 By online 64% of 55	1 student @100 avg 1 By online
6. Upper tercile	213 students @94.0 avg	73 students @93.9 avg 34% of 213	20 students @91.3 avg 9% of 213	115 students @94.7 avg 54% of 213	5 students @92.1 avg 2% of 213
7. Lower tercile	213 students @61.0 avg	87 students @59.8 avg 41% of 213	36 students @61.3 avg 17% of 213	65 students @62.6 avg 31% of 213	25 students @60.3 avg 12% of 213

Table 2: Composition by classtime of student performance profiles for Exam 1, Spring 2015

Class for some students is a chance to ask a series of follow-up questions, receive answers or explanations quicker than a chat board or watching videos. For others, class is a motivating factor, a reminder to gauge the allocation of time to learn solutions required for scoring enough points to reach targets. For a few, class is where they go because they are convinced that they're supposed to go, that just showing up is sometimes enough. Attendance at classes accrued no bonuses nor cost any penalties

on the Spring 2015 syllabus. 42 distance online students with zero scheduled classroom contact average 69.2, the lowest of any section.

Rows 5 and 6 of table 2 list the composition of the upper and lower tercile sorted on best exam score. 115 students with 50" weekly of teacher time fill 54% of the upper tercile. Beyond being more than half of the 213 students in the upper tercile, 115 is nearly half the 260 total students registered for the 50" weekly labs. Comparison of percentage enrollment from row 1 with the tercile percentages in rows 5 and 6 shows whether the section is under or over represented in the terciles. The 50" weekly section is over represented in the upper tercile; they are underrepresented in the lower tercile. Students from the 50" hybrid/blended section score well, average at 81.7, except when submitting the online exam. Row 4 shows that the 12 submissions from 50" registrants average 68.4. The distance online section contributes 5 of 213 students (2.3%) to the upper tercile. The online section with 7% of the total course enrollment is under represented in the upper tercile, over represented in the lower tercile.

The lower tercile of 213 students (row 6) distributes differently. About 40% includes students from the 200" section which is in line with the section's 38% share of total course enrollment (row 1). The 50" class with 42% of total course enrollment contributes 65 students, about a third of the lower tercile. The 25 students from the distance online section, 7% of total course enrollment, comprise 12% of the lower tercile. More than half of all students in the online section score in the lower tercile. The algorithmic exam is generating response patterns with diagnoseable meaningful outcomes. Like the question: Why did the online submissions perform so poorly when the online exam was substantively similar to the hundreds of algorithmic exams submitted by paper?

Rows 2 to 4 of table 2 sort by method of submission the 796 unique exam performances (= 561 paper + 154 both + 77 online+ 4 online twice) submitted by 639 students. 407 students submit by *Paper only* putting the average score at 79.7. 409 students (row 2) of the 561 submitting the paper exam never submit the optional online attempt. Perhaps they were satisfied with the original score, some subsequently withdrew from the course while they could, or possibly the expected gain wasn't worth scarce time or effort. 154 students (row 3) submit the paper exam once and 10 days later, the online exam once. The best score for these 154 students averages 77.2. Of the 154 online exam performances, more than half (108 students) scored worse on the retake than the original score on paper. 56 students improve their scores by an average of 13.6 points. The maximum gain from re-attempting the algorithmic online exam is 32.9 points, a nice accomplishment.

77 students submit only the online exam: 42 distance online students and 35 classroom bound students. 4 of the 42 distance online students submitted two online exam performances. The average best score of these 77 online submissions equals 68.5, some eleven points less than the average submission made by the 407 students submitting only the paper exam. The method of exam submission, online versus paper, apparently affects or correlates with student outcomes. Why?

An algorithmic document generator enables options for teacher and student alike since the next view of the same scenario setup is a unique view drawn by the algorithm. Each drawing of exam 1 is set by rules from 25 question slots in a table with 46 question codes. 16 of the slots list one code meaning the question is certain to appear at that order during the 25 question, 75 minute exam (the online exam is set to submit after 90 minutes; the super majority of students submit the exam, paper or online, before time expires). This is evidence they run out of ideas before running out of time, a good thing from the perspective of assessment design. 9 of the question slots list 2 to 4 codes, implying odds for viewing those question codes range from one-half to one-quarter. All 46 codes appear on 1 or more versions (16 codes are on every version of exam 1!). Every version displays a unique recalculation for each of the 25 exam questions.

The A-minus cutoff for an exam score of 90 was set at 84 raw points (15 5-pointers + 3 3-pointers). 205 submissions of exam 1 by 171 students put their best (and usually only) score above the A- cutoff. 41 students put the score at 100, a consequence of the syllabus policy that the total exam score "maxes out" at 100. A pool of students forms at raw points greater than about 79; that's about 16 5-pointers correct out of 25. That is, with 9 questions wrong you still can get a score of 100! Submissions in Spring 2015 from 7 out of 796 unique exam 1 performances score correctly on all 25 questions correct (7 ÷ 796 = 0.9%, 90 basis points). That's likely a lower percentage than the percentage graduating with a 4.0 GPA for a baccalaureate in the USA! 3 of the 7 perfect scores were submitted by paper from students registered for 200" weekly of classtime.

Class absentee rate often exceeded 50%, however, and in real time the scores seemed to have little or no correlation with attendance. Attendance as a factor explaining course performance outcomes declined since 2006 when the initial offering of the online section occurred. In Spring 2007 the syllabus wrote classroom students an option to submit the online exam that could supplement, but not replace, the paper exam score. In 2010, the convergence of all classroom and online registrants into a common learning community with one *Blackboard* section under one syllabus with multiple attempt online exam submission options (only the best score counts) made time with teacher less crucial for some students. 90% of the student's total course score is from assessment instruments made from the algorithmic document collection. The other 10% is for a directed 5-week financial markets trading game that required using the Bloomberg terminal at the library and 3 paper submissions (substitute documentation was specified for the distance section).

On demand access to online course resources meant that all registrants had a costless choice to behave like an online student. They were guaranteed seating at a fixed time paper exam session, too. 3 of the 7 perfect scores in Spring 2015 came from students registered for one weekly 50" fixed time slot with a teacher and classmates. Of those 3 perfect scores, 2 were by paper; the other was submission of the online exam retake option. 1 perfect score by paper came from 1 of the 94 students scheduled for 150" weekly of (optional) teacher time. None of the 7 perfect scores for exam 1 came from the distance online section which is not too unexpected since that section has only 7% of total class enrollment.

Figuring whether the online method of exam submission persistently biases student performance outcomes downward relative to ones submitted by paper requires analysis of other exam outcomes. Table 3 below for the Spring 2015 final exam about 11 weeks later reaffirms that the 248 campus students in the 50"/week hybrid section outperform all others. Though accounting for 42% of active students they get 54% of all the 100's scored on exam 4 (row 5). The average score of 89.5 for 36 hybrid section students that submit exam 4 online only (row 4) exceeds the 73.2 average score for 30 distance online students by 16.3 points! The next section examines exam 1 during Spring 2014, one year earlier than results reported in tables 2 and 3.

Spring 2015 Exam 4		***Registrant status by weekly classroom minutes: 50" weekly lab &/or twice weekly 75" lectures. Bonus points or penalties for attendance = 0; 0 minutes weekly indicates the online section***			
	Total # students	**200 minutes / week**	**150"**	**50"**	**0"**
1. Total # students	586 students @83.0 avg	220 students @82.7 avg	88 students @78.9 avg	248 students @85.9 avg	30 students @73.2 avg
		38% of 586	15% of 586	42% of 586	5% of 586
2. By paper only	**417** students @83.5 avg	170 students @83.1 avg	60 students @77.5 avg	187 students @85.9 avg	0 students
3. Both paper & online	**69** students @80.0 avg	32 students @79.5 avg	12 students @79.9 avg	25 students @80.8 avg	0 students
Total by paper	**486** students				
4. By online exam only	100 students @82.9 avg	18 students @85.1 avg	16 students @83.6 avg	36 students @89.5 avg	30 students @73.2 avg
5. Exam 4 Score=100	106 students @100 avg 77 By paper 29 By online 18% of 586	36 students @100 avg 27 By paper 9 By online 34% of 106	10 students @100 avg 6 By paper 4 By online 10% of 106	57 students @100 avg 44 By paper 13 By online 54% of 106	3 students @100 avg 3 By online 2% of 106
6. Upper tercile	196 students @94.7 avg	76 students @97.9 avg 39% of 196	19 students @98.6 avg 10% of 196	96 students @98.8 avg 49% of 196	5 students @99.4 avg 3% of 196
7. Lower tercile	196 students @63.6 avg	76 students @63.8 avg 39% of 196	32 students @58.1 avg 16% of 196	70 students @66.4 avg 36% of 196	18 students @61.8 avg 9% of 196

Table 3: Composition by classtime of student performance profiles for Exam 4, Spring 2015

C. Campus student demand for online learning

The classtime composition of the 737 students submitting exam 1 in Spring 2014 differs from 2015 due to institutional course registration rules and section offerings. The campus online section was not offered in 2015. Instead, a section with the twice weekly 75” traditional lecture (150” & no lab) launched in 2015. Enrollment in the Spring 2014 online sections at 185 students is 25% of the complete class, far bigger than the 7% it becomes in 2015. Campus online registrants number 151 and distance online 34. Class absentee rates 50% and higher meant that perhaps a majority of students who are traditional classtime registrants actually behave like online students and learn the content with online course resources. They forego class because teacher facetime becomes less relevant when digitized videos with a pause and replay button of lectures and scenario solutions are available 24/7. Many students never go to class except for testing. For readability, table 4 below for 2014 shows the 150” column as blank.

Row 1 of table 4 for 200”/week of teacher time in two 75" lectures plus 50” lab shows 150 active students for exam 1. This represents 20% of total enrollment in Spring 2014, a diverse course learning community of 737 students all submitting the same algorithmic exams and quizzes worth 90% of the course grade. The share of this section’s total course enrollment swells to 38% of the 639 total learning community in Spring 2015. Perhaps some students in 2015 would have registered for the campus online section were it offered. Maybe the course enrollment decline of 98 students from Spring 2014 to Spring 2015 relates to lack in 2015 of a clickable student option to register for the nearly always accessible anytime/anywhere campus online section.

The syllabus writes options for each student to synthesize their own personalized weighting of teacher time, even zero minutes, making a *de facto* synthesis of an online campus course irrespective of registrant section. Open door syllabus seating policies subject to availability at any scheduled classtime with any on-duty teacher at many different fixed times enables countless student learning and assessment options. Table 3 row 2 shows that 38 students from online sections submitted only the paper exam, foregoing the online option entirely. An open-door seating policy for paper exam submissions extended to all students enrolled in the course learning community. One distance online student submitted only by paper for exam 1.

Spring 2014 Exam 1		*Registrant status by weekly classroom minutes: 50" weekly lab &/or twice weekly 75" lectures. Bonus points or penalties for attendance = +/-3; 0 minutes weekly indicates the online sections*			
	Total # students	**200 minutes / week**	**150"**	**50"**	**0"**
1. Total # students	737 students @78.2 avg	150 students @74.7 avg	Section not offered	402 students @81.1 avg	185 students @74.7 avg
		20% of 737		55% of 737	25% of 737
					151 campus online @75.2 avg; 34 distance online @ 72.4 avg
2. By paper only	**229** students @74.5 avg	80 students @72. 8 avg		111 students @75.5 avg	37 campus online @74.9 avg; 1 distance online @75.9
3. Both paper & online exam	**164** students @79.7 avg;	32 students @76.0 avg		114 students @81.3 avg	18 campus online @75.7 avg
Total by paper	**393** students				
4. By online exam only	344 students @ 79.9 avg	38 students @77.5 avg		177 students @84.4 avg	129 students @74.5 avg
					95 campus online @75.3 avg; 34 distance online @ 72.4 avg
5. Exam 1 Score=100	71 students @100 avg 10 By paper 61 By online 9% of 737	10 students @100 avg 3 By paper 7 By online 9% of 67		46 students @100 avg 34 By paper 12 By online 69% of 67	15 students @100 avg 5 By paper 10 By online 22% of 67
					14 campus online exempt @100 avg; 1 distance online @100 avg
6. Upper tercile	246 students @94.7 avg	28 students @95.0 avg 25% of 246		171students @94.9 avg 43% of 246	47 students @94.1 avg 31% of 246
					39 campus online @94.4 avg; 8 distance online @ 92.8 avg
7. Lower tercile	246 students @61.2 % of 246	62 students @61.4 avg 11% of 246		106 students @61.6 avg 70% of 246	78 students @60.1 avg 19% of 246
					65 campus online @ 61.0 avg; 13 distance online @55.8 avg

Table 4: Composition by classtime of student performance profiles for Exam 1, Spring 2014

Row 4 of table 4 shows that 38 students from the 200” weekly section submitted only the online exam, foregoing the auditorium submission. An unknown number of those missed the paper exam due to illness or circumstance and, pursuant to the syllabus, the online submission serves as the make-up exam. This user-friendly no-fault makeup exam policy needs no excuse of illness or calamity, no notification nor teacher decision, an easy to implement policy given availability of a qualitatively similar algorithmic exam with each draw. The incremental cost of teaching team resources for administering the campus online submission diminishes into an acceptable fixed cost, a cost that falls as the capacity of the online testing facility grows. Most of these 38 students, they average 77.5, are synthesizing an online course even though they are registrants in the traditional twice weekly lecture plus weekly lab section.

A total of 344 students (row 4) in Spring 2014 submit only the online exam at 79.9 average. 95 students from the campus online section average 75.3, a 9.1 point spread below the 177 students averaging 84.4 from the 50” sections. Performance scores for online exam submissions include a higher share of good scores in Spring 2014 than Spring 2015 but still lag the hybrid/blended 50” sections. The distance online section exam average at 72.4 lags all other sections. In Spring 2015 the average falls to 68.4 by the distance online section. The invigorating influence in 2014 of the campus online section may have helped outcomes for distance online students.

The 2014 syllabus writes up to +3 bonus points for a record of 2 or fewer absences for students missing class. The bonus points of 1½ for the 75” lecture and another 1½ points for the 50” lab required recording attendance. The bonus declines by half-point increment per missed class bottoming out as a 3 point penalty (for 200” registrants; -1½ point for 50” registrants) applied to the weighted course average. Early classroom departures, scheduling and labor tasks, student excusals, costs like these more than offset benefits from the course administration of an attendance mandate. Even worse, the policy seemed to tilt lecture attendees toward students fearing the 3 bonus points would be the key to the C-minus cutoff and a degree. C’s get degrees.

For stronger students the incentive effect of the attendance bonus is diminished since the points are substitutable with three more 5-pointer questions correct on one exam, say 14 out of 25 correct instead of 11. For many figuring out a few more questions at home and streaming course solutions is preferable than class. The net gain for the course from the attendance mandate was negative. Thus, the policy was not written into the Spring 2015 common syllabus, the first time since 1994 that the teaching team did not collect student signatures for attendance. Students in Spring 2014 as well as Spring 2015 could synthesize from available course resources a format personalized for learning style preference and circumstance. The availability of an algorithmic document collection for the subject plus digitized anytime/anywhere content enables a uniform learning and assessment environment, a common leveler for many personalized playing fields.

The 2014 results in row 1 show disappearance of the 7.3 point gap found in 2015 between the online and traditional sections: 185 online students and 150 students in the 200” weekly classtime section are each at a 74.7 average. The gap persists albeit smaller than 2015 between the online sections and the 50" weekly sections, 402

students average 81.1 for a 6.4 point spread above online students. Even the distance student outcomes in 2014, 34 students at 72.4 average, are a few points higher than 69.2 in 2015. Comparison of row 7 with 1 shows the online students contribute nearly a third of the members in the upper tercile though they have only one fifth of the course enrollment. There may be positive externalities for the distance online section when campus online classmates are doing better.

For 56 of the 164 students (row 3) that submitted both paper and online performances of algorithmic exam 1 in 2014, the best score is the online exam submission. 108 of those submitting both, a supermajority, performed worse on the online submission of exam 1. Those 108 doing worse were left with the paper exam score, average at 82.7, as the best exam 1 score. Among the 56 students putting the retake option in the money, the average payoff is a 10.5 point gain in total exam score. The largest payoff of 32.9 points was earned by a student registrant in the section with 50" weekly of teacher time. The student submitted a paper exam1 with 2 questions correct out of 25 earning 8 raw points, an extremely improbable not easily replicated outcome given five A-to-E choices for nearly 25 questions. Random guessing draws $1/5^{th}$ of 25 correct (5 correct questions)! Regardless, the 2 questions worth 8 points gets a score fit to the line of the A-minus and C-minus cut-offs.

The C-minus cutoff for exam 1 was set *a priori* and announced on the syllabus and table of question codes at 55 raw points out of 115 total exam points possible. That means 11 5-point questions correct out of 25. The A-minus cut-off of 84 points (score = 90) and the C-minus cut-off of 55 points (score = 70) plugged into the point-slope formula from $Y=mX+b$ renown, converts 8 raw points (the X) into a score (the Y) of 37.9, a solid F but far better than a score of 0 or 7. The student subsequently submitted online exam 1 getting 67 raw points (e.g., 11 5-pointers plus 4 3-pointers). That converts into an exam score of 81.0, a B-minus, had the delivery date of the online submission been timely. The syllabus writes, however, that raw points earned beyond the first exam period incur a discounting cost of 18% per exam period, a hefty *borrow rate* that disincentives procrastination. By the way, exams submitted early and on-time, including the paper exam sittings, get a 6% bonus on raw points, akin to the *savings rate*. This particular student submitted online exam 1 in a computer lab where nearly all the other surrounding students from the course were submitting exam 3. The 67 raw points got discounted at 6% instead of 18% as on the syllabus, relief helping some without hurting any implemented after the grade record was complete. The discounted raw points convert for this student into a best score at 70.8, a solid C-minus some 32.9 points bigger than the 37.9 solid F from the classroom exam. A campus online student scored a 62 D by paper but put the score at a 94 A after submitting a winning performance on the online retake. A 200" student with a D-minus exam score by paper exerted best efforts and put the score from the online exam at an A-minus.

The smallest gain of $1/10^{th}$ point among 56 students goes to the 1 campus online student scoring 26 raw points correctly (4 5-pointers & 2 3-pointers) on the 115 point 25-question paper exam. That is 29 points fewer than the 55 raw points required for a C-minus score of 70. The paper exam score of 50.1 from the paper submission is bested by the online submission by 7 points, getting 33 raw points correct (6 5-pointers, 1 3-pointer). This student also procrastinated submitting the online option until the 3^{rd} exam

reporting period. The raw points after two periods of 6% compound interest convert to a score at 50.2, a gain of 0.1 which is better than a poke in the eye for sure. The 6 students within a one point of the average 10.5 point gain from submitting the online exam retake mostly moved from around 63 low D to 73 low C. That is an important improvement since the core curriculum requirement lists this course as subject to a C-minus rule, meaning students with course scores of D or F must retake this required course to graduate. Easy to make draws of algorithmic assessments gives teachers a way to let students work out of a difficult situation.

The 904 unique exam 1 Spring 2014 performances (= 393 paper + 164 both + 344 online + 3 online twice) submitted by 737 students saw 4 perfect 25-out-of-25 correct performances receive a score of 100.1 (4 ÷ 904 = 0.6%, 60 basis points). All 4 are online submissions by students in the 50" (3 students) and the 200" (1 student) sections. None of the 4 students submitted the paper exam. None of the 393 students that submit the paper exam get 25-out-of-25 correct, either. Student exam schedules vary widely but 4 weeks into a 15 week semester, like the situation here, is a busy time for taking exams. The online retake option lets students, wise students, time-shift workloads when advantageous.

Row 5 of table 4 shows that 67 students in Spring 2014 get a score of 100.0 (raw points > 93): 6 from the 200" class, 46 from the 50" class, 1 distance online and 14 campus online students. *A remarkable outcome is that 57 of the 67 students scoring 100 submit an online exam (10 submit by paper)*. Apparently, a tranche of talented students prefer to submit the exam online. Curiously, one reason rumored why the campus online section for 2015 did not get offered was to halt alleged widespread cheating on online submissions from home or office. One cheating strategy connected an external monitor in an adjacent room with a long discreet HDMI cable. Scenarios were solved by accomplices at the monitor and the correct multiple choice letter was signaled to the test taker. The institutional contract with the vendor providing proctor services definitely was cancelled. A new vendor was hired following a gap. Perhaps some of those 100s occurred through academic misconduct, perhaps rumors of misconduct contributed to cancellation of the Spring 2015 campus online section.

D. A complete, anonymous, publicly viewable standings of student performances

Student course scores publish on a publicly viewable standings webpage. Students select and submit to a on google-docs course form a confidential screen name. A complete and anonymous record of student performance outcomes is available for the entire learning community to see. The standings page publishes when timely messaging is prudent or incremental information emerges, usually weekly and more frequently around exams. The publicly viewable book of performance outcomes puts each student in the position of liking or disliking one's rank in class. Emotions that the open grade book infuses like pride, envy, anger, or relief, potentially drive student behavior to a greater or lesser extent. The standings page publicly announces exam and quiz scores. The scores are not reported in the *Blackboard* gradebook so informed students must check the standings. They have no choice but to see how they rank.

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The exam2 bonus period expires 11pmTuesday March 4
and already students Belle13, 35242, 37872, and rt6009 are showing it can be done!

Remember that the textbook shows calculator clues that are a big part of the time value lessons.

Get busy, participate, plan, and imagine the possibilities! \=\prof td

A score of 100.1 is a natural 100 indicating 25-out-of 25 questions answered correctly.

Screen name	*Class rank*	*Section-Teacher*	*#eQuizzes submitted*	*Weighted Quiz Average*	*Exam 1 Score*	*Exam 2 Score*	*Weighted Course Average*
37872	1	321-Lim1pm	11	40	**100.1**	100	49.0
Take Two	1	320-Banerjee2pm	13	46	**100.1**	0	32.1
38604	1	321-Arnatt630pm	7	25	**100.1**	0	30.0
Ckhalil86	1	321-Choi11am	0	0	**100.1**	0	27.5
rt6009	5	321-Choi10am	18	100	100	84	52.3
35242	6	321-Banerjee2pm	15	67	100	100	51.7
Belle13	7	321-Teterin2pm	14	50	100	**100.1**	50.1
NLG	8	321-Banerjee2pm	15	100	100	0	37.5
BRN	9	321-Banerjee2pm	16	100	100	0	37.5
--*--*--*--*--*--*--*--*	10	321-Arnatt5pm	17	100	100	0	37.5
Patrick Bateman	11	321-Choi11am	17	100	100	0	37.5
34596	12	321-Teterin11am	19	100	100	0	37.5
Rynzel	13	321-Arnatt5pm	19	100	100	0	37.5
aau03	14	902-Online902	14	50	100	0	32.5
EndlessLove%	15	321-Choi10am	13	48	100	0	32.3
PrimetimeTommy	16	321-Teterin11am	14	46	100	0	32.1
Jo	17	321-Teterin11am	11	41	100	0	31.6
Roger Dorn	18	321-Banerjee2pm	11	41	100	0	31.6
spongebob	19	321-Arnatt5pm	11	41	100	0	31.6
egr1030	20	902-Online902	11	41	100	0	31.6
3481	21	321-Teterin2pm	11	39	100	0	31.4
bamalone14	22	321-Teterin11am	10	37	100	0	31.2

Screenshot 5: Top of the Exam 1 rankings from the publicly viewable standings page, 2014.0217

Ranked 1st by Exam 1 score are 4 students with perfect performances, 25-out-of-25 correctly solved scenario setups. Student **37872** went on to submit exam 2 early scoring a 100 for an online submission (24-out-of-25 correct), possibly at the free campus proctored testing facility. Campus online incremental testing costs for students are minimal though they may choose to pay the institutionally approved vendor for online proctoring services from home (actually anywhere, approximately $40). Off campus proctoring costs for online exams for students in the Distance Online section typically equal the vendor's cost (about $40).

In all sections online assessments compose 90% of the course grade of which 10% equals a weighted average of 27 online anytime/anywhere non-proctored timed (14") 3-question quizzes. The course schedule and classes covered content through quiz 11 by that date, 02/17/2014, the publication date shown at top of the standings. The quizzes and exams are available online from beginning through end of the semester. Quiz scores incur no penalty for procrastinating. Online exams incur 14% discounting per exam period in Spring 2014. Each student gets an option to accelerate the pace of course progression. 13 of the top ranked 22 students, the majority, in the screenshot above are ahead of schedule for submitting quizzes; 3 students already submitted online exam 2 about 2½ weeks early!

6 of the 22 students in screenshot 4 above have submitted 11 quizzes, right on schedule. Student **Ckhalil86** scored 100.1 but has submitted zero quizzes. The rightmost column shows that the weighted course average for **Ckhalil86** is 27.5, the grade weight applied to the personal best exam score of the semester. Student **NLG**, ranked 8th, submitted 15 quizzes putting each at a score of 100. For **NLG** the weighted *course* average equals 37.5; sum of 27.5% for the exam score (100) plus 10% for a weighted *quiz* average (*wqa*) of 100. Submitting more quizzes will not change the *wqa*

up or down for **NLG**. Scores of 100 came on the first submission of quizzes 1-to-10. Exam 1 covers content on the first 7 quizzes. **NLG** also scored 100 on quizzes 12-to-14 with content pertinent to exam 2. Finally, **NLG** scored 100 on quizzes 26 and 27 relevant to exam 4 during the final exam period. Those quizzes at the end on futures and options are easier than quizzes on modern portfolio theory for exam 3. Regardless, the incentive to push up the weighted course average by submitting quizzes is nil for **NLG**. None are submitted the remainder of the semester, either. **NLG** finished the semester at rank 107 with a grade of A (weighted course average of 93.6).

The score motive for submitting quizzes is nil once a *wqa* of 100 is attained. None of the 9 students in screenshot 22 with a *wqa* of 100 submitted additional quizzes. The most submitted by anyone is 19 quizzes by **34596** and **Rynzel** in 12th and 13th rank. Both submitted quizzes #1 straight through enough to get 15 100's. Quizzes 20 through 27 remained unsubmitted without any adverse effect on the course grade.

The student in 7th place, **Belle13**, submitted online exam 2 early scoring a perfect 100.1 that goes well with the 100.0 score on exam 1. The *weighted quiz average* of 50 for **Belle13** equals the sum of scores for quiz 1 through 14 (see screenshot column **Number submitted quizzes**) divided by 27. **Belle13** scores 100.0 on 13 quizzes. On quiz #10 the score was 63.4, an average of multiple attempts at quiz 10. Each quiz permits 3 attempts. The specific quiz score equals the average of all attempts at that quiz. Quiz #10, like nearly all quizzes, has two 30-point and one 40-point question. Thus, (13x100 + 63.3) ÷ 27 equals the *wqa* of 52 as the standings shows.

The end of semester standings in screenshot 6 below shows that among the 789 students who submitted at least one assessment during the Spring 2014 semester **Belle13** finished #1 sharing the distinction with student **38604**. 672 students submitted 708 performances of the 4th and final exam. 638 students received a course grade of C-minus or better. **Belle13** and **38604** each submitted exam performances 1 through 4, and each student had one perfect exam performance with 25-out-of-25 correctly solved question scenario setups.

Publication date: 5/2/2014 2:39:22 PM

The paper exam4 second sitting and bonus period occur tonight in tenHoor 30 (7pm).
DEBUT: The scantrons from the first sitting last night of Exam4 appear below.

Good look to all, especially ones for whom marginal returns from investment right now are increasing due to industry, discipline, allocation of time, just plain figuring out. Happy weekend for all, especially graduates. Exceptions can remedy during my normal office hours today, June, or September so don't worry. Keep in touch. I'll eventually get current on emails. The Blackboard Discussion Board and messaging is up to date.
Many common answers already are there.\=\prof td

Improve your score!

Go to the TestLab and cash-in some options.

Screen name	*Class rank*	*Section-Teacher*	*#eQuizzes submitted*	*Weighted Quiz Average*	*Exam 1 Score*	*Exam 2 Score*	*Exam 3 Score*	*Exam 4 Score*	*Weighted Course Average*	*Course Score*	*Course grade w/o more*	*Screen name*	*Trading Game*
Belle13	1	321-Teterin2pm	16	100	100	**100.1**	100	100	100.6	102.1	A+	**Belle13**	106
38604	1	321-Arnatt630pm	18	100	**100.1**	100	100	100	100.6	102.1	A+	**38604**	106
Roger Dorn	3	321-Banerjee2pm	15	100	100	**100.1**	100	100	100.3	101.8	A+	**Roger Dorn**	103
BRN	3	321-Banerjee2pm	16	100	100	100	100	100	100.3	101.8	A+	**BRN**	103
Totti10	5	321-Arnatt630pm	18	100	100	100	100	98	100.1	101.6	A+	**Totti10**	104
jsgoldsboro	6	321-Choi1pm	22	100	100	**100.1**	100	100	100.0	101.5	A+	**jsgoldsboro**	100
CEJ7946	7	321-Choi11am	21	97	100	100	100	100	99.7	101.2	A+	**CEJ7946**	100
izc	8	321-Choi11am	15	100	98	100	100	**100.1**	99.7	101.2	A+	**izc**	100
39415	9	321-Arnatt630pm	19	100	100	100	100	100	99.6	101.1	A+	**39415**	96
cy79	10	321-Teterin2pm	17	100	100	99	96	100	99.6	101.1	A+	**cy79**	104
41841	11	321-Teterin2pm	16	100	99	100	100	94	99.4	100.9	A+	**41841**	106
risus	12	902-Online902	20	93	100	99	100	100	99.4	99.4	A+	**risus**	102
51988770	13	320-Teterin4pm	24	100	100	100	96	100	99.3	101.5	A+	**5.2E+07**	100
Ckhalil86	14	321-Choi11am	20	100	**100.1**	100	98	94	99.0	100.5	A+	**Ckhalil86**	103
O'Doyle Rules	15	320-Arnatt630pm	16	100	100	99	98	94	99.0	101.2	A+	**O'Doyle Rules**	104
lep1994	16	321-Choi1pm	17	100	94	100	100	98	98.7	100.2	A+	**lep1994**	100
xinyi ren	17	321-Choi10am	24	84	100	100	100	100	98.4	99.9	A+	**xinyi ren**	100
alwaystogether	18	321-Choi10am	17	86	100	100	100	100	98.4	99.9	A+	**alwaystogether**	98
girlygirldd	19	321-Choi10am	19	85	100	100	100	98	98.2	96.7	A+	**girlygirldd**	100
Annieyang	20	321-Teterin4pm	21	100	93	100	100	94	98.1	99.6	A+	**Annieyang**	104
bamalone14	21	321-Teterin11am	15	100	100	100	94	92	98.1	99.6	A+	**bamalone14**	105
42356	22	902-Online902	16	100	100	97	100	90	98.1	98.1	A+	**42356**	103

Screenshot 6: End of semester top rankings, 2014.0502

Student **Ckhalil86** that scored a perfect 100.1 on exam 1 ends the semester at rank 14. 20 submitted quizzes for **Ckhalil86** included 15 quiz scores of 100 thus putting the weighted quiz average at 100 (fifth column). Two of the 4 students scoring 100.1 on exam 1 fall out of the top 20. Three names in the top 22 after exam 1 remain in the top 22 after the final exam. Students **38604**, **Roger Dorn**, **Ckhalil86**, and **bamalone14** shared 1st rank after exam 1 based on perfect 100.1 performance scores. Student **Take Two** falls to 74th rank with a grade of A+, a distinctive accomplishment nonetheless.

12-out-of-5,000+ exam submissions by 746 students in Spring 2014 were perfect 25-out-of-25 correctly solved exam performances. Student **Take Two** at 74th rank, an A+, submitted two of the perfect performances, as shown below in screenshot 7.

Screen name	*Class rank*	*Section-Teacher*	*#eQuizzes submitted*	*Quiz Average*	*Exam 1 Score*	*Exam 2 Score*	*Exam 3 Score*	*Exam 4 Score*
strawberryswing	73	321-Shen9am	16	100	98	96	88	92
Take Two	74	320-Banerjee2pm	17	100	**100.1**	100	77	**100.1**
aau03	75	902-Online902	16	100	100	100	81	92
Yuki	76	320-Teterin4pm	16	85	98	94	100	88
eeeeesnht	77	321-Lim1pm	16	100	**100.1**	100	100	69
BakeHyun	78	321-Teterin4pm	22	100	75	100	94	100
jcwilliams11	79	321-Arnatt630pm	21	100	100	100	96	80
bcai1	80	321-Choi10am	24	100	93	96	96	88
show	81	321-Teterin2pm	19	86	99	90	97	90
klnolan	82	321-Lim10am	27	90	92	87	96	100
34596	83	321-Teterin11am	19	100	100	100	81	92
edward08	84	321-Banerjee2pm	15	100	98	85	86	100
ltsmith2	85	321-Arnatt5pm	19	100	91	100	87	90
Yimeng Wang	86	902-Online902	15	80	100	100	98	82
Coach Saban	87	321-Choi1pm	15	100	94	94	83	98
FlowerGirl	88	320-Teterin2pm	19	100	100	100	94	90
bde07	89	321-Teterin2pm	18	100	93	99	94	84
1	90	321-Teterin2pm	15	100	96	**100.1**	97	73
Bqin1	91	321-Arnatt3pm	17	87	100	90	100	84
tcf1219	92	321-Lim10am	19	100	94	100	87	86
Gandalf the Grey	93	320-Lim1pm	16	95	100	99	77	94
4006	94	321-Choi10am	16	79	94	97	100	92
515	95	321-Lim10am	17	100	99	99	81	92
natimay	96	902-Online902	16	100	92	99	87	88
25354	97	902-Online902	15	100	88	99	87	92
blackbird77	98	901-Online901	17	100	90	90	100	100
Paul George	99	902-Online902	21	100	93	97	81	96
jheisch	100	321-Lim10am	19	100	91	100	88	86
Riff Raff	101	321-Lim1pm	23	100	98	100	82	85
The Oracle Of Bromaha	102	321-Choi10am	24	100	100	100	90	99
mgbrantley12	103	321-Choi1pm	15	100	94	96	88	90
mckraken	104	321-Banerjee2pm	16	100	83	96	91	98
Tidesports1	105	321-Shen9am	15	100	88	100	87	90

Screenshot 7: End of semester rankings highlighting 4-of-12 perfect exam scores, 2014.0502

At the top of the standings page usually is timely course information. The default screenname is a substring of 5 numbers drawn from registration data. Nearly 90% of all students, however, personalize the screenname. 30 out of the top 32 A+ students in screenshot 7 above for Spring 2014 have personalized screennames. Likewise for screenshot 8 below for Spring 2015. They care about their public persona even though it may be anonymous.

Publication date: 5/1/2015 12:22:27 PM

JoeTheBull has clinched #1, scoring a perfect 25-out-of-25 on all 4 exams. The last time that was accomplished was about 4,600 students ago in Summer 2012 by student "23931". JoeTheBull is pretty amazing for the accomplishment. The exams are pretty amazing to possess such discriminatory power. Don't know quite what it means, but to me it seems pretty awesome.

There are a lot of good performances. All that really matters is whether you learned the basic lessons of Business Finance. Good luck to all as you move forward toward the next step.\=\prof td

Exam scores of 100.1 indicate perfect 25 questions correct!

Screen name	*Class rank*	*Section-Teacher*	*#eQuizzes submitted*	*Weighted Quiz Average*	*Exam 1 Score*	*Exam 2 Score*	*Exam 3 Score*	*Exam 4 Score*	*Weighted Course Average*	*Course grade w/o more*	*Trading Game*
JoeTheBull	1	Neil3pm320	15	100	**100.1**	**100.1**	**100.1**	**100.1**	100.08	A+	100
cjia1	2	Jeff1pm320	17	100	99	**100.1**	100	**100.1**	98	A+	79
mcita7	2	Joey9am320	15	100	85	100	99	**100.1**	97	A+	100
MMMMMMMMIIIIIIIIIIIIINNNN	2	Jeff10am321	27	96	85	99	**100.1**	**100.1**	97	A+	99
40708	2	Jeff1pm321	19	100	72	100	100	**100.1**	95	A+	100
l0003	2	Joey1pm320	18	74	91	85	83	**100.1**	88	B+	73
donjuan	7	Joey9am321	15	100	**100.1**	**100.1**	**100.1**	100	100.06	A+	100
PYT	8	Jeff10am321	15	100	**100.1**	**100.1**	100	100	100.05	A+	100
ela42	9	Joey9am321	16	100	100	**100.1**	**100.1**	100	100.05	A+	100
Hopefullynearthetop	10	Neil4pm320	17	100	**100.1**	**100.1**	100	100	100.05	A+	100
HallLundberg	11	Neil2pm320	18	100	100	**100.1**	**100.1**	100	100.05	A+	100
wafflefris4free	12	Jeff10am321	16	100	100	100	100	100	100.00	A+	100
19ecar	13	Jeff5pm321	17	100	100	100	100	100	100.00	A+	100
bauhinia	14	Jeff10am321	25	100	100	99	100	100	99.88	A+	100
gibfu	15	Joey10am320	16	100	100	99	100	100	99.77	A+	100
maddie95	16	Joey1pm321	18	100	100	100	98	100	99.69	A+	100
ThunderChicken	17	Neil2pm320	20	96	100	99	100	100	99	A+	98
Bama14	18	Neil4pm321	15	100	98	100	98	100	99	A+	97
pandafang	19	Neil2pm320	24	96	99	100	100	100	99	A+	94
Bernard Madoff	20	Neil2pm320	18	100	100	92	100	100	99	A+	100
kcbenos	21	Joey9am321	27	100	100	92	100	100	99	A+	100
12345666	22	Jeff10am321	16	100	92	100	**100.1**	100	99	A+	100

Screenshot 8: End of semester rankings highlighting perfect exam scores, 2015.0501

The next section of this document illustrates the workings of the *standard numerical* algorithm. The *Algogen* software automates making eight different types of algorithmic questions. The standard numerical wizard created 13 of the 25 questions on exam 1. *Algogen* also performs the item analysis and tercile performance rates from the scantron file of student responses and imports the data into the semester gradebook. Discussions throughout the different algorithms give information specific to that particular wizard as well as general guidance and hints for making algorithmic documents.

Algorithm 1. The Standard Numerical Wizard
Macro-name = StandardNumerical

The *standard numerical* algorithm randomizes in two dimensions: by location ($1/5^{th}$ chance choice **A** is correct, …, $1/5^{th}$ chance choice **E** is correct) and by rank ($1/5^{th}$ chance the smallest number, …, $1/5^{th}$ chance the biggest number). Sometimes teachers make a false decoy equal a number obtained by making a slight but common error in the solution. The difficulty of putting an "attractive decoy" such as this on the exam is when students make this common error they find a matching answer get this question wrong 100% of the time. Completely uninformed students guessing randomly among the five **A-to-E** choices, however, have a 20% chance of getting this question correct. By using a randomly generated wrong number instead of an attractive nuisance like a meaningful decoy then the student making the common error does not find the answer. Lacking a match, the student likely re-examines the solution process giving them a chance to find the common error and improve the outcome. Eradicate making a little knowledge a dangerous thing and instead reinforce learning. None of the algorithms therefore use attractive decoys. Rather, numerical multiple choices differ by *x%* from one another where *x%* is a setting on the user form (10% by default).

Making an algorithmic question requires that these two *Excel* add-ins are activated: **Analysis ToolPak** from *Microsoft* and **Algogen.xla** from *elementsOfFinance.net*. Completing step #3 of the *Algogen* installation instructions activates the 2 add-ins and

lets you create setups and launch a wizard whenever launching *Word* and *Excel*! Files made by standalone step #3 makes files ready for the *Algogen* app. The other steps install the optional *Algogen* app that makes working time after time with the documents easier.

One way to create a new question scenario is set it up first in *Word*. Second set it up in *Excel*. Third launch the wizard within *Excel* that packages the content algorithmically by linking the two files. That order seems most natural though the order of operations sometimes rearranges to suit the circumstance.

A file **WordName.docx** embeds links to the file **ExcelName.xlsx**. The file location of the *Excel* workbook must match the location specified in the embedded link. Thus, the *Word* algorithmic documents really can be stored anywhere, the embedded links may be copied here or there and still retain their capacity to recalculate, *as long as the Excel workbook is in the target location.*

Making a new *Word* and *Excel* file for every scenario setup is possible. All wizards permit multipart setups with incremental information that could grow forever. At the other extreme making only one *Word* and *Excel* file to contain every question scenario setup ever to be made during a career is possible. Again, choices for the filename system seem easy like **Everything.docx** and **Everything.xlsx**! That system could name worksheets within one **.xlsx** file for specific events or topics, like Exam1 or Bonds or a course name. Default headings in the *Word* algorithmic documents created by the wizards (3 levels) could reference specific properties like semesters, events or topics. The *Algogen* app makes lists from those properties and possibly the system could enable rapid retrieval and listing/viewing of the collection contents.

The system for naming folders and files described below creates new questions into *Word* documents dedicated to a common theme, like a chapter in a book. The one *Excel* workbook contains many different worksheets, each more or less dedicated to contain setups for a specific *Word* document.

C:\Users*your username*\Documents*CollectionTitle*\ExcelName.xlsx
C:\Users*your username*\Documents*CollectionTitle*\WordName1.docx
C:\Users*your username*\Documents*CollectionTitle*\WordName2.docx
…
C:\Users*your username*\Documents\FolderName\WordNameN.docx

The ***your username*** represents the active *Windows* user. **FolderName**, **ExcelName** and **WordName#** are names set by you when saving the initial *Word* document with the first question. The *Algogen* app makes documents for quizzes and exams by manipulating those files. Alternatively, some users may choose to initially forego the app and get an endless stream simply by using copy/paste/recalculate instead since the *Word* setups successfully copy the randomizing feature if the **Keep links intact** button is checked on the wizard's form (the default is unchecked). The instructions below create a new algorithmic scenario setup for a new collection.

1. Launch *Word* and open a new blank document.

-- Simultaneously hit the CTRL SHIFT 8 keys which toggles the display of hidden characters, such as the paragraph mark ¶. Hit the **Enter** key thus making a new paragraph. Hit **CTRL A** to select the entire document. > *Right*-click on the selection and click **Paragraph**. Format zero points **before** and **after**. Format line spacing as **Single**. Click **OK**. > *Right*-click on the selection and click **Font**. Set the font to **Arial 12** point (or use your preferred font and size).

-- Copy and paste at the top of the new document the following setup sentence and three questions: Your friend respects your financial acumen and asks about her business loan of xx at an annual percentage rate of xx (compounded xx) for a term of xx years. How much is the xx payment? If she repays the loan as stipulated then how much total interest over the life of the loan is paid? How long does it take to reduce the principal outstanding by half?
-- Hit the **Enter** key (again making a new paragraph).
-- Click **File** > **Save as** > Click **Browse** and select your **Documents** folder > Click to make a **New folder** that will contain this new algorithmic document, say the folder name is **PersonalFinance**. Name this *Word* file **Loans** > Click **Save**. This file was made:
C:\Users*your username*\Documents\PersonalFinance\Loans.docx
The file contents include exclusively the setup and 3 interrogative sentences pasted from above. Leave the document open.

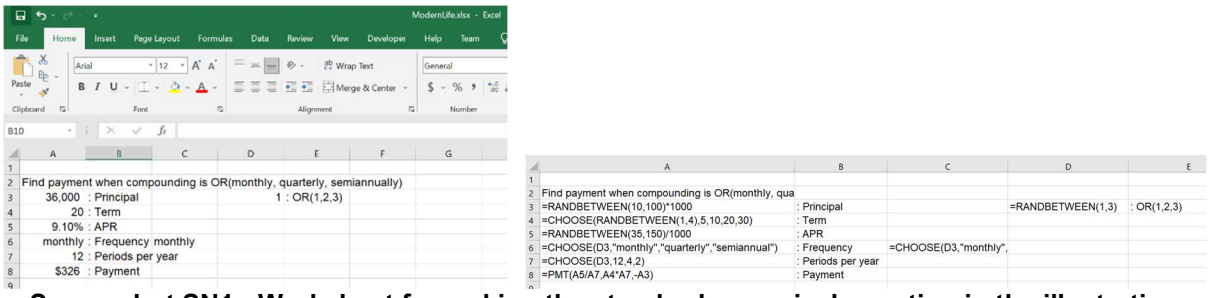
2. Launch *Excel* and click to Open a Blank Workbook.
-- Hit **CTRL A** to select the entire empty document: (a) Right-click on any column header (any letter above row 1), select **Column Width**, and set to **12**, click **OK**. (b) Again, **CTRL A** and set the font to **Arial 12** point. [Actually, making the *Excel* and *Word* documents have the same font and point size is the objective (use your preferred font and size).]
-- Make a one-time setting to toggle from automatic calculation (the default for a new workbook) to manual calculation. Click **File** > click **More Options** > click **Formulas** > in the Calculation Options section check the box **Manual** > click **OK**. While this setting is not essential it definitely makes working with an algorithmic document more convenient.
-- In cell **A2** type or copy/paste the question description below:
Find payment when compounding is OR(monthly, quarterly, semiannually)
-- In cell **A3** type or copy/paste the formula below:
=randbetween(10,100)*1000
In **B3** put the label : Principal
Format cell **A3** as Currency with zero decimal places.
-- In cell **D3** type or copy/paste the formula below:
=randbetween(1,3)
In **E3** put the label : OR(1,2,3)
-- In cell **A4** type or copy/paste the formula below:
=choose(randbetween(1,4),5,10,20,30)
In **B4** put the label : Term
-- In cell **A5** type or copy/paste the formula below:
=randbetween(35,150)/1000
In **B5** put the label : APR
Format cell **A5** as a Percentage with two decimal places.
-- In cell **A6** type or copy/paste the formula below:
=choose(D3,"monthly","quarterly","semiannual")
In **B6** put the label : Frequency
-- In cell **C6** type or copy/paste the formula below:
=choose(D3,"monthly","quarterly","semiannually")
-- In cell **A7** type or copy/paste the formula below:
=choose(D3,12,4,2)
In **B7** put the label : Periods per year
-- In cell **A8** type or copy/paste the formula below:

=pmt(A5/A7,A4*A7,-A3)
In **B8** put the label : Payment
Format cell **A8** as Currency with a $ symbol and zero decimal places.

-- Right justify **A3:A8** and left justify the labels in **B3:B8**.
-- Click **File** > **Save as** > **Browse**. Click to select the **PersonalFinance** folder and assign the workbook the same name (or, as you wish), **PersonalFinance**. The following was saved: **C:\Users*your username*\Documents\PersonalFinance\PersonalFinance.xlsx**

Find information below that clarifies the *Excel* question scenario setup.
-- The **randbetween(a,b)** function in **A3** returns an integer from *Analysis ToolPak* for the inclusive range **a** to **b**, in this case an integer from 10 to 100. The formula in **A3** multiplies the returned integer by 1,000. Thus, the loan principal ranges from $10,000 to $100,000 or any of the other numbers in between (rounded to thousands, 91 possible outcomes).
-- The **choose** function in **A4** has as its first argument an index, in this case an integer from 1 to 4 returned by **randbetween(1,4)**. The index specifies which of the subsequent choices (i.e., arguments) will be returned to the cell. That is, the term of the loan has a 1-in-4 chance of equaling a 5-year, 10-year, 20-year, or 30-year loan
-- The **randbetween** function in **A5** returns a number from 35 to 150 which gets divided by 1000 meaning that the annual percentage rate for the loan ranges from 3.5% to 15.0% (rounded to tenths; 116 unique rates are possible).
-- The **choose** function in **A6** uses the integer in **D3** returned by **randbetween** to choose either the word monthly, quarterly, or semiannual (adjectives). In **C6** the **choose** function returns either the word monthly, quarterly, or semiannually (adverbs).
-- The **choose** function in **A7** uses the integer in **D3** to choose either the number 12, 4, or 2, a number which corresponds to the word in **A6**.
-- The loan payment in **A8** computes from the *Excel* **pmt()** function. The first argument, **A5/A7**, is the periodic interest rate found as the annual percentage rate (APR) in **A5** divided by the number of periods per year in **A7**. The second argument, **A4*A7**, is the total number of loan payments found as the number of years times the periods per year. The third argument is the principal amount of the loan, **A3**, with a leading negative sign for peculiar *Excel* reasons.

Screenshot SN1 below shows the workbook completed from the preceding steps.



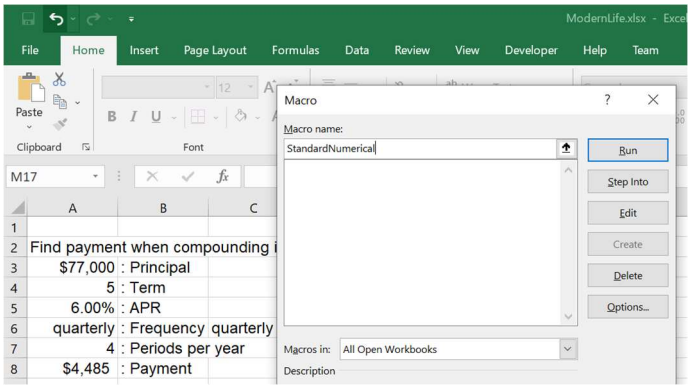
	A	B	C	D	E	F	G
1							
2	Find payment when compounding is OR(monthly, quarterly, semiannually)						
3	36,000	: Principal		1	: OR(1,2,3)		
4	20	: Term					
5	9.10%	: APR					
6	monthly	: Frequency monthly					
7	12	: Periods per year					
8	$326	: Payment					

	A	B	C	D	E
1					
2	Find payment when compounding is OR(monthly, qua				
3	=RANDBETWEEN(10,100)*1000	: Principal		=RANDBETWEEN(1,3)	: OR(1,2,3)
4	=CHOOSE(RANDBETWEEN(1,4),5,10,20,30)	: Term			
5	=RANDBETWEEN(35,150)/1000	: APR			
6	=CHOOSE(D3,"monthly","quarterly","semiannual")	: Frequency	=CHOOSE(D3,"monthly",		
7	=CHOOSE(D3,12,4,2)	: Periods per year			
8	=PMT(A5/A7,A4*A7,-A3)	: Payment			

Screenshot SN1: Worksheet for making the standard numerical question in the illustration

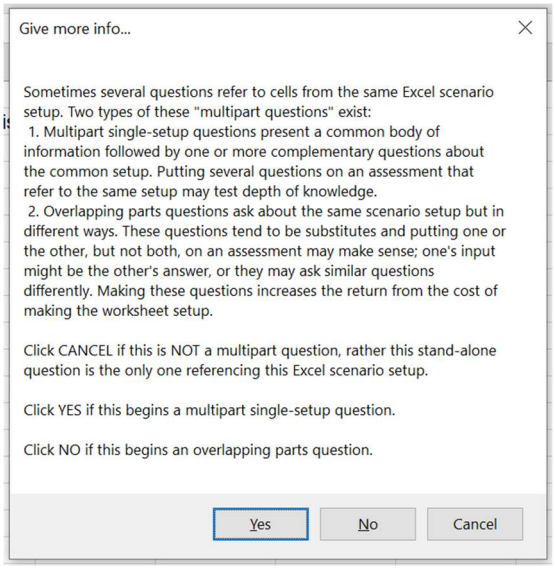
The left panel displays the results from the cell instructions. The right panel displays the cell instructions.

3. This step runs the question creator wizard that makes the algorithmic document by copying the *Excel* worksheet setup as embedded links into the *Word* question setup. Make worksheet cell **B10** the active cell. This cell becomes the upper left corner of the *answer block* (6 rows by 3 columns) that the wizard automatically writes in the workbook. Any prior contents will be overwritten by the wizard so always be sure the cells within the answer block are empty. Good practice leaves a blank row or two between the worksheet question scenario setup and the top of the answer block.
-- Hit the shortcut keys **ALT F8** to open the *Excel* Macro form (or click **View** > click **Macros** > click **View macros**).
-- In the input box for the Macro name type or copy/paste **StandardNumerical** (no space between words, capitalization is irrelevant). The view should look similar to below.



Screenshot SN2: The *Excel* macro form is viewed with the Alt F8 keys

The **StandardNumerical** macro is from the **Algogen.xla** add-in. When that add-in is properly activated then the **Run** button highlights with a blue border like the above screenshot shows. If the **Run** does not highlight then **Algogen.xla** is not activated; see Installation Instructions step #3.
-- Click **Run** to launch the question creator wizard. An information form opens that describes the standard numerical algorithm and gives an opportunity to abort or advance. Make sure that the caption at the top of the form lists the desired target *Word* document, for this illustration **PersonalFinance.docx**. > Read the information and click **OK** (or **YES**). The next form to open is shown below.



Screenshot SN3: The info for choosing a stand-alone question or a multipart question

Questions that reference the same *Excel* setup are called multipart questions. The form in screenshot SN3 describes two different types of multipart questions that the wizards make. (1) When the *Algogen* app puts one or more *multipart single-setup questions* on an exam the common question body is copied once. Then each selected question is copied one after another. These questions tend to be <u>complements</u> that follow-up the setup seeking more depth of knowledge. Multipart single-setup question codes always end with an incrementing suffix letter and **m** (e.g., FA3am, FA3bm, FA3cm). (2) *Overlapping parts questions* do not have a common question body. One overlapping parts question may contain the answer to another question from the same setup, or it may ask for pairs of answers from the same setup. Overlapping-parts questions tend to be <u>substitutes</u> so asking both on one document may be nonsensical. Question codes for overlapping parts questions always have the same part code and number and an incrementing suffix letter (e.g., BA1a, BA1b, BA1c) > For this illustration there are several follow up questions about the setup so click **Yes** to make a multipart single setup question. The effort creating a question scenario setup in *Excel* receives a higher return when several questions referencing the setup are made. Probably 70% of the 600 questions in the *elements Of Finance* algorithmic testbank are members of multipart setups. Even though only 2 o 3 questions on a 25-question exam are multipart questions the majority of the 25 may be multipart members.

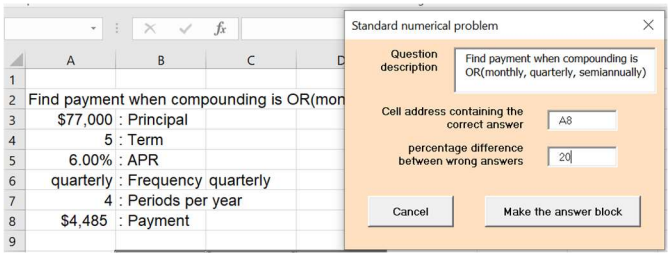
-- Since this is the first question in a new document the wizard prompts for the *part code*. Every question must have a question code that begins with a 2 or 3 character alphabetic string followed by a number. The alphabetic string is the part code. Many problems that are very similar, say because they are on the same topic, use the same alphabetic part code. The wizard automatically increments the number affixed after the part code as new questions are added to this part. > Type **AM** (for amortization) for the part code and click **OK**.

-- Copy and paste the following question description into the form: Find payment when compounding is OR(monthly, quarterly, semiannually)

-- Type **A8** as the cell address containing the correct answer.

-- The question creator form default setting for “percentage difference between wrong answers” is 10%. For small numerical answers, such as 0.0025 cents, the setting might

be increased to 25% or more in order to allow for student rounding error. For large answers, such as company market capitalization, this number may be set smaller. A setting of 100 forces answers to differ by one integer, e.g., 7, 8 , 9, 10, and 11 rearranging in **A-to-E** choices. For this illustration, increase the setting to 20.
-- Screenshot SN4 shows the completed question creator form.



Screenshot SN4: The *standard numerical* question creator form

-- Click **Make the answer block**. The wizard next prompts whether this is a stand-alone question, i.e., the only question using this *Excel* setup, or is this a multipart question, the first of several questions that will use this *Excel* setup. > The wizard next prompts for the *Excel* cell address of any variable that goes into the *Word* common question body. Type **A3** (the cell with the principal amount) and click **OK**. > When the prompt again returns type **A4** (the loan term) and click **OK**. > When the prompt again returns type **A5** (the APR) and click **OK**. > When the prompt again returns type **C6** (the loan frequency, adverb) and click **OK**. > When the prompt again returns click **Cancel** since there are no more inputs for the common question body. > The wizard next prompts for inputs going into the first question after the common body. Type **A6** (the loan frequency, adjective) and click **OK**. > Next click **Cancel** since there are no more inputs to transfer from *Excel* to *Word*.

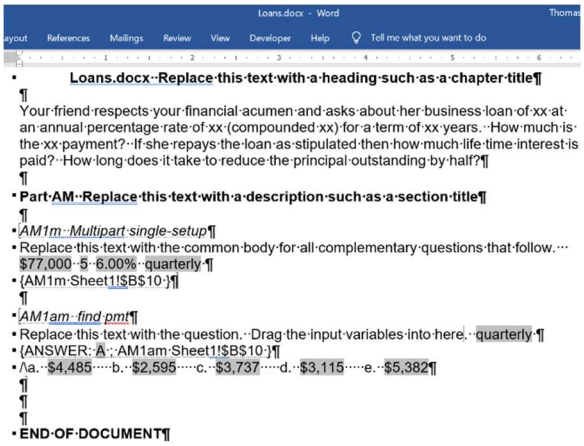
4. The question creator wizard finishes making the algorithmic question and suggests these next steps. First, finalize the *Excel* question scenario setup. > Select the five answers that appear in the range **C11:C15.** > Click to format the cells as Currency with zero decimal places. > Align the **C11:C15** cell contents in the center (it's trivial but prettier!). > Type the question code **AM1m** in cell **A2** so as to precede the description. > Format cell **A2** as bold italic. That's it! Save the *Excel* file. Notice that the workbook recalculates upon saving which gives something like screenshot SN5 below. The shortcut key to recalculate is **F9**. Hit **F9** repeatedly and notice how the setup changes.

	A	B	C	D	E
1					
2	***AM1m Find payment when compounding is OR(monthly, qu***				
3	$77,000	: Principal		2	: OR(1,2,3)
4	5	: Term			
5	6.00%	: APR			
6	quarterly	: Frequency	quarterly		
7	4	: Periods per year			
8	$4,485	: Payment			
9					
10		A	/\6/\77A0 2/\	AM1am Sheet1!$B$10	
11		$4,485			
12		$2,595			
13		$3,737			
14		$3,115			
15		$5,382			
16					

Screenshot SN5: The completed *Excel* question scenario setup and answer block for AM1

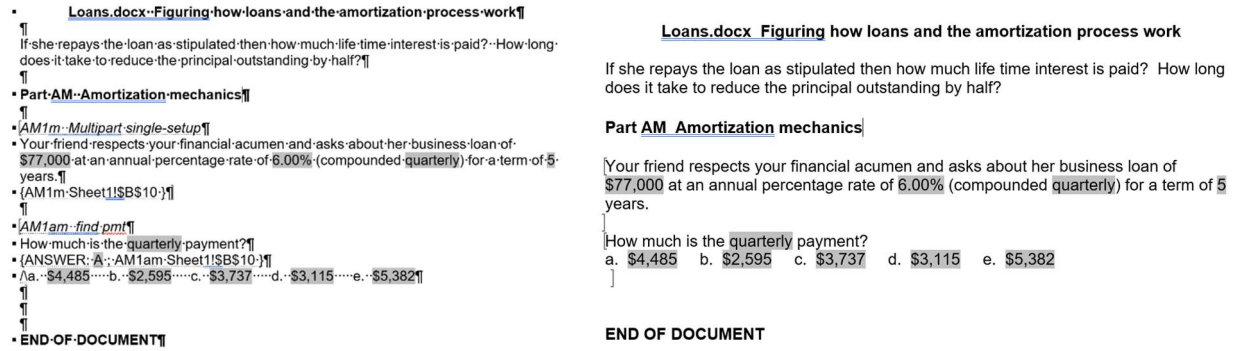
The *Excel* question scenario setup is in the cell range **A2:E8**. Several of those cells have been linked into the *Word* algorithmic document. The answer block is in the cell range **C10:E15**. Components of the answer block are described here:
-- Cell **C10** is the letter among the five **A-to-E** multiple choices that has the correct answer. In the screenshot above the correct answer is **C**. The chance was 1/5th of that occurrence.
-- Cell **D10** contains codes that the algorithmic wizard uses.
-- Cell **E10** contains the question code and workbook cell address with the answer. Cell **E10** is copied automatically as hidden text into the question in the *Word* document. Note the name of the worksheet, Sheet1, could (should?) have been renamed to match the docx filename, e.g., Loans.
-- Cells **C11:C15** are the five **A-to-E** choices that are copied into *Word* just after the question body.

5. The next step finalizes the *Word* question body. The standard numerical question creator wizard makes a **Loans.docx** that looks similar to screenshot SN6.



Screenshot SN6: The *Word* file made by the standard numerical wizard for a multipart single setup question

-- The wizard wrote the top header line in the screenshot that displays the document filename. Edit the brief heading to describe the common property of questions for this document.
-- Copy the complete first sentence from the paragraph below the lead heading that gives the four inputs as xx. Paste over the "Replace this text with the common body…" that is below the AM1m heading. Replace the respective "xx" in the common body with the four shaded input variables ($principal, term, APR, and compounding frequency).
-- The interrogative "How much is the xx payment?" question should be cut and pasted over the "Replace this text with the question" in the line beneath the AM1am heading. Click and drag the one input variable (compounding frequency) over the "xx".
-- Edit the heading that begins "Part AM… " to describe this part of the document, akin to a section heading within a chapter.
-- Delete any extra blank spaces. Assure the character format of everything looks as intended. The view after editing appears below.



Screenshot SN7: The edited *Word* file with and without hidden text displayed

The hidden text displays in the left panel but does not display in the right panel. The shortcut key **CTRL SHIFT 8** toggles the display of hidden text on or off (this shortcut is like clicking **Home** along the top left and then clicking the ¶ symbol near midcenter of the **Home** ribbon; also the shortcut is similar to clicking **File, More Options, Display, Show hidden text**). Hidden text can be erroneously deleted even though when it does not display. Thus, it always is wise to edit an algorithmic document with the hidden text visible. Part AM now includes the common setup AM1m plus the first question, AM1am, pertinent to the setup.

Two questions remain in the paragraph at the top of the document. Only the first of 3 questions has been made. Easily create the second question. It asks for total interest over the life of the loan.
-- In the workbook cell **D4** type or copy/paste the formula below (sum of total lifetime payments – original principal; the difference is interest):

=A8*A7*A4-A3

In **E4** put the label : Total interest

Format cell **D4** as Currency with zero decimal places.

-- Click in cell **F10** to make it the active cell, the upper left of the second question's answer block. > Hit **ALT F8** to open the macros form > Type **StandardNumerical** > Click **Run**. > When the form caption for selecting the target file lists **Loans.docx** then click **Yes** (or **OK**). > For the description enter: Find total interest over loan life > Enter **D4** as the

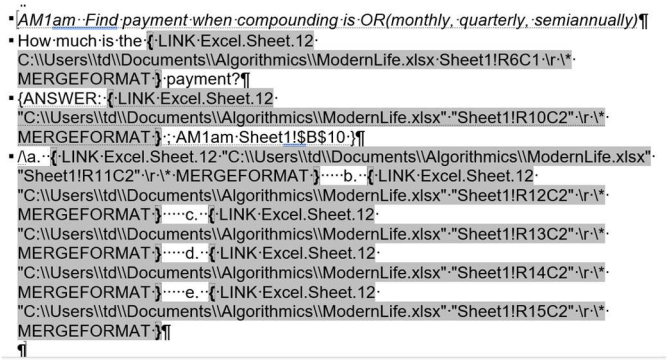
cell with the correct number > Leaving the difference between decoys at the default of 10 is usually fine, click **Make the answer block** > The form shown below opens. Click on **AM1am** and click **Finish**.
-- A form opens to query if the new question is part of the preceding multipart question, click **Yes**. Leave the checkboxes unchecked. > A form asks for confirmation to create AM1bm immediately after AM1am, click **Yes**. > To the query for cell addresses to transfer into the new question, click **Cancel** since there are none (all inputs are in the common body). The job finishes with advice for the next steps: Finalize the *Excel* workbook and edit the *Word* question.
-- In the workbook, format the numerical answers in cells **F11:F15** as Currency with zero decimal places, center alignment. Save **PersonalFinance.xlsx**. > In the *Word* document, cut the question text from the top of the page and paste it over the "Replace this text…" line just beneath the **AM1bm** header. > Highlight and select the entire **AM1** selection and hit **F9** to update with the current numbers in *Excel*. Save **Loans.docx**.

Now create the third question asking how long until the original principal is reduced by half.
-- In cell **D7** type or copy/paste the formula below (total number of payments – principal):
=A4*A7-NPER(A5/A7,A8,-D5/2)
In **E4** put the label : #pmts already paid when 50% of original principal remains
Format cell **D4** as Number with zero decimal places.
-- Click in cell **J10** to make it the active cell. > Hit **ALT F8** to open the macros form > Type **StandardNumerical** > Click **Run**. > When the form caption for selecting the target file lists **Loans.docx** then click **Yes** (or **OK**). > For the description enter: #pmts reducing original principal by half > Enter as the cell with the correct number > Leaving at 10 the difference between decoys is fine, click **Make the answer block** > The form shown below opens. Click on **AM1am** and click **Finish**.
-- A form opens to query if the new question is part of the preceding multipart question, click **Yes**. Leave the checkboxes unchecked. Later to add a new Part code or to start a new multipart question then check the relevant box. Later to add a new algorithmic document just open the target document (*.docx) to receive the question (maybe a blank new docx, maybe it already has bookmarks. Then from *Excel* just launch any one of the eight question creator wizards. > For now , click **Yes** to confirm creation of AM1bm immediately after AM1am. > For the query for a cell address to transfer into the new question, click **Cancel** since there are none (all inputs for this specific question are in the common body). The job finishes with advice for the next steps: Finalize the *Excel* workbook and edit the *Word* question.
-- In the workbook, format the numerical answers in cells **F11:F15** as Currency with zero decimal places, center alignment. Save **PersonalFinance.xlsx**. > In the *Word* document, cut the question text from the top of the page and paste it over the "Replace this text…" just below the **AM1bm** header. > Highlight and select the entire **AM1** selection and hit **F9** to update with the current numbers in *Excel*. Save **Loans.docx**. > The algorithmic question is ready to make an endless stream of unique versions. The *Word* question scenario setup may be copied and pasted in any *Word* document in any folder. The copied question retains its algorithmic functionality as long as the *Excel* workbook remains at the same path. Easily edit the path for all field links in the docx file, hit simultaneously **CTRL A** > Hit **SHIFT F9** > **CTRL H** shows the **Replace** form. Copy and paste from the **docx** the section of the path needing replaced in both the upper and

lower input boxes on the form. Edit to point to the right path in the lower input box. > Click **Replace All** > It's done. Hit **SHIFT F9** to toggle back to displaying cell contents instead of link paths. The endless stream of algorithmic questions is flowing again!

Two of the three algorithmic questions for this multipart single setup were created in the instructions above. The third question asks how long until the original loan principle is cut in half. The answer to that question is going to be some number of years plus some number of months (or quarters and half-years). That means two links in each A-to-E choice. The *Standard numerical* wizard offers just one link in each of the five choices. Two different wizards routinely write two links into each A-to-E choice. The *One correct pair* wizard from the next section is the best fit for the **AM1cm** question creation. Optional, sometimes very useful, background information on the field links is offered in the next paragraph and screenshot.

Make **Loans.docx** the active window, click the **F5** key (that's the shortcut for **Home, Find, Go To**) > Click **Bookmark** > The pull-down box at right labeled **Enter bookmark name** eventually may list dozens of question codes but now shows two bookmarks: the common question body **AM1m** and the first question **AM1am** > Click on **AM1am**, click **Go to** and click **Close**. The book mark is the selected shaded region. > Simultaneously hit the **CTRL Shift F9** keys (that's the shortcut to toggle **File, More Options, Advanced,** in the **Show Document Content** section **Show Field Codes**). The screenshot below shows the view.



Screenshot SN8: Links in *Word* show the path to the *Excel* question scenario setup

Each embedded link is shaded and begins with the word **LINK**. The path to the workbook **PersonalFinance.xlsx** appears with double backslashes. The Installation instructions describe how to change the link; the field can be edited like ordinary text and saved if ever necessary. Next appears the cell address, for example the first link is to the worksheet named **Finance,** to the cell at Row 6, Column 1 (**Finance!R6C1**). The non-shaded areas are standard *Word* text though possibly formatted as hidden text. The **A-to-E** choices are clearly visible. > **CTRL A** selects the entire document > Hit **Shift F9** to toggle from link path to cell contents in view.
-- Close and save both files, **Loans.docx** and **PersonalFinance.xlsx**.

Algorithm 2. The One Correct Pair Wizard
Macro-name = OneCorrectPair

The *One Correct Pair* wizard prompts for a pair of alphanumeric strings that together form a correct answer. Each string may be either a number or a phrase, or more likely a reference to a cell address containing a number or phrase. Each of the five **A-to-E** multiple choices displays two algorithmic strings but only the correct answer shows the correct pair. There is one decoy for the first item in the correct pair and two decoys for the second item. Numerical decoys are made automatically whereas decoy phrases must be user entered.

Perhaps the simplest use of the *one correct pair* algorithm is when each item in the correct pair is a number. Exam 1 in Spring 2015, for example, presented four unique versions (on 8 colors) shown in screenshot P1 below. Students had advance knowledge that this algorithmic question (code BA11a), albeit with unique numbers, would appear as question #13 on the exam.

13.
For year 2526 the company forecasts sales of $45,000 , an asset turnover ratio (= $sales_t$ ÷ total $assets_{t-1}$) of 3.0,a net profit margin (= net income ÷ sales) of 2.7%, a dividend payout ratio (=dividends ÷ net income) of 75%, and a debt-to-equity ratio (= total debt ÷ stockholders equity) of 117%. The company expects the equity price-to-book ratio of 0.65 to remain constant. Contrast for year 2526 the shareholder's book return-on-equity (= net $income_t$ ÷ stockholder's $equity_{t-1}$) and market rate of return.
a. the book return-on-equity is 15.3% whereas the market rate of return is 24.7%
b. the book return-on-equity is 13.3% whereas the market rate of return is 24.7%
c. the book return-on-equity is 17.6% whereas the market rate of return is 24.7%
d. the book return-on-equity is 15.3% whereas the market rate of return is 28.4%
e. the book return-on-equity is 17.6% whereas the market rate of return is 28.4%

	J	W
3	Question :	13
4	Total %correct :	55.3%
5	%correct TopTail :	85.8%
6	%correct LowTail :	28.0%
7	T-stat(tails) :	5.60
8	KEY1515	BA11A
9	Question :	13
10	Key :	C
11	A	20
12	B	21
13	C	75
14	D	19
15	E	11
16	#responses :	146
17	Total %correct :	50.7%
18	Upper %correct:	80.0%
19	Lower %correct :	31.0%
20	T-stat :	4.88

Screenshot P1: The *one correct pair* algorithm made BA11a
Exam 1, Spring 2015, colors 1&5, question #13

Finding the solution uses the input data to compute the return on equity: *roe* = net profit margin × asset turnover ratio × (1 + debt-to-equity ratio); 2.7% × 3.0 × 2.17 = 17.6%. The preceding formula is known in finance as the *DuPont decomposition* for the return on equity. Next, solve for the market rate of return (*ror*) using the formula (which is provided on the exam formula sheet) that relates *ror* to *roe* given a constant price-to-book ratio: $ror = roe \times \{1 - \text{payout ratio} \times (\text{price-to-book} - 1) \times (\text{price-to-book})^{-1}\}$; the solution for the *ror* above is $17.6\% \times \{1 - 75\% \times (0.65-1) \times 0.65^{-1}\} = 24.7\%$. The answer is choice **C** (see cell **W10** above right). Screenshot P1 shows that 55.3% (cell **W4)** of the 561 students score correctly. Within the upper tercile 85.8% score correctly (187 students per tercile, sorted on total exam points correct). Within the lower tercile, 28.0% score correctly. The difference between mean performance rates for the two terciles is statistically significant (t-stat in cell **W7** is 5.5) thereby implying that the question discriminates between students that do or don't satisfy the question learning outcome.

Uninformed students use a guessing strategy for the *one correct pair* algorithm that necessarily differs from the strategy for the *standard numerical* algorithm. Choice variables for the *standard numerical* multiple choices include exclusively the **A-to-E** location and numerical rank. For the *one correct pair* algorithm, however, a partially informed student that correctly knows the first number (e.g., *roe* is 17.6%) improves the

odds of guessing the second number (if clueless about that). In BA11a above, an algorithmic string with the correct *roe* appears twice in the five **A-to-E** locations. Only choice **C** shows the correct *roe* with the correct *ror.* Choice **E** shows the correct *roe* but a decoy for the *ror*. Choice **E**, nonetheless, attracted the fewest responses. Incorrect choices **A** and **B** in screenshot P1 contain no correct number yet attract more responses than **E** thereby suggesting that partially informed guesses are less than the more numerous completely uninformed student guesses.

Possibly with the *one correct pair* algorithm uninformed students use a guessing strategy based on the frequency of numerical appearances. Screenshot P2 below displays the *Word* question setup for question BA11a. The embedded field codes are shaded. Each field code links to a random variable in the *Excel* workbook that draws a new value with each recalculation.

▪ *BA11a··Contrast·ROR·and·ROE·(numerically)·given·ratios*¶
▪ For·year·2526·the·company·forecasts·sales·of·$60,000;·an·asset·turnover·ratio·(=·sales$_t$·÷·total·assets$_{t-1}$)·of·3.8,a·net·profit·margin·(=·net·income·÷·sales)·of·4.4%,·a·dividend·payout·ratio·(=dividends·÷·net·income)·of·55%,·and·a·debt-to-equity·ratio·(=·total·debt·÷·stockholders·equity)·of·99%.··The·company·expects·the·equity·price-to-book·ratio·of·0.70·to·remain·constant.··Contrast·for·year·2526·the·shareholder's·book·return-on-equity·(=·net·income$_t$·÷·stockholder's·equity$_{t-1}$)·and·market·rate·of·return.¶
▪ {ANSWER:·A·;··xlADDRESS:·FA1!$B$736··CLUES:··SE$_{2525}$·=·$7,934··,·SE$_{2526}$·=$9,122·}¶
▪ /\a.··the·book·return-on-equity·is·33.3%·whereas·the·market·rate·of·return·is·41.1%¶
▪ /\b.··the·book·return-on-equity·is·44.0%·whereas·the·market·rate·of·return·is·41.1%¶
▪ /\c.··the·book·return-on-equity·is·44.0%·whereas·the·market·rate·of·return·is·47.3%¶
▪ /\d.··the·book·return-on-equity·is·38.3%·whereas·the·market·rate·of·return·is·47.3%¶
▪ /\e.··the·book·return-on-equity·is·38.3%·whereas·the·market·rate·of·return·is·41.1%¶
¶

Screenshot P2: The *one correct pair* algorithm displays two random variables in each answer

Each **A-to-E** choice shows two shaded numeric strings. The first string in BA11a above offers three unique numbers (33.3%, 44.0%, and 38.3%). Two of the numbers appear twice and one appears once. The paragraph immediately before the multiple choices is formatted as hidden text and does not display on the exam. The answer is **A**, a number (33.3%) that appears only once. To check how the *one correct pair* algorithm distributes correct answers, question BA11a is recalculated to make 100 unique versions and results are tallied. The middle panel in the table below shows, like in screenshot P2, that the correct number appears only once in the first string for 23 out of 100 recalculations. In the other 77 recalculations, like in screenshot P1, the correct number in the first string appears twice: one time with a decoy in the second string and one time with the correct *roe*.

% correct in each A-to-E location	
A	21
B	19
C	24
D	10
E	26

Frequency of appearance of a number in the correct choice. Each multiple choice displays 2 algorithmic strings		
1st string (2 decoys) ↓	↓ *2nd string (1 decoy)* ↓	
	twice	*thrice*
once	0	23
twice	39	38

Rank of correct number relative to the decoy (false) numbers in the one correct pair algorithm.		
1st string, 2 decoys + 1 correct ↓	*2nd string, 1 decoy + 1 correct* ↓	
	smallest	*biggest*
smallest	24	18
middle	14	15
biggest	20	9

Table P1: Distribution of the answer in the *one correct pair* algorithm, 100 recalculations

The bottom row of the middle panel shows that when the first string displays the correct number twice, then the second string splits evenly between showing the second item in the correct pair twice (39%) or thrice (38%). An anomalous finding is that when the first item in the correct pair displays only once in the first string, always the second item in the correct pair is shown 3 times. Never (0%) is it correct to choose the number appearing once in the first string when it pairs with a number showing twice in the second string. Regardless, among the 558 student responses submitted for #13 BA11a (3 blank responses were submitted out of 561 students), there were 310 correct responses. Among the 248 incorrect responses, 137 selected the number appearing thrice; 111 selected the number appearing twice. Little to no evidence is found that uninformed students reveal a guessing strategy based on frequency of number appearance.

The right panel of table P1 shows how the numerical rank of the correct answer distributes relative to the wrong answers for 100 unique recalculations of question BA11a. The first string in the **A-to-E** choices displays the correct number and two wrong numbers. In 42 of the recalculations the correct number is the smallest of the 3 numerical choices; for 24 of those 42 occurrences it pairs with the smallest number in the second string and 18 times it pairs with the biggest number. In 29 of the 100 recalculations the correct number in the first string ranks in the middle the 3 numerical choices; it pairs with the smallest or biggest of two numbers in the second string with equal likelihood (14 versus 15 occurrences). Also, in 29 of the 100 recalculations the correct number in the first string ranks as the biggest of the 3 numerical choices; it tends to pair with the smallest instead of the biggest of two numbers in the second string (20 versus 9 occurrences). Even though not distributed uniformly (as expected), few of the preceding tendencies inherent with the *one correct pair* algorithm seem to enable a reliable guessing strategy for uninformed guessers.

The right panel in table P1 above shows that out of 100 recalculations only 10 times is the correct answer **D**. On the other hand, **E** is correct 26 times. The expectation is that each of the five **A-to-E** multiple choices has a 20% probability of containing the pair of correct algorithmic strings. This anomalous finding supports a worthwhile guessing strategy for uninformed students with the *one correct pair* algorithm: stay away from **D**, especially when it contains the biggest numbers!

The remainder of this section instructs how to make an algorithmic question with assistance from the *one correct pair* wizard. The question is based on the one in screenshot P3 below that was answered by 488 students on the 25-question non-cumulative final exam in Spring 2015. All students had advance knowledge that the question (code AP5b) would appear as #7 on the exam. Furthermore, students could practice the algorithmic problem repeatedly on Blackboard. The spreadsheet results from the right panel of the screenshot show that 98.8% of students in the upper tercile (sorted on total exam points correct, 163 students per tercile) get this question correct. Apparently, if you prepared for AP5b then it was not difficult. Among students in the lower tercile, however, only 64.0% (cell **Q6**) get the question correct (62.0% for the version on colors 1 and 6, cell **Q19**).

7.
The company's beta is 1.45, its dividend growth rate is 8.1%, just yesterday it paid a dividend of $1.70 , and today's shareprice is $24.50 . You believe that today's shareprice equals today's intrinsic value. Furthermore, you believe that the shareprice moves in accordance with the dividend constant growth model. The economy wide risk free interest rate is 5.0%, and the expected risk premium for the market portfolio is 9.5%. You believe that the stock represents a good investment if the expected total rate of return implied by the dividend constant growth model exceeds the required rate of return implied by the Capital Asset Pricing Model. Which of the following statements is most accurate?

a. The required return is 18.8% and the expected return is 15.6% so do not buy it
b. The required return is 18.8% and the expected return is 12% so buy it
c. The required return is 21.6% and the expected return is 12% so buy it
d. The required return is 21.6% and the expected return is 15.6% so do not buy it
e. The required return is 24.8% and the expected return is 15.6% so do not buy it

	J	Q
3	Question :	7
4	Total %correct :	86.3%
5	%correct TopTail :	98.8%
6	%correct LowTail :	64.0%
7	T-stat(tails) :	4.00
8	KEY1616	AP5B
9	Question :	7
10	Key :	A
11	A	105
12	B	7
13	C	2
14	D	10
15	E	2
16	#responses :	126
17	Total %correct :	83.3%
18	Upper %correct:	95.0%
19	Lower %correct :	62.0%
20	T-stat :	3.69

Screenshot P3: The *one correct pair* algorithm made AP5b
Exam 4, Spring 2015, colors 1&6, question #7

The instructions below presume that you are creating the founding question for a new collection of algorithmic questions. If you are adding the question to an existing *Excel* workbook and a *Word* document, however, then open those two files and follow the steps below with little modification.

1. Launch *Word* and open a new blank document.
-- Hit the **Enter** key. Hit **CTRL A** to highlight the entire empty document: (a) Click **Home** > **Paragraph**, format **lines** as single-spaced with zero points **before** and **after** (b) Click **Home** and set the font to Arial 12 point (or use your preferred font and size).
-- Copy and paste the following sentences at the end of the new document: The company's beta is x, its dividend growth rate is x, just yesterday it paid a dividend of x, and today's share price is x. You believe that today's share price provides the best unbiased estimate of the stock's intrinsic value. Furthermore, the share price moves in accordance with the dividend constant growth model. The economy wide risk-free interest rate is x, and the required risk premium for the market portfolio is x. Which statement is most consistent with the preceding data?
-- Hit the **Enter** key.
-- Click **File** > **Save as** > Click **Browse** and select your **Documents** directory > For this illustration click to make a **New Folder** with the name **2525-Fall-Fin322** > For the filename, type **StockAnalysis** > Click **Save**. For Windows 7 and Windows 10 systems the file below was made:
C:\Users*your username*\Documents\2525-Fall-Fin322\StockAnalysis.docx
The file contents include exclusively the sentences pasted from above. Leave the document open.

2. Launch *Excel* and click to Open a Blank Workbook.
-- Hit **CTRL A** to highlight the entire empty document: (a) Right-click on any column header (any letter above row 1), select **Column Width**, and set to **12**, click **OK**. (b) Set the font to Arial 12 point. [Making the *Excel* and *Word* documents have the same font and point size is the objective (use your standard font and size).]
-- Make a one-time setting to toggle from automatic calculation (the default for a new workbook) to manual calculation. Click **File** > Click **More Options** > Click **Formulas** > In the Calculation Options section click **Manual** > Click **OK**. While this setting is not essential it definitely makes working with an algorithmic document more convenient.
-- In cell **A2** type or copy/paste the question description below:

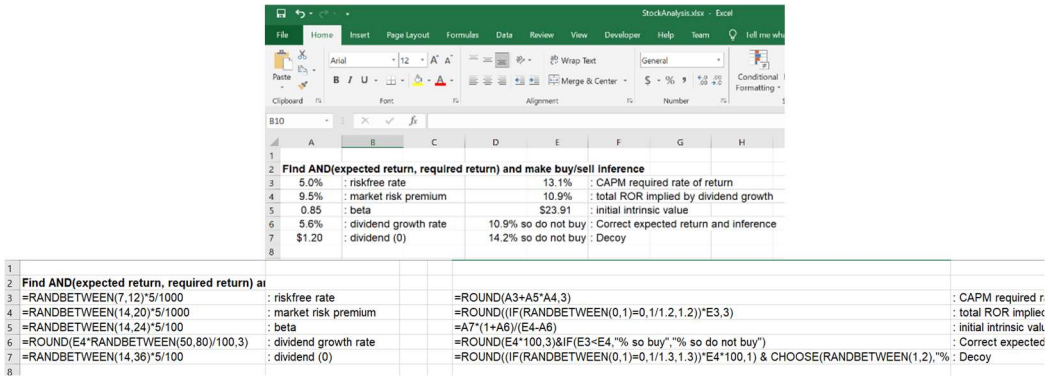
Find AND(expected return, required return) and make buy/sell inference

-- In cell **A3** type or copy/paste the formula below:
=RANDBETWEEN(7,12)*5/1000
In cell **B3** put this label ": riskfree rate"
-- In cell **A4** type or copy/paste the formula below:
=RANDBETWEEN(14,20)*5/1000
In cell **B4** put this label ": market risk premium"
-- In cell **A5** type or copy/paste the formula below:
=RANDBETWEEN(14,24)*5/100
In cell **B5** put this label ": beta"
-- In cell **A6** type or copy/paste the formula below:
=ROUND(E4*RANDBETWEEN(50,80)/100,3)
In cell **B6** put this label ": dividend growth rate"
-- In cell **A7** type or copy/paste the formula below:
=RANDBETWEEN(14,36)*5/100
In cell **B7** put this label ": dividend (0)"
-- In cell **E3** type or copy/paste the formula below:
=ROUND(A3+A5*A4,3)
In cell **F3** put this label ": CAPM required rate of return"
-- In cell **E4** type or copy/paste the formula below:
=ROUND((IF(RANDBETWEEN(0,1)=0,1/1.2,1.2))*E3,3)
In cell **F4** put this label ": total ROR implied by dividend growth"
-- In cell **E5** type or copy/paste the formula below:
=A7*(1+A6)/(E4-A6)
In cell **F5** put this label ": initial intrinsic value"
-- In cell **E6** type or copy/paste the formula below:
=ROUND(E4*100,3)&IF(E3<E4,"% so buy","% so do not buy")
In cell **F6** put this label ": Correct expected return and inference"
-- In cell **E7** type or copy/paste the formula below:
=ROUND((IF(RANDBETWEEN(0,1)=0,1/1.3,1.3))*E4*100,1) &
CHOOSE(RANDBETWEEN(1,2),"% so buy","% so do not buy")
In cell **F7** put this label ": Decoy"

Find information below that clarifies the *Excel* question scenario setup.
-- In cell **A3** the **randbetween(a,b)** function returns an integer from *Analysis ToolPak* for the inclusive range **a** to **b**, in this case an integer from 7 to 12. The formula in **A3** multiplies the returned integer by 5 and divides by 1,000. Thus, the riskfree rate ranges from 3.5% to 6.0% or any of the other numbers in between (percentage rounded to tenths, 26 possible outcomes). Format cell **A3** as a Percentage with one decimal place. Center justify **A3** and left justify **B3**. Cells **A4** and **B4** are analogous. Cells **A5** and **B5** are analogous except format **A5** as a Number with 2 decimal places. Cells **A6** and **B6** are analogous except the **ROUND()** function truncates the numerical result from the algebraic operations. Format **A6** as a Percentage with one decimal place. Cells **A7** and **B7** are analogous except format **A7** as Currency with two decimal places.
-- Cell **E3** uses the **ROUND()** function to truncate the numerical result from an algebraic operation. Format **E3** as a Percentage with one decimal place. Center justify **E3** and left justify **F3**. The number in **E3** is the first item in the one correct pair answer. Since the item itself is a number then the question creator wizard will automatically make 2 decoy numbers for the wrong multiple choices.

-- Cell **E4** either multiplies or divides the number from **E3** by 1.2 depending on whether **RANDBETWEEN(0,1)** returns 0 (multiply) or 1 (divide). Notice how the conditional **IF()** statement easily operates within the cell formula. Format **E4** as a Percentage with one decimal place. Center justify **E4** and left justify **F4**.
-- Format **E5** as Currency with two decimal places. Center justify **E5** and left justify **F5**.
-- Cell **E6** uses the conditional **IF()** function to make the inference that the stock is a "buy" if the required rate of return (**E3**) is less than the expected rate of return (**E4**); otherwise, it is a "sell" (i.e., do not buy). The ampersand (&) is an *Excel* operator that concatenates the string returned by the **IF()** statement to the number in **E4**. Right justify **E6** and left justify **F6**. The alphanumeric string in **E6** is the second item in the one correct pair answer. Since the item is an alphanumeric string then the question creator wizard will prompt for a decoy string. Cell **E7** contains the decoy phrase for the second item wrong answers. A wrong number is made by either multiplying or dividing the correct expected rate of return by 1.3; with the number off by 30% then the *Excel* **CHOOSE()** function randomly selects the irrelevant buy/sell inference.
-- Click **File** > **Save as** > Click **Browse** and select the same folder containing the *Word* document. Use the same filename, too, for example:
C:\Users*your username*\Documents\2525-Fall-Fin322\StockAnalysis.xlsx

Screenshot P4 below shows the workbook made by completing the preceding steps.



2	**FInd AND(expected return, required return) and make buy/sell inference**				
3	5.0%	: riskfree rate	13.1%	: CAPM required rate of return	
4	9.5%	: market risk premium	10.9%	: total ROR implied by dividend growth	
5	0.85	: beta	$23.91	: initial intrinsic value	
6	5.6%	: dividend growth rate	10.9% so do not buy	: Correct expected return and inference	
7	$1.20	: dividend (0)	14.2% so do not buy	: Decoy	

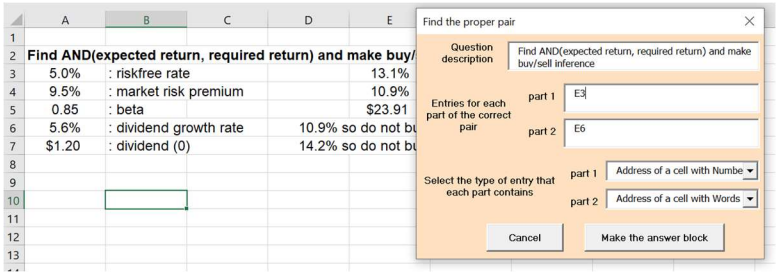
2	**Find AND(expected return, required return) a**			
3	=RANDBETWEEN(7,12)*5/1000	: riskfree rate	=ROUND(A3+A5*A4,3)	: CAPM required r
4	=RANDBETWEEN(14,20)*5/1000	: market risk premium	=ROUND((IF(RANDBETWEEN(0,1)=0,1/1.2,1.2))*E3,3)	: total ROR implie
5	=RANDBETWEEN(14,24)*5/100	: beta	=A7*(1+A6)/(E4-A6)	: initial intrinsic valu
6	=ROUND(E4*RANDBETWEEN(50,80)/100,3)	: dividend growth rate	=ROUND(E4*100,3)&IF(E3<E4,"% so buy","% so do not buy")	: Correct expected
7	=RANDBETWEEN(14,36)*5/100	: dividend (0)	=ROUND((IF(RANDBETWEEN(0,1)=0,1/1.3,1.3))*E4*100,1) & CHOOSE(RANDBETWEEN(1,2),"%	: Decoy

Screenshot P4: Worksheet for making the *one correct pair* question in the illustration

The upper panel displays the results from the cell instructions. The lower panel displays the cell instructions.

3. This step will run the question creator wizard that makes the algorithmic document by linking the *Excel* worksheet setup to the *Word* question setup. Click or move the arrow keys to make worksheet cell **B10** the active cell. This cell becomes the upper left corner of the *answer block* (6 rows by 3 columns) that the wizard automatically writes in the workbook. Any prior contents will be overwritten by the wizard so always be sure the cells within the answer block are empty. Good practice leaves a row or two blank between the worksheet question scenario setup and the top of the answer block.
-- Hit the shortcut keys **ALT F8** to open the *Excel* Macro form (or click **View** > Click **Macros** > Click **View macros**).
-- In the input box for the Macro name type or copy/paste **OneCorrectPair** (no space between words, capitalization is irrelevant). > Click **Run**. An information form pops

open that describes the *one correct pair* algorithm > Click **OK** to make an algorithmic question > Type or copy/paste the question description in the form box: Find AND(expected return, required return) and make buy/sell inference > Type cell address **E3** for part 1 of the correct pair and **E6** for part 2 > For the type of entry that each part contains select for part 2 “Address of a cell with Words”; the default for part 1 “Address of a cell with Numbers” already fits. The completed form should look similar to below.

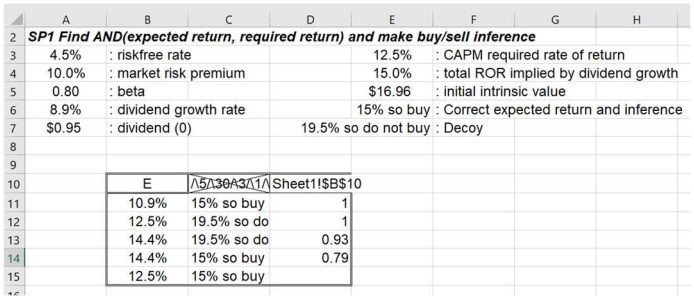


Screenshot P6: The *one correct pair* question creator form

> Click **Make the answer block**. Do not interrupt execution while the wizard writes the answer block into the *Excel* worksheet scenario setup. Since this is the first question in a new document the wizard prompts for the 2 or 3 character *part code*. Every question must have a question code that begins with a 2 or 3 character alphabetic string followed by a number. The alphabetic string is the part code. Many problems that are very similar, say because they are on the same topic, begin with the same alphabetic part code. The number affixed to the part code automatically increments as new questions are added to this part of the document. The wizard writes the question code into the *Word* document. > Type **SP** (for stock pickin’) for the part code. > Click **OK** to confirm the part code. > The wizard next prompts for the *Excel* cell address of the decoy for the second item in the one correct pair. Type **E7** and click **OK**. > The wizard prompts next for the *Excel* cell address of any variable that goes into the *Word* question body, that is, the paragraph(s) containing the question which precedes the multiple choices. Type **A3** (the risk-free rate) and click **OK**. > When the prompt again returns type **A4** (the market risk premium) and click **OK**. > When the prompt again returns type **A5** (the beta and click **OK**. > When the prompt again returns type **A6** (the dividend growth rate) and click **OK** . > When the prompt again returns type **A7** (the dividend payment) and click **OK**. >When the prompt again returns click **Cancel** since there are no more inputs for the question body.

4. The question creator wizard finishes making the algorithmic question and suggests these next steps. First, finalize the *Excel* question scenario setup. > Select the five answers that appear in the range **B11:B15** > Click to format the cells as Percentage showing tenths of percent, as 15.1% > Align the **B11:B15** cell contents in the center (it’s trivial but prettier!) > Type **SP1** in cell **A2** so that the question code precedes the question description > Format cell **A2** as bold italic > Format cells **D13** and **D14** to two decimal places, e.g., 0.77. That’s it! Save the *Excel* file. Notice that the workbook recalculates upon saving giving something like screenshot P7 below. The shortcut key to force recalculation is **F9**. Hit **F9** repeatedly and notice how the algorithmic setup

changes.

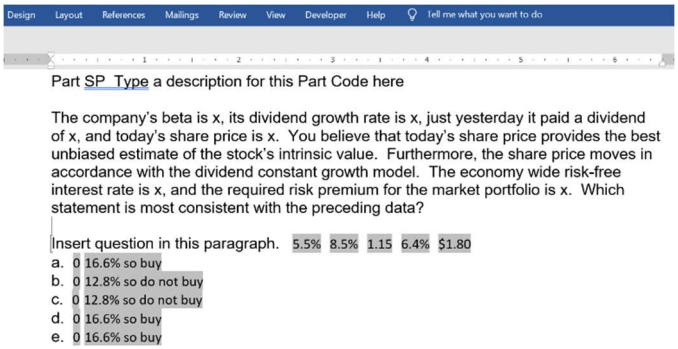


	A	B	C	D	E	F	G	H
2	***SP1 Find AND(expected return, required return) and make buy/sell inference***							
3	4.5%	: riskfree rate			12.5%	: CAPM required rate of return		
4	10.0%	: market risk premium			15.0%	: total ROR implied by dividend growth		
5	0.80	: beta			$16.96	: initial intrinsic value		
6	8.9%	: dividend growth rate			15% so buy	: Correct expected return and inference		
7	$0.95	: dividend (0)		19.5% so do not buy		: Decoy		
8								
9								
10		E	/\5/\30A3/\1/\	Sheet1!$B$10				
11		10.9%	15% so buy	1				
12		12.5%	19.5% so do	1				
13		14.4%	19.5% so do	0.93				
14		14.4%	15% so buy	0.79				
15		12.5%	15% so buy					

Screenshot P6: The finalized *Excel* setup for the *one correct pair* illustration

The *Excel* question scenario setup is in the cell range **A2:F7**. Some of those cells have been linked into the *Word* algorithmic document that contains the question body. The answer block is in the cell range **B10:D15**. Components of the answer block are described here:
-- Cell **B10** is the letter among the five **A-to-E** multiple choices that has the correct answer. In the screenshot above the correct answer is **E**. The chance was 1/5th of that occurring.
-- Cell **C10** contains codes that the *one correct pair* algorithm uses.
-- Cell **D10** contains the address of the cell with the answer. Cell **D10** is copied automatically as hidden text into the question in the *Word* document.
-- Cells **B11:C15** are copied into the five **A-to-E** choices in *Word* just after the question body displays. Each row contains the pair of strings in each answer.
-- Cells **D11:D14** contain random variables sometimes useful for making a question scenario setup. Find descriptions for these variables following screenshot SN5 for the *standard numerical* algorithm.

5. The next step finalizes the *Word* question body. The standard numerical question creator wizard makes a **StockAnalysis.docx** that looks similar to screenshot SN6.



Design Layout References Mailings Review View Developer Help Tell me what you want to do

Part SP Type a description for this Part Code here

The company's beta is x, its dividend growth rate is x, just yesterday it paid a dividend of x, and today's share price is x. You believe that today's share price provides the best unbiased estimate of the stock's intrinsic value. Furthermore, the share price moves in accordance with the dividend constant growth model. The economy wide risk-free interest rate is x, and the required risk premium for the market portfolio is x. Which statement is most consistent with the preceding data?

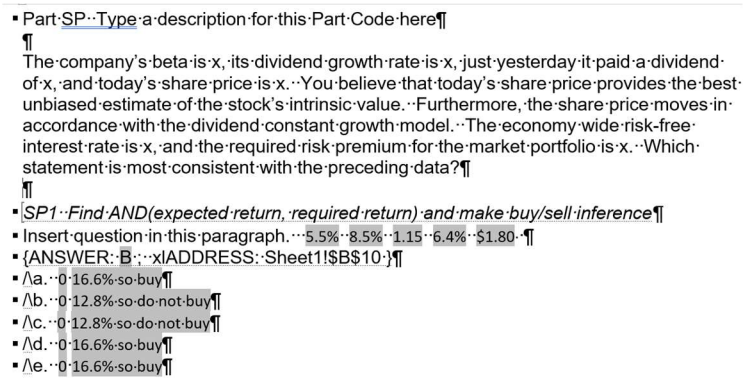
Insert question in this paragraph. 5.5% 8.5% 1.15 6.4% $1.80

a. 0 16.6% so buy
b. 0 12.8% so do not buy
c. 0 12.8% so do not buy
d. 0 16.6% so buy
e. 0 16.6% so buy

Screenshot P7: The *Word* file made by the *one correct pair* wizard

The wizard wrote the top header line in the screenshot that marks the beginning of Part SP, the 2-character alphabetic code supplied during execution of the question creation. Beneath the header are the sentences with the question that was typed or pasted before launching the wizard. Beneath that within the grey square brackets is the content written by the wizard during question creation. Finalize this algorithmic *Word*

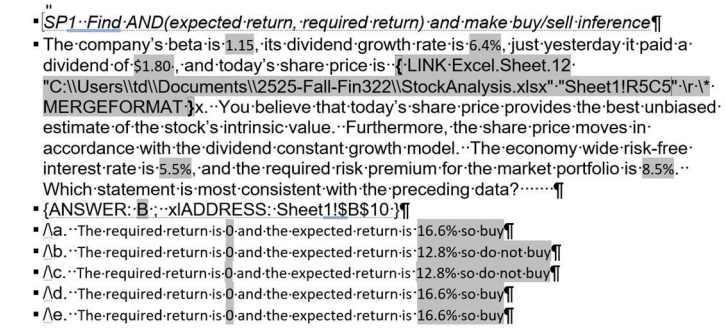
document with the instructions below.
-- Hit the shortcut key **CTRL** * which toggles the display (or not) of hidden text (this shortcut is like clicking Home along the top left and then clicking the ¶ symbol near midcenter of the **Home** ribbon; also the shortcut is similar to clicking **File, More Options, Display, Show hidden text**). The view showing hidden text appears in screenshot P8.



Screenshot P8: The *Word* file made by the *one correct pair* wizard when hidden text displays

Always it's best to edit an algorithmic document with the hidden text showing. The five shaded items at the end of the line "Insert question …" are embedded links from the *Excel* workbook copied into the *Word* question body by the wizard during the "enter cell address for inputs into the question body" query.
-- It's not essential for this illustration but typically edit the top line and type a proper description for the part code. Bold format is recommended.
-- Select the question sentences "The company's beta… preceding data?" and cut (**CTRL x**). Then paste (**CTRL v**) that sentence to replace "Insert question in this paragraph."
-- Select the first field after the pasted sentence which in the screenshot above is 5.5%. Often it's easiest to select from the space before through the space after the shaded field, then click and drag the selection in place just before the x for the risk-free rate. Delete any extra spaces (and delete the x).
-- Select the next field after the question which in the screenshot above is 8.5%, the required risk premium for the market portfolio. Click and drag into place, delete extra spaces (and delete the x). Continue to click and drag the other fields (beta, dividend growth rate, last dividend).
-- Finalize the multiple choices. Before the first shaded field (which is 0 in the screenshot above) in all five **A-to-E** answers type or copy/paste this phrase "The required return is ". Between the two shaded fields in all five **A-to-E** answers type or copy/paste this phrase " and the expected return is ".
-- Inspect the *Word* question scenario setup. Notice the phrase "today's share price is x" which means that this required field link was not copied by the wizard during the question creation procedure. No worries! Would have been easier to have entered cell **E5** as an input field in response to the query during question creation. But at this point it's easiest (and instructive) to select one of the other fields, say yesterday's dividend ($1.80 in screenshot P8). Hold the **CTRL** key and then click and drag the selection to just before the x in "share price is x." Holding the **CTRL** key during a click and drag makes a copy of the selection. To edit the copied field and change it from linking to

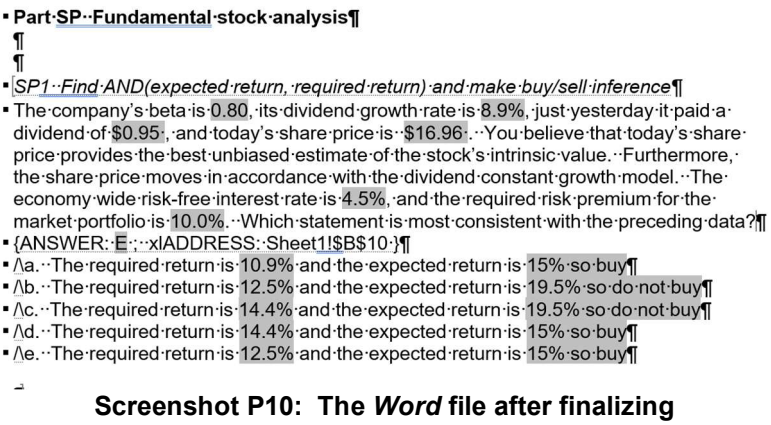
yesterday's dividend and instead linking to today's share price, select the field. > Hit **SHIFT F9** to toggle the view of the selected link > Overtype **R1C7** with **R5C5**. This links to the cell at row 5, column 5, that is cell **E5**. The view should be similar to below.



Screenshot P9: Each shaded field is an embed link to *Excel* from *Word*

> Select the field hit **SHIFT F9** to display the cell contents instead of the field code. Delete any extra blank spaces. > If the text is not all the same font and size, select the entire question body and answers. Make it all, say, Arial 12 point.

The *Word* document is finalized and ready to update. Click in the left margin and extend the selection to include the question body and answers. Hit **F9** and all the embedded links in *Word* reach out to the *Excel* workbook and update so as to display the current cell contents.



Screenshot P10: The *Word* file after finalizing

Save the *Word* file. Notice that the field for today's share price displays the number from the finalized *Excel* file.

-- View the range of appearances for question **SP1** created above by switching to *Excel* workbook **StockAnalysis.xlsx** and hit **F9** to recalculate, do it over and over. Eventually switch to **StockAnalysis.docx** and with the question highlighted hit **F9** to update. That's it, the algorithmic question is ready to make an endless stream of unique versions. The *Word* question scenario setup may be copied and pasted in any *Word* document in any folder. The copied question retains its algorithmic functionality as long as the *Excel* workbook remains at the same path. > Close and save both files, **StockAnalysis.docx** and **StockAnalysis.xlsx**.

Algorithm 3. The Complex Verbal Wizard
Macro-name = ComplexVerbal

The complex verbal wizard presents five phrases or sentences in answer locations **A-to-E** with one *Excel* workbook link embedded in each *Word* answer location. Minimal input requirements equal three true statements and three false statements about a body of evidence. One of the **A-to-E** locations is randomly chosen with a 1/5th chance of being the correct answer. If either **A**, **B**, or **C** is the correct answer then that location displays a true statement; false statements display in the other two locations. If **D** is the correct answer then that location displays, with a one out of three chance, either **Two choices, A and B, are correct**, or **Two choices, A and C are correct**, or **Two choices, B and C are correct**. When **D** is correct then the two referenced **A-to-C** locations display true statements and the other location displays a false statement. If **E** is the correct answer then that location displays, with a one out of two chance, either **The three A-B-C choices are all correct** or **None of the A-B-C choices are correct**. When **E** is correct, the appropriate true or false statements display in the **A-B-C** locations.

Perhaps the simplest application of the *complex verbal* algorithm is in a completely non-numerical problem. Two versions of question FF22 in screenshot CV1 below were answered by half of the 561 students that submitted exam 1 in Spring, 2015. Students knew from the first day of the semester that question #9 could display either of three algorithmic questions among which FF22 was one. All three questions indeed appeared on at least one of the four versions distributed at the exam (8 colors of paper). Students could practice the algorithmic questions on Blackboard. The screenshot shows the two versions of question FF22 as well as the student performance outcomes. The question tests the notion that an increase in a liability account on the balance sheet during a reporting period implies that this account was a source of financing. Conversely, an increase in an asset account during the reporting period means that financing was used on the asset.

9. (3 points)
Which statement best describes how sources or uses of funds relate to asset or liability accounts on the balance sheet?
a. a decrease in a liability account represents a source of funds
b. a decrease in an asset account represents a use of funds
c. a decrease in an asset account represents a source of funds
d. Two choices, A and C, are correct
e. None of the A-B-C choices are correct

	J	S
36	KEY3737	FF22
37	Question :	9
38	Key :	C
39	A	10
40	B	29
41	C	85
42	D	10
43	E	6
44	#responses :	140
45	Total %correct :	60.7%
46	Upper %correct:	89.0%
47	Lower %correct :	30.0%
48	T-stat :	5.77

- 9. (3 points)
- FF22 What are sources v. uses of funds
- Which statement best describes how sources or uses of funds relate to asset or liability accounts on the balance sheet?
- {ANSWER: E; xlADDRESS: Conceptual!$B$83}
- a. an increase in a liability account represents a source of funds
- b. an increase in an asset account represents a use of funds
- c. a decrease in a liability account represents a use of funds
- d. Two choices, A and C, are correct
- e. The three A-B-C choices are all correct

	J	S
50	KEY4848	FF22
51	Question :	9
52	Key :	E
53	A	6
54	B	10
55	C	10
56	D	32
57	E	77
58	#responses :	135
59	Total %correct :	57.0%
60	Upper %correct:	82.0%
61	Lower %correct :	40.0%
62	T-stat :	4.09

Screenshot CV1: The *complex verbal* algorithm made FF22
Exam 1, Spring 2015, question #9, colors 3&7 and 4&8

The version on colors 3 and 7 in the top panel displays as seen on paper, without the hidden text showing. Worksheet cell **S38** on the right lists the answer as **C**. This means that **A** and **B** display false statements. Choices **D** and **E** are wrong regardless which string they display. The version on colors 4 and 8 in the lower panel displays the hidden text showing that the answer is choice **E**: **The three A-B-C choices are all correct**. The **A-B-C** choices thus display correct statements. This apparently simple verbal question is scored correctly by only 162 students of the 275 that receive it (58.9%). About 85% (cells **S46** and **S60**) of students in the upper tercile (92 students, sorted by total exam score) get it correct; 35% of students in the lower tercile (cells **S47** and **S61**) get it correct. Despite being a simple idea, e.g. that if your checking account started high and ended low then the account was a source of cash, and despite being able to practice the algorithmic question repeatedly on Blackboard, the performance outcomes indicate the question discriminates between those that do and don't learn this fundamental idea.

The *complex verbal* algorithm also handles alphanumeric statements. Question CY21 in screenshot CV2 below appeared on all 4 versions (8 colors) of exam 2 distributed to 531 students in Spring 2015. Students knew from the first day of the semester that definitely algorithmic question CY21 would display as #8 on exam 2. Students could practice the algorithmic question on Blackboard. The screenshot shows two of the four versions as well as the student performance outcomes. The question asks students to figure whether a company should pay a discounted price early or forego the discount and pay the full price later.

8.
Suppliers X and Z are competing to sell your company supplies. The full price of supplies from supplier X is $1,800 and they offer these payment plans: 3.1% discount if you pay within 5 days, otherwise pay full price within 75 days. The full price with supplier Z is $1,700 and they offer these payment plans: 3.0% discount if you pay within 5 days, otherwise pay full price within 70 days. Your company financing rate is 13.1% compounded daily. Find the supplier and payment plan that represent the lowest present value of cost.

a. If you buy from supplier X the lowest present value of cost occurs when you pay the full price on day 75
b. If you buy from supplier Z the lowest present value of cost occurs when you pay the discounted price on day 5
c. The lowest possible present value of cost occurs when you pay the discounted price from supplier Z
d. Two choices, B and C, are correct
e. None of the A-B-C choices are correct

	J	R
3	Question :	8
4	Total %correct :	60.1%
5	%correct TopTail :	86.8%
6	%correct LowTail :	29.0%
7	T-stat(tails) :	5.49
8	KEY1212	CY21
9	Question :	8
10	Key :	D
11	A	11
12	B	17
13	C	16
14	D	89
15	E	6
16	#responses :	139
17	Total %correct :	64.0%
18	Upper %correct:	89.0%
19	Lower %correct :	39.0%
20	T-stat :	5.00

▪ 8.¶
▪ CY21··Supplier's·discount·and·best·deal·(boolean·choices·w/o·numbers)¶
▪ Suppliers·X·and·Z·are·competing·to·sell·your·company·supplies.··The·full·price·of·supplies·from·supplier·X·is·$1,900·and·they·offer·these·payment·plans:·4.1%·discount·if·you·pay·within·10·days,·otherwise·pay·full·price·within·140·days.··The·full·price·with·supplier·Z·is·$1,830·and·they·offer·these·payment·plans:·4.0%·discount·if·you·pay·within·5·days,·otherwise·pay·full·price·within·135·days.··Your·company·financing·rate·is·13.6%·compounded·daily.··Find·the·supplier·and·payment·plan·that·represent·the·lowest·present·value·of·cost.¶
▪ {ANSWER:·A·;··xlADDRESS:·LumpSum!$B$916;··CLUES:··PV(discounted·price,·full·price),·for·X($1,815·,$1,803·)·and·for·Z($1,754·,$1,740·)·}¶
▪ /a.··If·you·buy·from·supplier·X·the·lowest·present·value·of·cost·occurs·when·you·pay·the·full·price·on·day·140¶
▪ /b.··If·you·buy·from·supplier·Z·the·lowest·present·value·of·cost·occurs·when·you·pay·the·discounted·price·on·day·5¶
▪ /c.··The·lowest·possible·present·value·of·cost·occurs·when·you·pay·the·full·price·from·supplier·X¶
▪ /d.··Two·choices,·A·and·B,·are·correct¶
▪ /e.··The·three·A-B-C·choices·are·all·correct¶
¶

	J	R
22	KEY3434	CY21
23	Question :	8
24	Key :	A
25	A	65
26	B	34
27	C	13
28	D	13
29	E	5
30	#responses :	130
31	Total %correct :	50.0%
32	Upper %correct:	81.0%
33	Lower %correct :	14.0%
34	T-stat :	6.22

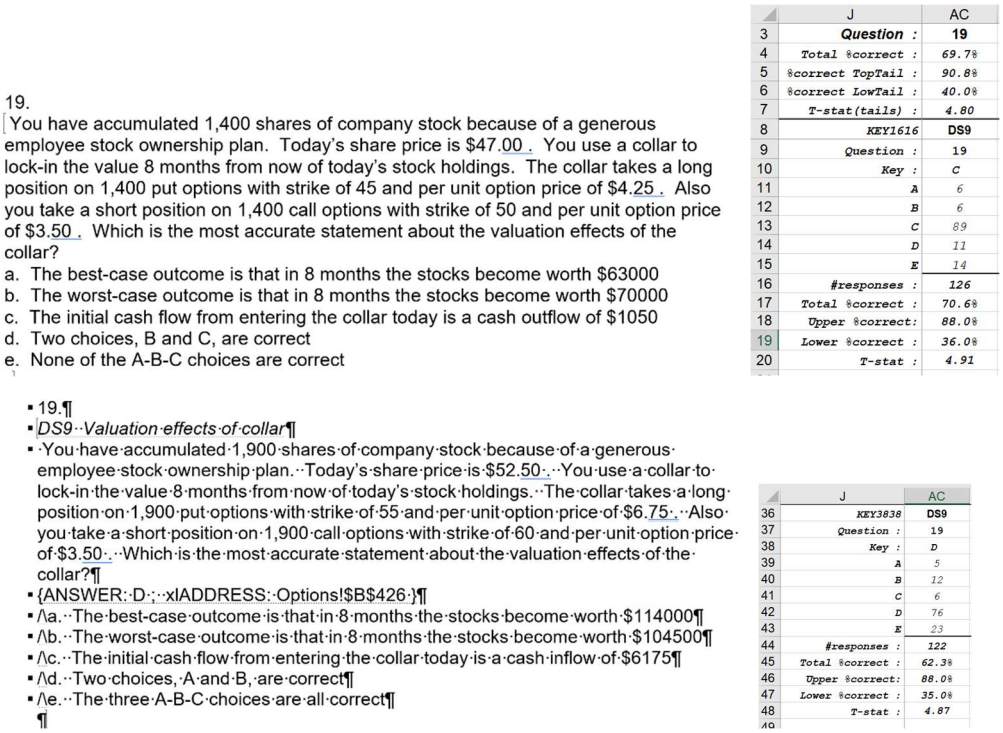
Screenshot CV2: The *complex verbal* algorithm made CY21
Exam 2, Spring 2015, question #8, colors 1&2 and 3&4

The version in the top panel displays as seen on paper, without the hidden text showing. The version in the lower panel displays the hidden text Worksheet cell **R4** on the right shows that 60.1% of the 531 students get CY21 correct. The solution finds the four numeric clues formatted as hidden text in the lower panel paragraph immediately preceding the multiple choices. The present value of cost from supplier X when taking the discount is $\$1{,}900\times(1-.041)\times(1+.136/365)^{-5}$, which is \$1,815. Foregoing the discount and paying the full price has a present value of cost which is \$1,803 [$\$1{,}900\times(1-.041)\times(1+.136/365)^{-75}$]. After computing all four numbers then the student interprets which statement is correct. For the version in the lower panel only statement **A** is correct. In the upper panel, the correct answer is **D** which means statements **B** and **C** are true. Once again, the upper tercile of students significant outperforms the lower tercile (86.8% versus 29.0%, respectively, cells **R5** and **R6**.)

To assess how the *complex verbal* algorithm distributes answers, question scenario setup CY21 is recalculated 100 times and the results tallied. Given a uniform distribution the expected value for each of the five **A-to-E** multiple choices being the correct answer is 20. The actual tallies: **A** was the correct answer 24 times; **B** was the correct answer 23 times; **C** was the correct answer 19 times; **D** was the correct answer 18 times; **E** was the correct answer 16 times. Though deviating slightly from a uniform distribution, the tallies nonetheless do not significantly contradict the hypothesis. Among the 18 times **D** was the correct answer, 6 times **A and B** displayed true statements, 5 times **A and C** displayed true statements, and 7 times **B and C** displayed true statements. That finding is consistent with expectations. Among the 16 occurrences when **E** was the correct answer, for 8 occurrences **all of the A-B-C** choices displayed true statements and for 8 occurrences **none of the A-B-C** statements were true. That finding is consistent with expectations, too.

The remainder of this section instructs how to make an algorithmic question with assistance from the *complex verbal* wizard. The question is based on the one in screenshot CV3 below that was answered by 488 students on the 25-question non-cumulative final exam in Spring 2015. The question scenario setup was inspired by a newspaper article used in a classroom discussion describing how Ted Turner had used an options strategy called a “collar” to lock-in the value of his shares in TBS (Turner

Broadcasting System). All students had advance knowledge that the question (code DS9) would appear as #18 on the exam. Furthermore, students could practice the algorithmic problem repeatedly on Blackboard. The spreadsheet results from the right panel of the screenshot (cell **AC5**) show that 90.8% of students in the upper tercile (sorted on total exam points correct, 163 students per tercile) get this question correct. Apparently, DS9 was fairly easy if you prepared. Among students in the lower tercile, however, only 40.0% (cell **AC6**) get the question correct (36.0% for the version on colors 1 and 6, cell **AC19**).



19.
You have accumulated 1,400 shares of company stock because of a generous employee stock ownership plan. Today's share price is $47.00 . You use a collar to lock-in the value 8 months from now of today's stock holdings. The collar takes a long position on 1,400 put options with strike of 45 and per unit option price of $4.25 . Also you take a short position on 1,400 call options with strike of 50 and per unit option price of $3.50 . Which is the most accurate statement about the valuation effects of the collar?
a. The best-case outcome is that in 8 months the stocks become worth $63000
b. The worst-case outcome is that in 8 months the stocks become worth $70000
c. The initial cash flow from entering the collar today is a cash outflow of $1050
d. Two choices, B and C, are correct
e. None of the A-B-C choices are correct

	J	AC
3	*Question :*	19
4	*Total %correct :*	69.7%
5	*%correct TopTail :*	90.8%
6	*%correct LowTail :*	40.0%
7	*T-stat(tails) :*	4.80
8	*KEY1616*	DS9
9	*Question :*	19
10	*Key :*	C
11	*A*	6
12	*B*	6
13	*C*	89
14	*D*	11
15	*E*	14
16	*#responses :*	126
17	*Total %correct :*	70.6%
18	*Upper %correct:*	88.0%
19	*Lower %correct :*	36.0%
20	*T-stat :*	4.91

▪ 19.¶
▪ *DS9··Valuation·effects·of·collar*¶
▪ ·You·have·accumulated·1,900·shares·of·company·stock·because·of·a·generous· employee·stock·ownership·plan.··Today's·share·price·is·$52.50·.··You·use·a·collar·to· lock-in·the·value·8·months·from·now·of·today's·stock·holdings.··The·collar·takes·a·long· position·on·1,900·put·options·with·strike·of·55·and·per·unit·option·price·of·$6.75·.··Also· you·take·a·short·position·on·1,900·call·options·with·strike·of·60·and·per·unit·option·price· of·$3.50·.··Which·is·the·most·accurate·statement·about·the·valuation·effects·of·the· collar?¶
▪ {ANSWER:·D·;··xlADDRESS:·Options!$B$426·}¶
▪ /\a.··The·best-case·outcome·is·that·in·8·months·the·stocks·become·worth·$114000¶
▪ /\b.··The·worst-case·outcome·is·that·in·8·months·the·stocks·become·worth·$104500¶
▪ /\c.··The·initial·cash·flow·from·entering·the·collar·today·is·a·cash·inflow·of·$6175¶
▪ /\d.··Two·choices,·A·and·B,·are·correct¶
▪ /\e.··The·three·A-B-C·choices·are·all·correct¶
¶

	J	AC
36	*KEY3838*	DS9
37	*Question :*	19
38	*Key :*	D
39	*A*	5
40	*B*	12
41	*C*	6
42	*D*	76
43	*E*	23
44	*#responses :*	122
45	*Total %correct :*	62.3%
46	*Upper %correct:*	88.0%
47	*Lower %correct :*	35.0%
48	*T-stat :*	4.87

Screenshot CV3: The *complex verbal* algorithm made DS9
Exam 4, Spring 2015, colors 1&6 and 3&8, question #19

The instructions below presume that you are creating the founding question for a new collection of algorithmic questions. If you are adding the question to an existing *Excel* workbook and a *Word* document, however, then open those two files and follow the steps below with little modification.

1. Launch *Word* and open a new blank document.
-- Hit the **Enter** key. Hit **CTRL A** to highlight the entire empty document: (a) Click **Home** > **Paragraph**, format **lines** as single-spaced with zero points **before** and **after** (b) Click **Home** and set the font to Arial 12 point (or use your preferred font and size).
-- Copy and paste the following sentences at the end of the new document: You have accumulated x shares of company stock because of a generous employee stock ownership plan. Today's share price is x. You use a collar to lock-in the value x months from now of today's stock holdings. The collar takes a long position on x put options with strike of x and per unit option price of x. Also you take a short position on x call options with strike of x and per unit option price of x. Which is the most accurate statement about the valuation effects of the collar?

-- Hit the **Enter** key.
-- Click **File** > **Save as** > Click **Browse** and select your **Documents** directory > For this illustration click to make a **New Folder** with the name **2023-Spring-Fin322** > For the filename, type **Options** > Click **Save**. For Windows 7 and Windows 10 systems the file below was made:
C:\Users*your username*\Documents\2023-Spring-Fin322\Options.docx
The file contents include exclusively the sentences pasted from above. Leave the document open.

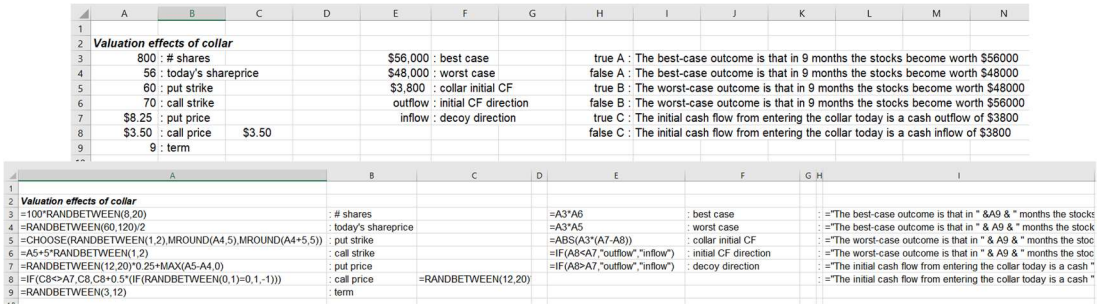
2. Launch *Excel* and click to Open a Blank Workbook.
-- Hit **CTRL A** to highlight the entire empty document: (a) Right-click on any column header (any letter above row 1), select **Column Width**, and set to **12**, click **OK**. (b) Set the font to Arial 12 point (or use your preferred font and size). [Making the *Excel* and *Word* documents have the same font and point size is the objective.]
-- Make a one-time setting to toggle from automatic calculation (the default for a new workbook) to manual calculation. Click **File** > Click **More Options** > Click **Formulas** > In the Calculation Options section click **Manual** > Click **OK**. While this setting is not essential it definitely makes working with an algorithmic document more convenient.
-- In cell **A2** type or copy/paste the question description below:
Valuation effects of collar
-- In cell **A3** type or copy/paste the formula below:
=100*RANDBETWEEN(8,20)
In cell **B3** put this label ": # shares"
-- In cell **A4** type or copy/paste the formula below:
=RANDBETWEEN(60,120)/2
In cell **B4** put this label ": today's share price"
-- In cell **A5** type or copy/paste the formula below:
=CHOOSE(RANDBETWEEN(1,2),MROUND(A4,5),MROUND(A4+5,5))
In cell **B5** put this label ": put strike"
-- In cell **A6** type or copy/paste the formula below:
=A5+5*RANDBETWEEN(1,2)
In cell **B6** put this label ": call strike"
-- In cell **A7** type or copy/paste the formula below:
=RANDBETWEEN(12,20)*0.25+MAX(A5-A4,0)
In cell **B7** put this label ": put price"
-- In cell **A8** type or copy/paste the formula below:
=IF(C8<>A7,C8,C8+0.5*(IF(RANDBETWEEN(0,1)=0,1,-1)))
In cell **B8** put this label ": call price"
In cell **C8** put this formula: =RANDBETWEEN(12,20)*0.25+MAX(A4-A6,0)
-- In cell **A9** type or copy/paste the formula below:
=RANDBETWEEN(3,12)
In cell **B9** put this label ": term"
-- In cell **E3** type or copy/paste the formula below:
=A3*A6
In cell **F3** put this label ": best case"
-- In cell **E4** type or copy/paste the formula below:
=A3*A5
In cell **F4** put this label ": worst case"

-- In cell **E5** type or copy/paste the formula below:
=ABS(A3*(A7-A8))
In cell **F5** put this label ": collar initial CF"
-- In cell **E6** type or copy/paste the formula below:
=IF(A8<A7,"outflow","inflow")
In cell **F6** put this label ": initial CF direction"
-- In cell **E7** type or copy/paste the formula below:
=IF(A8>A7,"outflow","inflow")
In cell **F7** put this label ": decoy direction"
-- In cell **i3** type or copy/paste the formula below:
="The best-case outcome is that in " & A9 & " months the stocks become worth $" & E3
In cell **H3** put this label "true A :"
-- In cell **i4** type or copy/paste the formula below:
="The best-case outcome is that in " & A9 & " months the stocks become worth $" & E4
In cell **H4** put this label "false A :"
-- In cell **i5** type or copy/paste the formula below:
="The worst-case outcome is that in " & A9 & " months the stocks become worth $" & E4
In cell **H5** put this label "true B :"
-- In cell **i6** type or copy/paste the formula below:
="The worst-case outcome is that in " & A9 & " months the stocks become worth $" & E3
In cell **H6** put this label "false B :"
-- In cell **i7** type or copy/paste the formula below:
="The initial cash flow from entering the collar today is a cash " & E6 & " of $" & E5
In cell **H7** put this label "true C :"
-- In cell **i8** type or copy/paste the formula below:
="The initial cash flow from entering the collar today is a cash " & E7 & " of $" & E5
In cell **H8** put this label "false C :"

Find information below that clarifies the *Excel* question scenario setup.
-- In cell **A3** the **randbetween(a,b)** function returns an integer from *Analysis ToolPak* for the inclusive range **a** to **b**, in this case an integer from 8 to 20. The formula in **A3** multiplies the returned integer by 100. Thus, the number of shares ranges from 800 to 2,000 or any of the other numbers in between (13 possible outcomes). By the way, Ted Turner, the inspiration for this problem, had millions of TBS shares! Format cell **A3** as a Number with zero decimal places. Right justify **A3** and left justify **B3**. Cells **A4** and **B4** are analogous except format **A4** as Currency with two decimal places.
-- Cell **A5** sets the strike price of the put option using the **MROUND()** function to truncate the stock price from **A4** to the nearest multiple of 5 (as stock options do). The **CHOOSE()** function selects either an (1) “at the money strike” or (2) the next higher “in the money” multiple of 5; the choice depends on whether **randbetween(1,2)** returns 1 or 2. Format **A5** as a Number with 0 decimal places. Right justify **A5** and left justify **B5**.
-- Cell **A6** sets the call option strike as the put strike from **A5** plus either (1) five or (2) ten; the choice depends on whether **randbetween(1,2)** returns 1 or 2. Format **A6** as a Number with 0 decimal places. Right justify **A6** and left justify **B6**.

-- Cell **A7** sets the price of the put option equal to the sum of its *intrinsic value*, which is the strike price in **A5** minus the stock price in **A4** (the **MAX()** function assures a non-negative intrinsic value), plus its *time value* which is between $3 and $5 (**randbetween(12,20)x0.25**). Format **A7** as Currency with two decimal places. Right justify **A7** and left justify **B7**.
-- Cell **A8** sets the price of the call option. A tentative price is set in cell **C8** that equals the sum of its *intrinsic value*, which is the stock price in **A4** minus the strike price in **A6** (the **MAX()** function assures a non-negative intrinsic value), plus its *time value* which is between $3 and $5 (**randbetween(12,20)x0.25**). Cell **A8** uses the call price in cell **C8** unless that's the same as the put price in **A7** (a no-no!) in which case the call price is adjusted up or down 50 cents (depending on whether **randbetween(0,1)** returns 0 or 1). Format **A8** as Currency with two decimal places. Right justify **A8** and left justify **B8**.
-- Cell **A9** sets the term of the collar between 3 and 12 months as determined by **randbetween(3,12)**. Format **A9** as a Number with zero decimal places. Right justify **A9** and left justify **B9**.
-- Cell **E3** computes the best case outcome occurring when the stock prices rises thereby pushing the call option deep in the money. The shares are sold at the call strike price to cover the short call option position. Right justify **E3** and left justify **F3**.
-- Cell **E4** computes the worst case outcome occurring when the stock prices falls thereby pushing the put option deep in the money. The shares are sold at the put strike price thereby exercising the long put option position. Right justify **E4** and left justify **F4**.
-- Cell **E5** computes the initial cash flow (in absolute value) as the number of shares times the put price (an outflow) minus the call price (an inflow).. Right justify **E5** and left justify **F5**.
-- Cell **E6** uses the **IF()** statement to determine whether the initial cash flow is an outflow or inflow. Right justify **E6** and left justify **F6**.
-- Cell **E7** is a decoy. Right justify **E6** and left justify **F6**.
-- Cell **i3** uses the ampersand (&) to concatenate the contents of cells **A9** and **E3** into the first true statement for the question creator wizard. Cell **i4** is a matching false statement.
-- Cell **i5** uses the ampersand (&) to concatenate the contents of cells **A9** and **E4** into the second true statement for the question creator wizard. Cell **i5** is a matching false statement.
-- Cell **i7** uses the ampersand (&) to concatenate the contents of cells **E5** and **E6** into the third true statement for the question creator wizard. Cell **i8** is a matching false statement.
-- Click **File** > **Save as** > Click **Browse** and select the same folder containing the *Word* document. Use the same filename, too, for example:
C:\Users*your username*\Documents\2023-Spring-Fin322\Options.docx
A requirement of **Algogen.xla** is that the founding algorithmic *Word* document in a new collection is saved in the same folder with the same name as the *Excel* workbook that contains the question scenario setup.

Screenshot CV4 below shows the workbook made by completing the preceding steps.



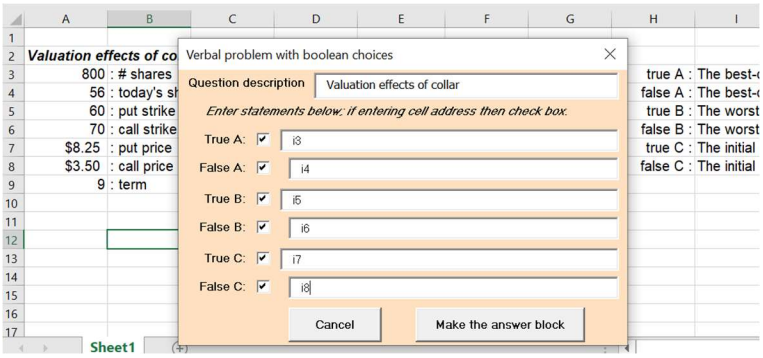
1													
2	*Valuation effects of collar*												
3	800	: # shares			$56,000	: best case		true A :	The best-case outcome is that in 9 months the stocks become worth $56000				
4	56	: today's shareprice			$48,000	: worst case		false A :	The best-case outcome is that in 9 months the stocks become worth $48000				
5	60	: put strike			$3,800	: collar initial CF		true B :	The worst-case outcome is that in 9 months the stocks become worth $48000				
6	70	: call strike			outflow	: initial CF direction		false B :	The worst-case outcome is that in 9 months the stocks become worth $56000				
7	$8.25	: put price			inflow	: decoy direction		true C :	The initial cash flow from entering the collar today is a cash outflow of $3800				
8	$3.50	: call price	$3.50					false C :	The initial cash flow from entering the collar today is a cash inflow of $3800				
9	9	: term											

	A	B	C	D	E	F	G H	I
1								
2	*Valuation effects of collar*							
3	=100*RANDBETWEEN(8,20)	: # shares			=A3*A6	: best case		: ="The best-case outcome is that in " &A9 & " months the stocks
4	=RANDBETWEEN(60,120)/2	: today's shareprice			=A3*A5	: worst case		: ="The best-case outcome is that in " & A9 & " months the stock
5	=CHOOSE(RANDBETWEEN(1,2),MROUND(A4,5),MROUND(A4+5,5))	: put strike			=ABS(A3*(A7-A8))	: collar initial CF		: ="The worst-case outcome is that in " & A9 & " months the stoc
6	=A5+5*RANDBETWEEN(1,2)	: call strike			=IF(A8<A7,"outflow","inflow")	: initial CF direction		: ="The worst-case outcome is that in " & A9 & " months the stoc
7	=RANDBETWEEN(12,20)*0.25+MAX(A5-A4,0)	: put price			=IF(A8>A7,"outflow","inflow")	: decoy direction		: ="The initial cash flow from entering the collar today is a cash "
8	=IF(C8<>A7,C8,C8+0.5*(IF(RANDBETWEEN(0,1)=0,1,-1)))	: call price	=RANDBETWEEN(12,20)					: ="The initial cash flow from entering the collar today is a cash "
9	=RANDBETWEEN(3,12)	: term						

Screenshot CV4: Worksheet for making the *complex verbal* question in the illustration

The upper panel displays the results from the cell instructions. The lower panel displays the cell instructions.

3. This step will run the question creator wizard that makes the algorithmic document by linking the *Excel* worksheet setup to the *Word* question setup. Click or move the arrow keys to make worksheet cell **B12** the active cell. This cell becomes the upper left corner of the *answer block* (6 rows by 3 columns) that the wizard automatically writes in the workbook. Any prior contents will be overwritten by the wizard so always be sure the cells within the answer block are empty. Good practice leaves a blank row or two between the worksheet question scenario setup and the top of the answer block.
-- Hit the shortcut keys **ALT F8** to open the *Excel* Macro form (or click **View** > Click **Macros** > Click **View macros**).
-- In the input box for the Macro name type or copy/paste **ComplexVerbal** (no space between words, capitalization is irrelevant). > Click **Run**. An information form pops open that describes the *complex verbal* algorithm > Click **OK** to make an algorithmic question > Type or copy/paste this question description in the form box: Valuation effects of collar > Type cell address **i3** for the true statement for **A**, **i4** for false **A**, **i5** for true **B**, **i6** for false **B**, **i7** for true **C**, and **i8** for false **C** > Check all boxes beside the cell addresses (if statements had been typed on the form then the boxes would remain unchecked). The completed form should look similar to below.



Screenshot CV5: The *complex verbal* question creator form

> Click **Make the answer block**. Do not interrupt execution while the wizard writes the answer block into the *Excel* worksheet scenario setup. Since this is the first question in a new document the wizard prompts for the 2 or 3 character *part code*. Every question must have a question code that begins with a 2 or 3 character alphabetic string followed by a number. The alphabetic string is the part code. Many problems that are very similar, say because they are on the same topic, begin with the same alphabetic part

code. The number affixed to the part code automatically increments as new questions are added to this part of the document. The wizard writes the question code into the *Word* document. > Type **DS** (for derivative securities) for the part code. > Click **OK** to confirm the part code. > The wizard next prompts for the *Excel* cell address of any variable that goes into the *Word* question body, that is, the paragraph(s) containing the question which precedes the multiple choices. Type **A3** (the #shares) and click **OK**. > When the prompt again returns type **A4** and click **OK**, then do the same for **A5**, **A6**, **A7**, **A8** and **A9**. > When the prompt again returns click **Cancel** since there are no more inputs for the question body.

4. The question creator wizard finishes making the algorithmic question and suggests these next steps. First, finalize the *Excel* question scenario setup. > Type **DS1** in cell **A2** so that the question code precedes the question description > Format cell **A2** as bold italic > Format cells **D15** and **D16** to two decimal places, e.g., 0.77. That's it! Save the *Excel* file. Notice that the workbook recalculates upon saving giving something like screenshot CV7 below. The shortcut key to force recalculation is **F9**. Hit **F9** repeatedly and notice how the algorithmic setup changes.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
2	***DS1 Valuation effects of collar***													
3	2,000	: # shares			$100,000	: best case		true A :	The best-case outcome is that in 10 months the stocks become worth $100000					
4	$46.00	: today's shareprice			$90,000	: worst case		false A :	The best-case outcome is that in 10 months the stocks become worth $90000					
5	45	: put strike			$500	: collar initial CF		true B :	The worst-case outcome is that in 10 months the stocks become worth $90000					
6	50	: call strike			inflow	: initial CF direction		false B :	The worst-case outcome is that in 10 months the stocks become worth $100000					
7	$4.25	: put price			outflow	: decoy direction		true C :	The initial cash flow from entering the collar today is a cash inflow of $500					
8	$4.50	: call price	$4.50					false C :	The initial cash flow from entering the collar today is a cash outflow of $500					
9	10	: term												
10														
11														
12			D	^4^2^H^The	Sheet1!$B$12									
13			The best-case outcome is		1									
14			The worst-case outcome is		0									
15			The initial cash flow from e		0.93									
16			Two choices, A and C, are		0.79									
17			The three A-B-C choices are all correct											
18														

Screenshot CV5: The finalized *Excel* setup for the *complex verbal* illustration

The *Excel* question scenario setup is in the cell range **A2:i9**. Some of those cells have been linked into the *Word* algorithmic document that contains the question body. The answer block is in the cell range **B12:D17**. Components of the answer block are described here:

-- Cell **B12** is the letter among the five **A-to-E** multiple choices that has the correct answer. In the screenshot above the correct answer is **D**. The chance was $1/5^{th}$ of that occurring. Because that occurred, choices **A** in **B13** and **C** in **B15** display true statements whereas choice **B** in **B14** displays a false statement.

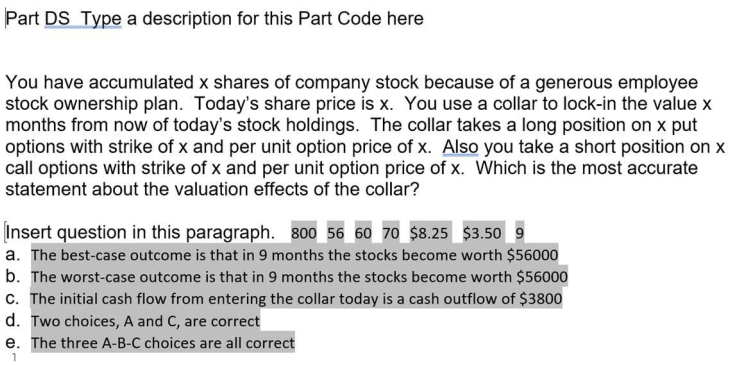
-- Cell **C12** contains codes that the *complex verbal* algorithm uses.

-- Cell **D12** contains the workbook address of the cell with the answer. Cell **D12** is copied automatically as hidden text into the question in the *Word* document.

-- Cells **B13:C17** are copied into the five **A-to-E** choices in *Word* just after the question body.

-- Cells **D13:D16** contain random variables sometimes useful for making a question scenario setup. Find descriptions for these variables following screenshot SN5 for the *standard numerical* algorithm.

5. The next step finalizes the *Word* question body. The *complex verbal* question creator wizard makes an **Options.docx** file that looks similar to screenshot CV6.


Part DS Type a description for this Part Code here

You have accumulated x shares of company stock because of a generous employee stock ownership plan. Today's share price is x. You use a collar to lock-in the value x months from now of today's stock holdings. The collar takes a long position on x put options with strike of x and per unit option price of x. Also you take a short position on x call options with strike of x and per unit option price of x. Which is the most accurate statement about the valuation effects of the collar?

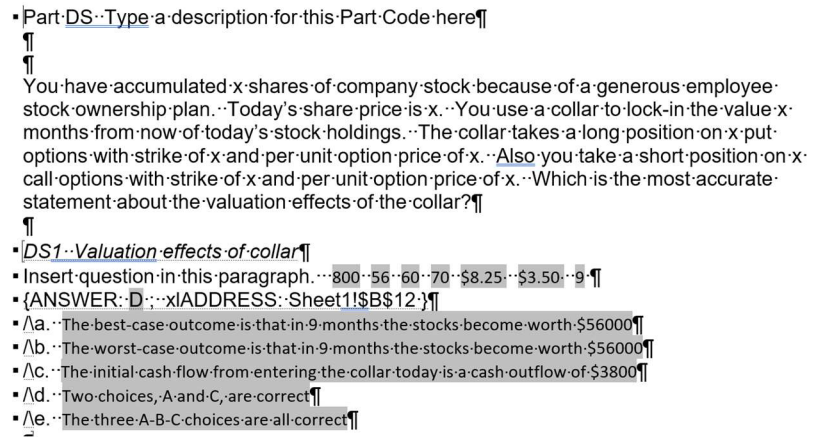
Insert question in this paragraph. 800 56 60 70 $8.25 $3.50 9

a. The best-case outcome is that in 9 months the stocks become worth $56000
b. The worst-case outcome is that in 9 months the stocks become worth $56000
c. The initial cash flow from entering the collar today is a cash outflow of $3800
d. Two choices, A and C, are correct
e. The three A-B-C choices are all correct

Screenshot CV6: The *Word* file made by the *one correct pair* wizard

The wizard wrote the top header line in the screenshot that marks the beginning of Part DS, the 2-character alphabetic code supplied during execution of the question creation. Beneath the header are the sentences with the question that was typed or pasted before launching the wizard. Beneath that within the grey square brackets is the content written by the wizard during question creation. Finalize this algorithmic *Word* document with the instructions below.

-- Hit the shortcut key **CTRL *** which toggles the display (or not) of hidden text (this shortcut is like clicking **Home** along the top left and then clicking the ¶ symbol near midcenter of the **Home** ribbon; also the shortcut is similar to clicking **File, More Options, Display, Show hidden text**). The view showing hidden text appears in screenshot CV7.


Part DS Type a description for this Part Code here¶
¶
¶
You have accumulated x shares of company stock because of a generous employee stock ownership plan. Today's share price is x. You use a collar to lock-in the value x months from now of today's stock holdings. The collar takes a long position on x put options with strike of x and per unit option price of x. Also you take a short position on x call options with strike of x and per unit option price of x. Which is the most accurate statement about the valuation effects of the collar?¶
¶
DS1 Valuation effects of collar¶
Insert question in this paragraph. 800 56 60 70 $8.25 $3.50 9 ¶
{ANSWER: D ; xlADDRESS: Sheet1!$B$12 }¶
/\a. The best-case outcome is that in 9 months the stocks become worth $56000¶
/\b. The worst-case outcome is that in 9 months the stocks become worth $56000¶
/\c. The initial cash flow from entering the collar today is a cash outflow of $3800¶
/\d. Two choices, A and C, are correct¶
/\e. The three A-B-C choices are all correct¶

Screenshot CV7: The *Word* file made by the *complex verbal* wizard when hidden text displays

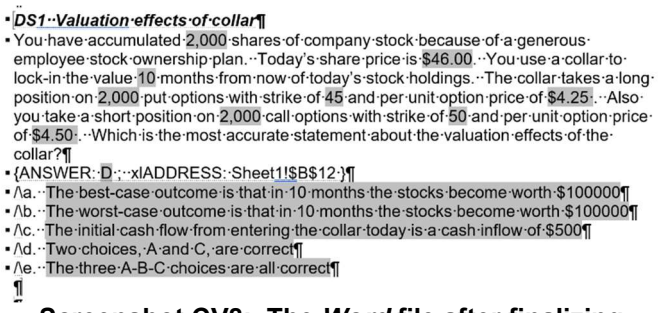
Always it's best to edit an algorithmic document with the hidden text showing. The seven shaded items at the end of the line "Insert question …" are embedded links from the *Excel* workbook copied into the *Word* question body by the wizard during the "enter cell address for inputs into the question body" query.

-- It's not essential for this illustration but typically edit the top line and type a proper description for the part code. Bold format is recommended.

-- Select the question sentences "You have… the collar?" and cut (**CTRL x**). Then paste (**CTRL v**) that sentence to replace "Insert question in this paragraph."

-- Select the first field after the pasted sentence which in the screenshot above is 800. Often it's easiest to select from the space before through the space after the shaded field, then click and drag the selection in place just before the x for the shares. Delete any extra spaces (and delete the x). The number of shares appears in two other places, as the #put options and #call options. Highlight the field, hold the **CTRL** key as you click and drag it, twice, into the other two places; this action copies the dragged field.
-- Select the next field after the question which in the screenshot above is 56, today's stock price . Click and drag into place, delete extra spaces (and delete the x). Continue to click and drag the other fields (the strike price for the put, call strike, put price, call price, months to expiry).

The *Word* document is finalized and ready to update. Click in the left margin and extend the selection to include the question body and answers. Hit **F9** and all the embedded links in *Word* reach out to the *Excel* workbook and update so as to display the current cell contents. > If the text is not all the same font and size, select the entire question body and answers. Make it all, say, Arial 12 point. The view should be similar to screenshot CV8.


DS1··Valuation·effects·of·collar¶
You·have·accumulated·2,000·shares·of·company·stock·because·of·a·generous·employee·stock·ownership·plan.··Today's·share·price·is·$46.00.··You·use·a·collar·to·lock-in·the·value·10·months·from·now·of·today's·stock·holdings.··The·collar·takes·a·long·position·on·2,000·put·options·with·strike·of·45·and·per·unit·option·price·of·$4.25.··Also·you·take·a·short·position·on·2,000·call·options·with·strike·of·50·and·per·unit·option·price·of·$4.50:.··Which·is·the·most·accurate·statement·about·the·valuation·effects·of·the·collar?¶
{ANSWER:·D·;··xlADDRESS:·Sheet1!$B$12·}¶
/\a.··The·best-case·outcome·is·that·in·10·months·the·stocks·become·worth·$100000¶
/\b.··The·worst-case·outcome·is·that·in·10·months·the·stocks·become·worth·$100000¶
/\c.··The·initial·cash·flow·from·entering·the·collar·today·is·a·cash·inflow·of·$500¶
/\d.··Two·choices,·A·and·C,·are·correct¶
/\e.··The·three·A-B-C·choices·are·all·correct¶
¶

Screenshot CV8: The *Word* file after finalizing

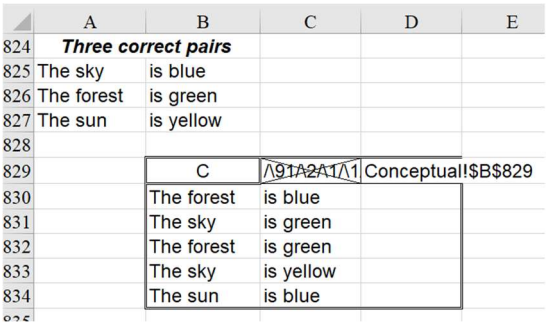
Save the *Word* file.

-- View the range of appearances for question **DS1** created above by switching to the *Excel* workbook **Options.xlsx** and hit **F9** to recalculate. Switch to **Options.docx** and with the question highlighted hit **F9** to update. That's it, the algorithmic question is ready to make an endless stream of unique versions. The *Word* question scenario setup may be copied and pasted in any *Word* document in any folder. The copied question retains its algorithmic functionality as long as the *Excel* workbook remains at the same path. Close and save both files.

Algorithm 4. The Three Correct Pairs Wizard
Macro-name = ThreeCorrectPairs

The *Three Correct Pairs* question creator prompts for 3 pairs of inputs. Each pair has two items that correspond correctly. The five **A-to-E** selections each present only one selection containing a correct pair. The correct pair, and its location too, are

chosen randomly. The four wrong answers combine items from non-corresponding pairs. Screenshot TP1 below exemplifies the basic function of the *three correct pairs* algorithm.



	A	B	C	D	E
824	***Three correct pairs***				
825	The sky	is blue			
826	The forest	is green			
827	The sun	is yellow			
828					
829		C	/\91A2A1/\1	Conceptual!$B$829	
830		The forest	is blue		
831		The sky	is green		
832		The forest	is green		
833		The sky	is yellow		
834		The sun	is blue		

Screenshot TP1: The *three correct pairs* algorithm

The three top rows cells (range **A825:B827**) display the two items in each correct pair, e.g., “The sky” & “ is blue”. The question creator wizard writes the answer block in range **B829:D834**. Only the correct answer in choice **C** (cells **B832:C832**) combines two items from the same correct pair, i.e., “The forest” & “ is green”. The other four multiple choices display recombinations that are false.

The question below (code TR12) was made by the *three correct pairs* algorithm. It appears on one of the four versions for exam 4. Students know that either TR12 is one of four questions that will appear in that question slot. The algorithmic question could be practiced repeatedly online in Blackboard. The question asks students to correctly identify three important concepts from modern portfolio theory: the security market line, the efficient frontier, and the capital market line. The upper panel displays the question as it appeared on the exam, the lower panel displays hidden text that is not printed.

9. (3 points)
Which statement about important concepts in the Capital Asset Pricing Model is most accurate?
a. the security market line is the risk-return profile that contains the set of all dominant portfolios comprised possibly of all securities
b. the efficient frontier is the risk-return profile that contains the set of all dominant portfolios comprised possibly of all securities
c. the efficient frontier passes through two points with coordinates (beta, rate of return) equal to (0, risk-free rate) and (1, expected market return)
d. the security market line passes through two points with coordinates (standard deviation, rate of return) equal to (0, risk-free rate) and (market standard deviation, expected market return)
e. the capital market line passes through two points with coordinates (beta, rate of return) equal to (0, risk-free rate) and (1, expected market return)

	J	S
36	KEY3838	TR12
37	Question :	9
38	Key :	B
39	A	2
40	B	95
41	C	9
42	D	3
43	E	13
44	#responses :	122
45	Total %correct :	77.9%
46	Upper %correct:	98.0%
47	Lower %correct :	53.0%
48	T-stat :	4.52

10. (3 points)
TR12 Which CAPM concept is correct
Which statement about important concepts in the Capital Asset Pricing Model is most accurate?
{ANSWER: D: xlADDRESS: Conceptual!$B$829 }
/\a. the capital market line passes through two points with coordinates (beta, rate of return) equal to (0, risk-free rate) and (1, expected market return)
/\b. the security market line is the risk-return profile that contains the set of all dominant portfolios comprised possibly of all securities
/\c. the efficient frontier passes through two points with coordinates (beta, rate of return) equal to (0, risk-free rate) and (1, expected market return)
/\d. the efficient frontier is the risk-return profile that contains the set of all dominant portfolios comprised possibly of all securities
/\e. the security market line passes through two points with coordinates (standard deviation, rate of return) equal to (0, risk-free rate) and (market standard deviation, expected market return)

	J	T
36	KEY3838	TR12
37	Question :	10
38	Key :	D
39	A	19
40	B	8
41	C	14
42	D	54
43	E	8
44	#responses :	103
45	Total %correct :	52.4%
46	Upper %correct:	71.0%
47	Lower %correct :	32.0%
48	T-stat :	3.22

Screenshot TP2: Question TR12 made by the *three correct pairs* algorithm
Upper panel is question #9, exam 4, Spring 2015; Lower panel is #10, exam 4, Fall 2015

The worksheet setup for this algorithmic question splits a sentence describing each of the three concepts into two cells. The algorithm recombines the cells such that only one of the three concepts is described correctly. Coincidentally, for both versions shown above the *efficient frontier* is the correctly identified concept. The performance profiles for the two versions, however, are surprisingly different. Only 52.4% of 103 students correctly choose choice **D** on the Fall 2015 exam; 77.9% of 122 students on the Spring 2015 exam correctly choose **B**. It's a conjecture whether the difference is a revealed preference for the **B** location and disdain for **D**, or perhaps it's adverse effects from fall football!

The *Excel* workbook setup for the question in screenshot TP2 appears below. The fragmented correct sentences appear in the range **A825:B827**. The *Word* document adds the suffix "The " at the front of each multiple choice. The *three correct pairs* wizard automatically writes the answer body shown in **B829:D834**.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
823	TR12 Which CAPM concept is correct														
824	3 correct pairs														
825	efficient frontier	is the risk-return profile that contains the set of all dominant portfolios comprised possibly of all securities													
826	capital market line	passes through two points with coordinates (standard deviation, rate of return) equal to (0, risk-free rate) and (market standard deviation, expected market return)													
827	security market line	passes through two points with coordinates (beta, rate of return) equal to (0, risk-free rate) and (1, expected market return)													
828															
829		D	/\13A8\2/\	Conceptual!$B$829											
830		efficient frontier	passes through two points with coordinates (beta, rate of return) equal to (0, risk-free rate) and (1, expected market return)												
831		capital market line	is the risk-return profile that contains the set of all dominant portfolios comprised possibly of all securities												
832		security market line	passes through two points with coordinates (standard deviation, rate of return) equal to (0, risk-free rate) and (market standard deviation, expected market return)												
833		security market line	passes through two points with coordinates (beta, rate of return) equal to (0, risk-free rate) and (1, expected market return)												
834		efficient frontier	passes through two points with coordinates (standard deviation, rate of return) equal to (0, risk-free rate) and (market standard deviation, expected market return)												

Screenshot TP3: The *Excel* workbook setup for TR12 simply splits three correct sentences

A final example of a question made by the *three correct pairs* algorithm appears below. The question body sets up the scenario giving different facts, in this case a corporate bond coupon rate, bond price, the current date, and the maturity date. The

multiple choices then offer statements about three properties of the scenario, in this case how much is the current yield, the yield-to-maturity, and the capital gains yield. The chance is 1/3rd that any one of the three measurements is correctly matched to its number. The basic framework has universal application across many disciplines.

- *BD12b··Find·and·match·ytm,·current·yield,·capital·gain·yield·(count·dates·to·find·#coupons)*¶
- Today·is·a·day·in·September·2525·and·a·bond·with·annual·coupon·rate·of·4.30%·just·yesterday·paid·a·coupon.·The·bond·matures·in·September·2535·and·its·quoted·bond·price·is·88.74·percent·of·par·(semiannual·compounding).··Find·the·yield-to-maturity,·current·yield·and·capital·gains·yield.¶
- {ANSWER:·A·;··xlADDRESS:·BondApps!$B$199;·CLUES:··#coupons·=·20;·ytm·=···5.80%}¶
- /\a.··the·capital·gains·yield·equals·0.95%¶
- /\b.··the·capital·gains·yield·equals·5.80%¶
- /\c.··the·yield-to-maturity·equals·0.95%¶
- /\d.··the·current·yield·equals·5.80%¶
- /\e.··the·yield-to-maturity·equals·4.85%¶

¶

	A	B	C	D	E	F	G
19	***Month names***						
20	January	February	March	April	May	June	July
21							
22	***BD1 Coupon bond***						
23	=INDEX($A$20:$L$20,D23)	: today's month		=RANDBETWEEN(1,12)		=C28/C27*2	The current yield equals
24	=INDEX($A$20:$L$20,D24)	: maturity month		=D23+(RANDBETWEEN(0,1))*IF(D23<7,6,-6)		=A29-F23	The capital gains yield is
25	=2525+D25	: maturity year		=RANDBETWEEN(5,20)		=(-PV(A29/2,A26-1,C28,1000)/C27-1)*2	: checksum
26	=2*(D25-1)+IF(D23<7,1,0)+IF(D24<7,1,2)	: number of coupons					
27	=ROUND(C27/10,2)	: price	=-PV(A29/2,A26,C28,1000)				
28	=RANDBETWEEN(35,65)/1000	: coupon :	=A28*1000/2				
29	=A28+RANDBETWEEN(10,35)/1000	The yield-to-maturity equals					
30							

Screenshot TP4: The *three correct pairs* algorithm makes question BD12b
Top panel shows the *Word* question with hidden text displayed.
Bottom panel shows formulas in the *Excel* scenario setup.

The corporate bond issues coupon payments semiannually equal to the annual coupon rate (4.30% above) times the $1000 face value divided by two (thus, $21.50 every 6 months, cell **C28**). To find the solution the student must count the number of semiannual coupons remaining (e.g., above that is 2535 – 2525 times 2 which is 20). The *Word* question shades the fields (like the month name) that update from *Excel*. Cell **A23** uses the **index(range,counter)** function to choose the beginning month; the 12 cells in the range **A20:L20** list the month names from **January** to **December**. Cell **D23** uses **randbetween(1,12)** to select which month name to display. Cell **A24** displays the maturity month; the choice depends on the number in **D24**. When **randbetween(0,1)** in **D24** returns zero (about half the time) then the maturity month is the same as the beginning month. When **randbetween(0,1)** returns 1 then the maturity month name is either 6 months before or 6 months after the beginning month. The **IF()** statements in **D24** and **A26** assist with finding the proper month names (e.g., September matches with March) and number of coupons (e.g., from 2525 to 2536 the number of semiannual coupons might equal 19, 20, or 21).

The bond price in **C27** uses the *Excel* **PV()** function in **C27**. **PV()** inputs include the coupon payments based upon **C28**, the yield-to-maturity from **A29**, the number of coupons from **A26**, and the bond face value of $1,000. The quoted bond price typically is per $100; hence cell **A27** divides **C27** by 10.

To make a new algorithmic question like the ones above, write out the question in *Word* leaving, say, an x where the linked variables will display. Then make the setup

in *Excel*. If this is a founding document in a new algorithmic collection then save both files with the same name; see the illustrations for the algorithms discussed above for more clarity. Launch the *three correct pairs* question creator wizard as described below (**ALT F8**). For the remainder of this illustration, however, the new question is added to an existing document, namely the files **StockAnalysis.xlsx** and **StockAnalysis.docx** that were created during discussion of the *one correct pair* algorithm.

1. Launch *Word* and open the document:
C:\Users*your username*\Documents\2525-Fall-Fin322\StockAnalysis.docx
-- Make sure hidden text is displayed; hit the **CTRL** * to toggle hidden text on and off. Hit CTRL END to move to the end of the document. > Hit the **Enter** key. > Type or copy this sentence: Today is a day in x 2525 and a bond with annual coupon rate of x just yesterday paid a coupon. The bond matures in x x and its quoted bond price is x percent of par (semiannual compounding). Find the yield-to-maturity, current yield and capital gains yield. Choose the statement most consistent with your findings.
-- Hit the **Enter** key.
-- Click **File** > **Save** > Leave the file open.

2. Launch *Excel* and open:
C:\Users*your username*\Documents\2525-Fall-Fin322\StockAnalysis.xlsx
-- In cell **A19** type or copy/paste: Month names
Format **A19** ***Bold Italic***
-- In cell **A20** type: January; in **B20** put February; put the remaining month names in the adjacent cells, finally finishing with December in **L20**
-- In cell **A2** type or copy/paste the question description below:
BD1 Find bond yield-to-maturity, current yield and capital gains yield
Format **A19** ***Bold Italic***
Notice that the above description begins with a part code (BD) for the question. Every question has a code that includes two-or-three alphabetic characters followed by a numerical component. The workbook **StockAnalysis.xlsx** already contains a setup for problem SP1 that was made with the *one correct pair* algorithm; SP is where the "stock pickin'" questions go. A new part, BD, will contain the current illustration on bonds.
-- For convenience, the formulas viewable in screenshot TP4 are displayed below and may be typed or copied and pasted into the workbook:

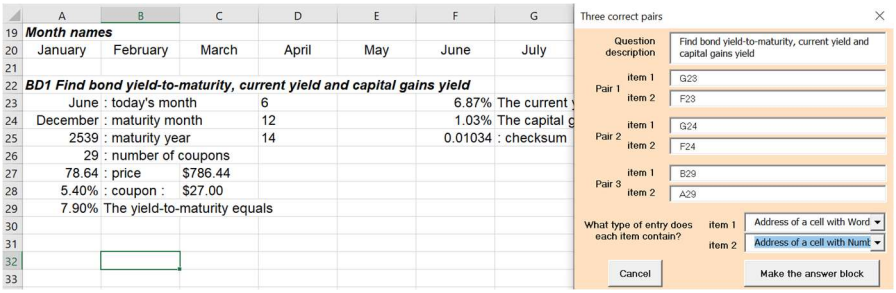
A23: =100*RANDBETWEEN(8,20)
D23: =RANDBETWEEN(1,12)
F23: =C28/C27*2
G23: "The current yield equals "
A24: =INDEX($A$20:$L$20,D24)
D24: =D23+(RANDBETWEEN(0,1))*IF(D23<7,6,-6)=D23+(RANDBETWEEN(0,1))*IF(D23<7,6,-6)
F24: =A29-F23
G24: "The capital gains yield is "
A25: =2525+D25
D25: =RANDBETWEEN(5,20)
F25: =(-PV(A29/2,A26-1,C28,1000)/C27-1)*2
A26: =2*(D25-1)+IF(D23<7,1,0)+IF(D24<7,1,2)
A27: =ROUND(C27/10,2)
C27: =-PV(A29/2,A26,C28,1000)

A28: =RANDBETWEEN(35,65)/1000
C28: =A28*1000/2
A29: =A28+RANDBETWEEN(10,35)/1000
B29: "The yield-to-maturity equals "

The labels for cells **B23** to **B28** are viewable in screenshot TP4. Cell formats are displayed therein, too. Cells **G23 & F23** are the first correct pair; they make a true statement. The other two pairs are **G24 & F24** and **B29 & A29**. The *Word* question body should include cells **A23**, **A24**, **A25**, **A27**, and **A28**.

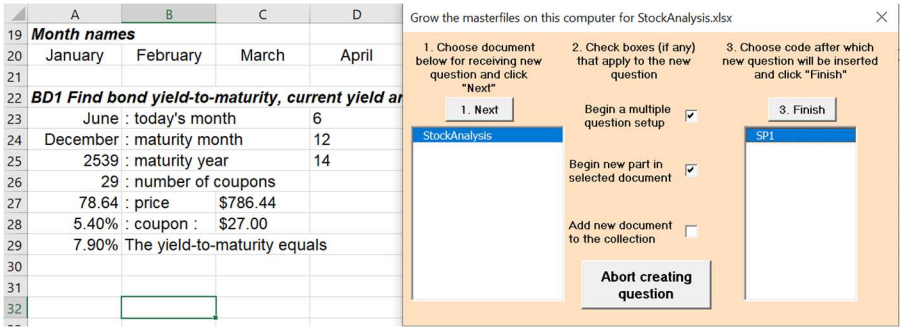
-- Click **File** > **Save** > If using the same filename for this *three correct pairs* algorithm as you did for the *one correct pair* question, for example, the file is:
C:\Users*your username*\Documents\2525-Fall-Fin322\StockAnalysis.xlsx

Select cell a few blank rows beneath the workbook setup that will be the upper left corner of the answer block, for example, **B31**. To launch the question creator wizard hit the **ALT F8** keys, type **ThreeCorrectPairs** (no spaces, capitalization is irrelevant) and click Run. An information box opens that briefly describes the *three correct pairs* algorithm, click **OK** to make an algorithmic question. The question creator form opens; when completed as described below it looks similar to the screenshot below.



Screenshot TP5: The *three correct pairs* question creator wizard

Type or copy/paste this description into the top box: Find bond yield-to-maturity, current yield and capital gains yield. Next enter the cell addresses for the three correct pairs. The first item in each of the three pairs is the cell address with the statement, e.g., “The yield to maturity equals ”. The second item of each pair is the cell address with the matching number, e.g., 7.90%. Notice toward the bottom that the default selection for item 1 in the drop-down box for “What type of entry does each item contain” is correct. For item 2, however, select from the drop-down box **Address of a cell with Numbers**, as shown in the screenshot. Click **Make the answer block**. Were this the founding algorithmic question for this content collection then execution would continue and prompt for inputs to the question body. For this illustration, however, this is the second question going into this document. The form in screenshot TP6 opens whenever adding a new question to an existing document.



Screenshot TP6: The form to select where to insert the new question

The leftmost white box under the label **1. Choose document...** lists all the different *Word* files attached to the algorithmic document collection powered by the *Excel* workbook shown in the form caption, **StockAnalysis.xlsx** for this illustration. A single algorithmic document collection for *Algogen* may include many *Word* files, all powered by one *Excel* workbook. The *elementsOfFinance* collection, for example, has 14 *Word* files but one *Excel* workbook (namely, **elementsOfFinance.xlsx**). The first step in completing this form is to select the target document that will receive this new question. Then click the button **1. Next**. The current collection in the screenshot has only one filename listed, **StockAnalysis**. Click that filename, then click **Next**, then see that the rightmost white box displays all the questions in the selected document. The second step is to check any "special action boxes" in the middle section of the form that might be desired. For this illustration, check the box to **Begin a multiple question setup** and the box **Begin new part in selected document**. To add a new *Word* file to receive this new question then check the box **Add new document to collection**; don't check the box for this illustration. The third step is to select the question code after which the new question will be inserted. The only code thus far is SP1 from the *one correct pair* illustration so click SP1. Then click the button labeled **3. Finish**.

Algorithm 5. The Standard Verbal Wizard
Macro-name = StandardVerbal

The Standard Verbal wizard presents five phrases or sentences in answer locations **A-to-E** with one *Excel* workbook link embedded in each *Word* answer location. Minimal input requirements equal five true statements and five false statements about a body of evidence. One location **A-to-E** chosen with $1/5^{th}$ chance displays one of the five randomly chosen ($1/5^{th}$ chance) true statements. Four false statements display as decoy answers shuffled throughout the 4 wrong locations. Run this wizard with 10 statements for any question scenario setup to endow an endless algorithmic return stream of scenario views.

The scenario question body below presents the question body for **FF5** plus a true statement in location **B** and false statements in the other 4 locations.

- 6. (3 points)¶
- FF5 Legal organizational form¶
- Which one statement about the legal form of business is most consistent?¶
- {ANSWER: B; xlADDRESS: Conceptual!$B$558}¶
- /a. A disadvantage of the corporation is that they raise capital more easily.¶
- /b. A disadvantage of the corporation is that it has relatively high organizational costs.¶
- /c. An advantage of the sole proprietorship is that they offer limited liability to the owner.¶
- /d. An advantage of the corporation is that they are subject to relatively fewer government regulations.¶
- /e. An advantage of the sole proprietorship is that they do not generally offer easy transferability of ownership.¶

	J	P
8	KEY1515	FF5
9	Question :	6
10	Key :	B
11	A	0
12	B	142
13	C	1
14	D	1
15	E	4
16	#responses :	148
17	Total %correct :	95.9%
18	Upper %correct:	100.0%
19	Lower %correct :	92.0%
20	T-stat :	2.00

FF5 is question #6 on exam 1 for 148 students, one of four versions of exam 1 distributed to 530 students that day. The question presents students with the paragraphs preceding the screenshot above. The correct answer is **B**: "A disadvantage of the corporation is that it has relatively high organizational costs." 95.9% of 148 student in-class responses to this question on a scantron form, #2 pencil, a 25 question exam with workspace and instructions, a 256 seat auditorium, many students picked up 3 points on **FF5**. The next exam question **FA15c** was more difficult, by the way, more discriminating. Only 42.6% of the 148 seeing **FA15c** get 5 points by figuring this one correctly. Sort the 148 students seeing this version into terciles based on the total score earned on this exam. Find that 100% of the individuals from the upper tercile get **FF5** correct, 78% figure **FA15c** correctly. Among the lower tercile only 10% of students earn points from **FA15c**, less than unbiased guessers (20%) get from this 5 choice a-to-e multiple choice question. Difficult challenges require discrimination, practice, and learning to overcome. Most exams need a mixture of both easy questions so mediocre students can get Cs; exams also need discriminating question scenario setups so that talented students can reveal distinctive accomplishment.

Students a semester later draw a version of **FF5** that only 84% get correct:

7. (3 points)
Select the one statement about the legal form of business organization that is most consistent with the actual USA market backdrop?

a. An advantage of the sole proprietorship is that they do not generally offer easy transferability of ownership.
b. An advantage of the corporation is that they are subject to relatively fewer government regulations.
c. An advantage of the sole proprietorship is that they offer limited liability to the owner.
d. An advantage of the corporation is that it has relatively low organizational costs.
e. An advantage of the corporation is that they raise capital more easily.

The response pattern below shows a qualitatively equivalent interpretation as the previous semester. More than 4/5th of students get points knowing for **FF5** "An advantage of the corporation is that they raise capital more easily".

File | C:/Admin/Fi302/Grades/201540/ex1_25from46_QuestionStats.htm

KEY1515	FF20	FA3J	FA3F	FF9	FA1	FA14	FF5	BA6	FA15C	BE2A	BE3	BA12B	BA9C	BA11A
Question :	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Key :	D	B	D	C	B	D	E	E	C	E	E	E	E	D
A	20	2	13	7	3	16	9	14	20	12	2	22	20	24
B	8	109	10	4	77	14	5	11	22	13	12	22	18	28
C	10	4	19	103	16	14	3	19	49	13	10	23	52	17
D	75	2	61	5	7	65	2	24	16	8	11	17	19	44
E	8	4	15	2	18	10	102	53	13	75	86	35	11	8
#responses :	121	121	118	121	121	119	121	121	120	121	121	119	120	121
Total %correct :	62.0%	90.1%	50.4%	85.1%	63.6%	53.7%	84.3%	43.8%	40.5%	62.0%	71.1%	28.9%	9.1%	36.4%
Upper %correct:	83.0%	100.0%	88.0%	100.0%	93.0%	83.0%	93.0%	70.0%	78.0%	58.0%	95.0%	63.0%	13.0%	70.0%
Lower %correct :	40.0%	78.0%	23.0%	68.0%	20.0%	15.0%	73.0%	28.0%	10.0%	55.0%	43.0%	10.0%	3.0%	18.0%
T-stat :	3.95	3.11	5.84	3.88	6.58	6.08	2.35	3.76	6.13	0.27	5.02	4.93	1.70	4.69

▪ 4.·(3·points)¶
▪ FF9··Define·market·capitalization¶
▪ A·company's·market·capitalization·equals:¶
▪ {ANSWER:·C·:··xlADDRESS:·Conceptual!$B$334·}¶
▪ /\a.··total·stockholders'·equity·divided·by·number·of·shares·outstanding¶
▪ /\b.··equity·book·value·per·share·divided·by·market·price·per·share¶
▪ /\c.··number·of·shares·outstanding·times·market·price·per·share¶
▪ /\d.··market·price·per·share·divided·by·equity·book·value·per·share¶
▪ /\e.··total·assets·divided·by·number·of·shares·outstanding¶

	J	S
3	Question :	9
8	KEY1515	FF9
9	Question :	9
10	Key :	C
11	A	6
12	B	4
13	C	132
14	D	0
15	E	6
16	#responses :	148
17	Total %correct :	89.2%
18	Upper %correct:	100.0%
19	Lower %correct :	76.0%
20	T-stat :	3.62

▪ 4.·(3·points)¶
▪ FF9··Define·market·capitalization¶
▪ A·company's·market·capitalization·equals:¶
▪ {ANSWER:·E·:··xlADDRESS:·Conceptual!$B$334·}¶
▪ /\a.··market·price·per·share·divided·by·equity·book·value·per·share¶
▪ /\b.··total·stockholders'·equity·divided·by·number·of·shares·outstanding¶
▪ /\c.··equity·book·value·per·share·divided·by·market·price·per·share¶
▪ /\d.··total·assets·divided·by·number·of·shares·outstanding¶
▪ /\e.··number·of·shares·outstanding·times·market·price·per·share¶

	J	N
3	Question :	4
8	KEY1515	FF9
9	Question :	4
10	Key :	E
11	A	6
12	B	15
13	C	7
14	D	1
15	E	101
16	#responses :	130
17	Total %correct :	77.7%
18	Upper %correct:	98.0%
19	Lower %correct :	49.0%
20	T-stat :	5.13

Algorithm 6. The Simplistic Verbal Wizard
Macro-name = SimplisticVerbal

Say that you have a *Word* document **OldExam.doc** that contains many questions. Even though this document is not algorithmic, you want to convert the questions into algorithmic ones. Suppose you'll start with the question below on the yield curve.

- 5.··(3·points)¶
- *FF2··Three·sources·of·value*¶
- What·are·the·three·sources·of·financial·value?¶
- {ANSWER:·C·;··xlADDRESS:·Conceptual!$B$262·}¶
- /\a.··time·value,·investments,·and·financial·planning¶
- /\b.··arbitrage,·hedging,·and·speculating¶
- /\c.··time·value,·transformation·value,·and·arbitrage¶
- /\d.··investments,·corporate·finance,·and·institutions¶
- /\e.··financial·accounting,·risk·&·insurance,·and·real·estate¶

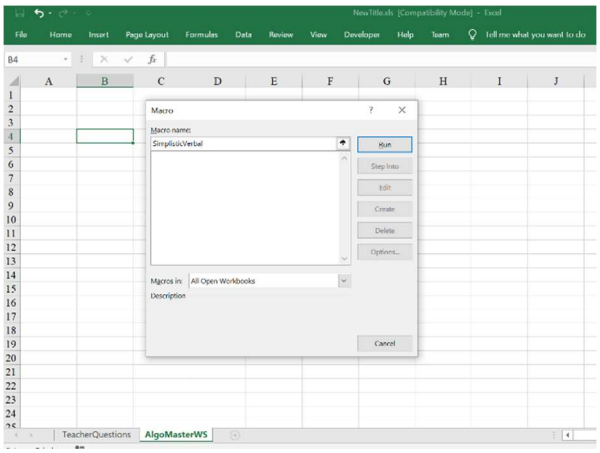
	J	O
8	KEY1616	FF2
9	Question :	5
10	Key :	C
11	A	1
12	B	0
13	C	124
14	D	1
15	E	0
16	#responses :	126
17	Total %correct :	98.4%
18	Upper %correct:	98.0%
19	Lower %correct :	95.0%
20	T-stat :	0.74
21		

- 6.··(3·points)¶
- *FF2··Three·sources·of·value*¶
- What·are·the·three·sources·of·financial·value?¶
- {ANSWER:·D·;··xlADDRESS:·Conceptual!$B$262·}¶
- /\a.··investments,·corporate·finance,·and·institutions¶
- /\b.··time·value,·investments,·and·financial·planning¶
- /\c.··financial·accounting,·risk·&·insurance,·and·real·estate¶
- /\d.··time·value,·transformation·value,·and·arbitrage¶
- /\e.··arbitrage,·hedging,·and·speculating¶

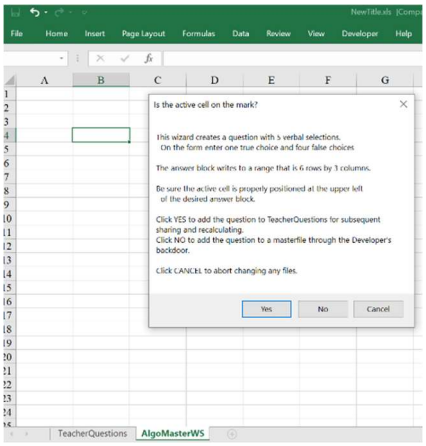
	J	P
8	KEY1616	FF2
9	Question :	6
10	Key :	D
11	A	3
12	B	0
13	C	1
14	D	96
15	E	3
16	#responses :	103
17	Total %correct :	93.2%
18	Upper %correct:	100.0%
19	Lower %correct :	82.0%
20	T-stat :	2.62

Which characteristic best describes the Treasury yield curve?
a. The curve normally begins with a steep upward slope that flattens toward the right.
b. Coordinates of the yield curve are interest rate on horizontal axis and term-to-maturity on vertical axis.
c. The curve normally begins flat and steepens downward toward the right.
d. The curve depicts the spread between corporate bond yields and Treasury bonds.
e. Coordinates of the yield curve are yield-to-maturity on horizontal axis and term-to-maturity on vertical axis.

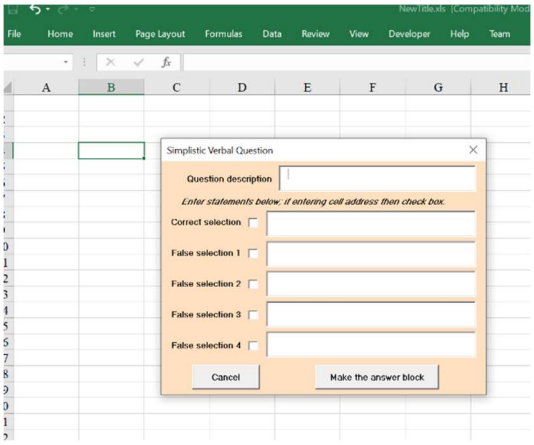
The correct answer for the preceding static question is always the sentence in choice "a". Adding this question to the testbank allows a question in which the five choices randomly rearrange on each version. Always the same sentence choices appear, but the odds are 1/5 that the correct phrase is in position "a", 1/5 that it's in "b", …, and 1/5 that it's in "e" (there are 120 unique permutations of the five sentences). Hit **Alt F8** and type **SimplisticVerbal** into the Macro form.



Click **Run** and see the form below.



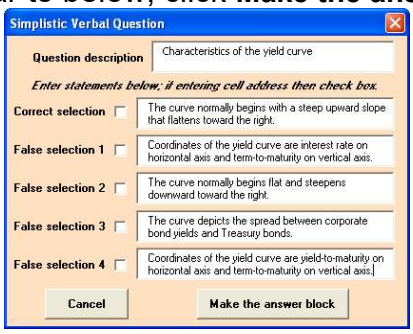
Click **YES** and see the question creator form.



Enter a description for this question into the top text box (see the completed form below). Click on *Word* to restore **OldExam.doc** . Click to highlight the sentence showing the correct answer (don't highlight the letter selection "a"). While the sentence is highlighted, right-click and copy. This copies the selection to the Windows clipboard (equivalent to clicking the *Word* copy icon). Click on *Excel* to restore the Simplistic Verbal form. Click in the textbox **Correct selection**, and right-click **Paste.** Switch to *Word* and copy the first wrong selection (that is, the sentence following "b"). Paste this into the *Excel* form **False selection 1**. Repeat for selections c, d, and e.

ASIDE: Notice that an alternative procedure would have been to paste each selection from the *Word* question into a unique *Excel* cell. For example, paste the correct sentence into worksheet cell B4 while cells B5 to B8 could contain the 4 false sentences. In that case, leave row 9 blank and click cell B10 to make it the active cell at the upper right of the answer block, then run the macro. For this alternative procedure, instead of typing the sentence in the Correct selection textbox, only type B4. Type B5 in the False selection 1 box, etc. Then check all the checkboxes indicating that the form has cell addresses, not sentences.

When the form appears similar to below, click **Make the answer block**.



When the input box prompts for cells with content that belong in the question body click **Cancel** since there none. Click **OK** when the message box confirms that the job finished. Finalize the *Word* and *Excel* documents, then Save and Exit. Eventually launch *Algogen* to add this new question to the catalog files.

Algorithm 7. The True-False Wizard
Macro-name = StandardTrueFalse

The wizard prompts for two statements: one true and one false. The following is a question that might appear in a history testbank.

True-False

4.·(3·points)¶
MB24··T/F··Bond·v.·Stock·market·size¶
The·largest·financial·markets·in·the·U.S.A.·include·the·bond·market·and·the·stock·market.··One·of·these·markets,·however,·is·significantly·larger·than·the·other·market.·Decide·whether·this·statement·is·true·or·false:·On·an·average·day·the·dollar·trading·volume·of·all·stocks·traded·in·the·U.S.A.·is·significantly·less·than·the·dollar·trading·volume·of·all·bonds·in·the·U.S.A.·¶
{ANSWER:·A·;··xlADDRESS:·Conceptual!$B$1760·}¶
/\a.··True·····b.··False¶

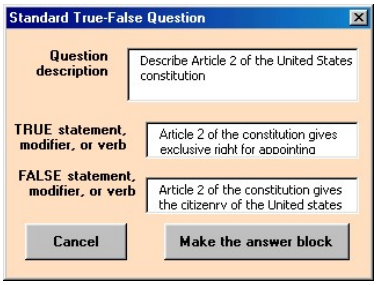
8	*KEY1818*	MB24
9	*Question :*	4
10	*Key :*	A
11	A	89
12	B	21
13	C	1
14	D	0
15	E	0
16	*#responses :*	111
17	*Total %correct :*	79.5%
18	*Upper %correct:*	92.0%
19	*Lower %correct :*	62.0%
20	*T-stat :*	3.07

12.·(3·points)¶
TR34··T/F·Moving·average·trading·strategy¶
A·mainstay·of·technical·analysis·is·comparison·of·moving·averages·with·different·lengths.··Is·the·following·statement·of·the·moving·average·trading·strategy·*True*·or·*False*:··A·sell·signal·results·when·the·short-run·moving·average·becomes·bigger·than·the·long-run·moving·average.·¶
{ANSWER:·B·;··xlADDRESS:·Conceptual!$B$1544·}¶
/\a.··True·····b.··False¶

KEY1818	TR34
Question :	12
Key :	B
A	38
B	72
C	2
D	0
E	0
#responses :	112
Total %correct :	64.3%
Upper %correct:	92.0%
Lower %correct :	24.0%
T-stat :	5.93

Run the question creator wizard from *Excel*. Click on the cell that is to become the upper left corner of the answer block. To launch the wizard, run the macro **StandardTrueFalse**. The wizard presents an introductory message box. Click "YES" after reading the message box. BTW, click **NO** when launching a new collection or when growing one of the other algorithmic documents already in the collection.

Enter an adequate question description, and the true and false statements shown above. The form appear as below:



After the wizard is finished, open **elementsOfFinanceTQ.doc**, click on Tools, Options, View, checkmark the boxes for Bookmarks and All, and click Ok. Inspect the question. Do the following.

1. Eliminate the phrase "Insert question here."
2. Highlight the entire question from just before the question code to just after "b. False." Hit **F9** to update the fields. Verify question integrity.
3. Save and close ElementsOfFinance**TQ.doc** and the *Excel* workbook.

Add the question to the *Algogen* list by starting *Algogen*, and selecting **Maintenance, Update Catalog**.

Algorithm 8. The Three Choices Wizard
Macro-name = ThreeChoice

This wizard creates a question with 3 selections. On the form enter one true choice and two false choices. Later, if you wish, enter a D and/or E choice with contents satisfying your objective. The answer block writes to a range that is 4 rows by 3 columns.

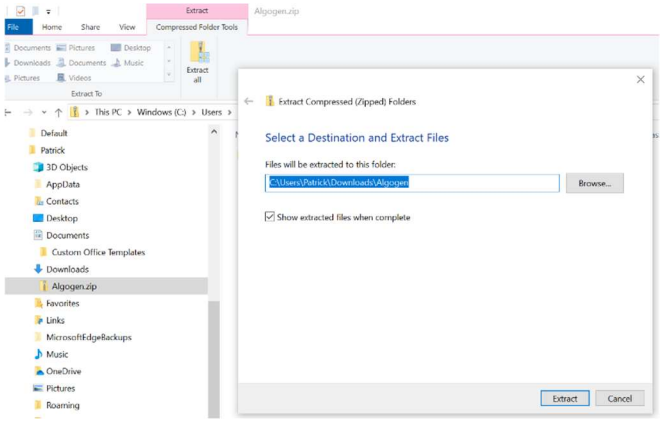
Algogen Installation Instructions

v2021.0321

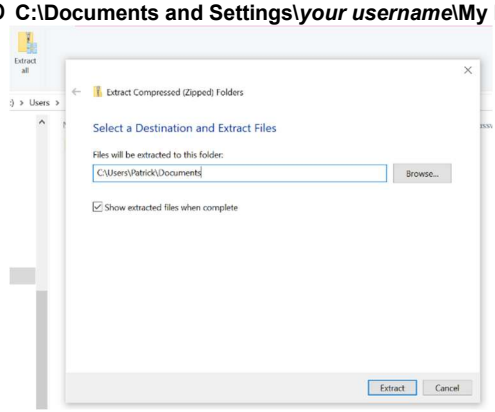
Click http://elementsOfFinance.net/Algogen.zip to download software for making algorithmic documents.
Save to the Downloads folder. Follow Installation Instructions below.
For the pdf format of this help document with screenshots see:
http://elementsOfFinance.net/support/AlgorithmicDocumentGenerator.pdf

1. The software download from http://elementsOfFinance.net/Algogen.zip usually Opens in File Manager to show an **Extract all** button beneath the pink Extract bar. Select the **Download** folder. Click to **Extract all** files and see a view similar to the screenshot inserted below. If your browser isn't displaying the screenshots see them at http://elementsoffinance.net/support/AlgogenInstallationInstructions.pdf, a pdf file with identical text. Sometimes scrolling through instructions without screenshots is quicker. Screenshots

show detail when needed. The **Extract all** procedure sometimes queries to Select a Destination like shown below.

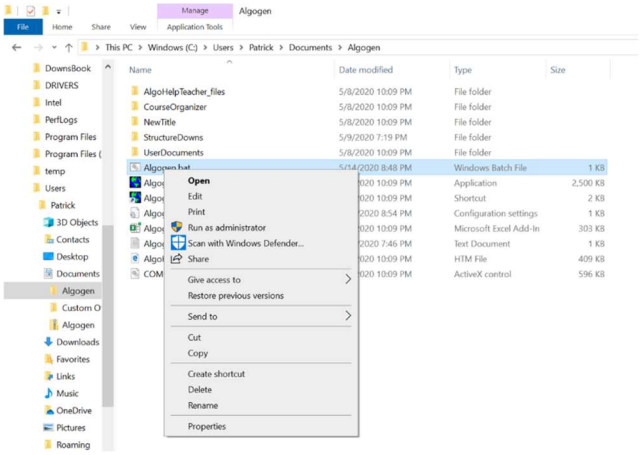


For *Windows* 7 & 10 **Browse** or overtype the blue path so as to extract to your Documents folder: **C:\Users*your username*\Documents** . See screenshot below.
For *Windows XP* extract to **C:\Documents and Settings*your username*\My Documents**



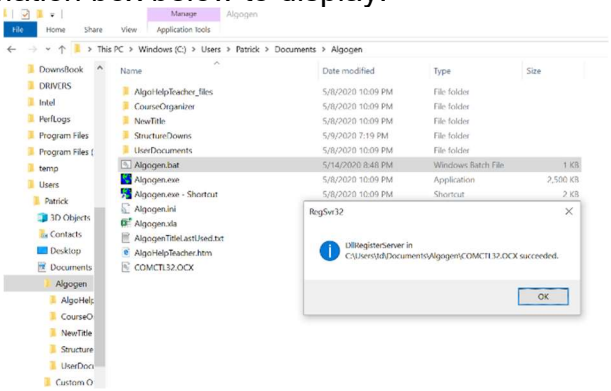
Click **Extract** at the bottom of the form shown above. All contents in **Algogen.zip** will be extracted to the **Documents\Algogen** folder for *your username*. The username in the above screenshot is **Patrick**. Successful execution of the procedure is verifiable by confirming the path for file **Algogen.exe** is as shown below.
C:\Users*your username*\Documents\Algogen\Algogen.exe

2. This step runs instructions in the file **C:\Users*your username*\Documents\Algogen\Algogen.bat** that (a) puts *your username* in a few files that *Algogen* uses, and (b) registers a required Microsoft file (Comtctl32.ocx) in your computer registry. Right-click on **Algogen.bat**; to find it in **File Explorer** expand the **Windows C:** by clicking the **>** symbol at its left. Expand the **Users** folder, expand *your username* folder (e.g., **Patrick**), expand the **Documents** folder, click on the **Algogen** folder, then in the middle panel right-click on **Algogen.bat,** a Windows batch file. The view should be similar to below.



Click **Run as Administrator**. If you cannot run this choice then contact a user with Administrative privilege on this computer.

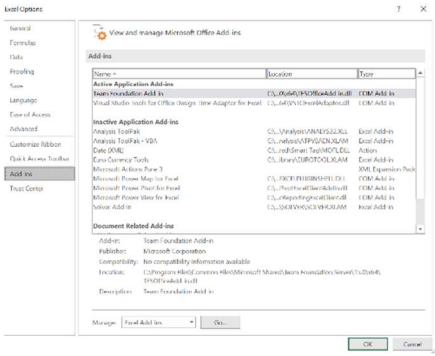
One instruction in **Algogen.bat** file registers the file from *Microsoft*:
C:\Users*your username*\Documents\Algogen\COMCTL32.OCX
that causes the confirmation box below to display.



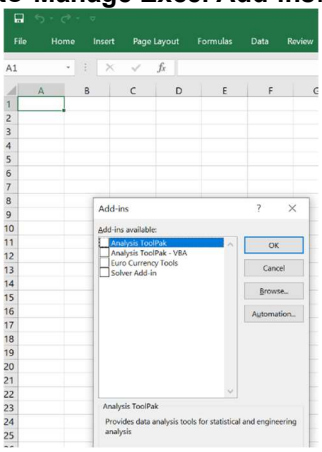
Click **OK** to the form above.

For your information, the **Algogen.bat** file automatically executes instructions to replace the ***wrongname*** string in the three files below with *your* actual Windows *username*. Successful execution of the procedure is verifiable. Double-click, if needed, to open each file in Notepad showing that ***wrongname*** was replaced with *your username.* If needed, open the file in Notepad and overtype ***wrongname*** with *your username*.
C:\Users*your username*\Documents\Algogen\Algogen.ini
C:\Users*your username*\Documents\Algogen\AlgogenTitleLastUsed.txt
C:\Users*your username*\Documents\Algogen\UserDocuments\CourseOrganizer01.ini

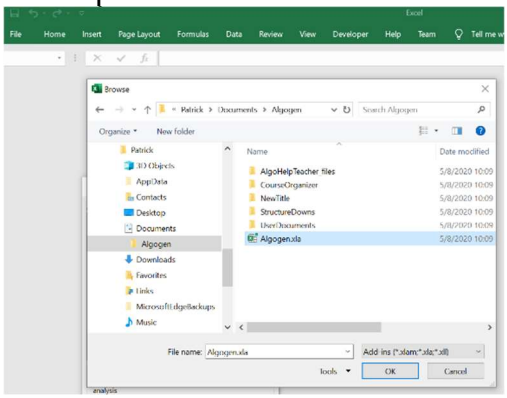
3. This step activates two required *Excel* add-ins. One is from *Microsoft,* the other is from elementsOfFinance.net . Launch *Excel*. Along the left vertical frame are choices like **Home**, **New**, **Open**, etc. Click the bottom choice, **More Options**. Next click **Add-ins** which, as the screenshot below shows, is second from bottom. After clicking **Add-ins** the window looks similar to below.



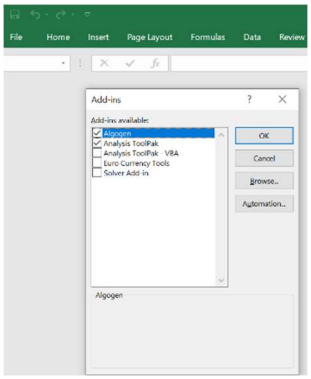
In the above screenshot notice that the middle panel lists the Inactive Application **Analysis ToolPak**. The user in the screenshot above surely has **Analysis ToolPak**. Your objective is to activate the **Analysis ToolPak** and also the **Algogen.xla** add-in. Click **Go** at the bottom of the above window to **Manage Excel Add-ins**. See a view similar to:



Click **Browse**. Expand the **Windows C:** by clicking **>**. Next expand the **Users** folder, expand your username folder (e.g., **Patrick**), expand the **Documents** folder, click on the **Algogen** folder, then in the middle panel click on the **Algogen.xla** file. A **File Manager** window similar to below should open.



Click **OK** at the bottom of the above form to see the form below.



Check the box for both the **Algogen** add-in and **Analysis ToolPak**. Click **OK** above.

If the **Analysis ToolPak** is not listed on the Manage *Excel* add-ins form then search on Google for **Analysis ToolPak**. This add-in is distributed by Microsoft with *Excel.* The **Analysis ToolPak** is NOT a third-party product purchased separately. It comes with many but not all *Excel* versions. *Algogen* requires **Analysis ToolPak**. The installation is complete. The next step could be either (a) Follow the instructions for the Standard Numerical Algorithm that illustrates making a new algorithmic document and how it works; or (b) Follow the instructions that enable the *elementsOfFinance* algorithmic content collection that contains about 600 question scenario setups.

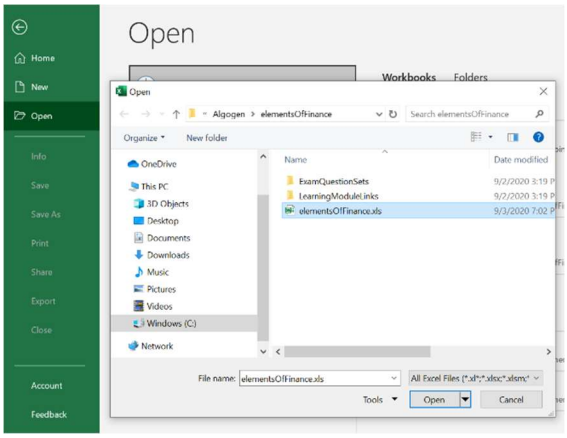
If recalculated versions display the **#NAME** error code rather than the value of redrawn random variables then the **Algogen.xla** add-in isn't properly activated. Check the *Excel* Trust Center setting for Trusted Folders or Trusted Directories, especially if you are running Windows 7 with *Excel 2010.* Click **File > Trust Center** and click to **Add** this location to the list of Trusted Folders:
C:\Users*your username*\Documents\Algogen
If you like, run its files through a virus checker and if anomalous please notify **prof-td@elementsOfFinance.net** with details. The **Algogen.xla** add-in lets *Excel* run the 8 algorithmic wizard macros in **Algogen.xla** that package content into algorithmic question scenario setups. With the folder permission granted and the add-ins activated the **#NAME** error should disappear.

Using the algorithmic content collection for the elementsOfFinance

v2021.0322

These 3 steps enable use of the algorithmic documents drawn from the *Elements of Finance* book (see http://elementsoffinance.net/elements.pdf). The same steps would allow sharing an algorithmic document collection for any subject, probably in any language too, since *Microsoft Word* and *Excel* handle diverse content including multimedia.

1. In *Excel* click the **Open** choice along the left vertical frame. **Browse** through the folder path to open the ***elementsOfFinance*.xls** workbook:
C:\Users*your username*\Documents\Algogen\elementsOfFinance\elementsOfFinance.xls

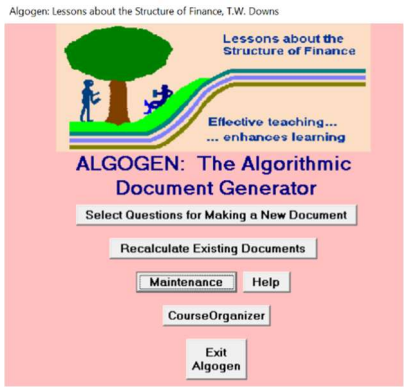


Click **Open** at the bottom of the above form. The file possibly opens in "Protected View". If so, click the **Enable Editing** button that is toward the right in the yellow bar. Next, there may be a security warning. If so, click the **Enable Content** button that is toward the right in the yellow bar. Then there is a notification that links can't be updated. That's expected since the links don't' yet contain ***your username*** for MS *Word*, *Excel*, and *Windows*. Click **Continue**. The tab at the bottom shows the name of the active worksheet is **TeacherQuestions**. Click cell **B21** once to make it the active cell. The address bar at the top beside f_x and beneath the **Formulas** and **Data** menu items likely points to a path through ***wrongname*** that doesn't exist on your computer.

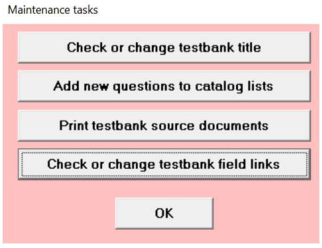
If the *Excel* display in the address bar for cell **B21** shows the path **C:\Users*wrongname*\Documents…** then that path is wrong. To put *<u>your</u> username* instead of ***wrongname*** press the **Ctrl h** to open the **Replace** form. In the **Find what** box type a substring that includes the ***wrongname*** displayed, e.g for Windows 10 (or 7) type **\Users*wrongname*** . In the **Replace with** box type **\Users*your username*** (use *your* actual Windows 10 (or 7) *username*; for Windows XP type **\Documents and Settings*your username***). Next click the **Options** button toward the lower right of the form. For the **Within** box select **Workbook** (instead of Sheets). For the **Look in** box select **Formulas**.

Click **Replace All** toward the lower left of the form. After all replacements were made *Excel* confirms with a message box "All done. We made 5,103 replacements." Click **OK** to the confirmation and then **Save** the file.

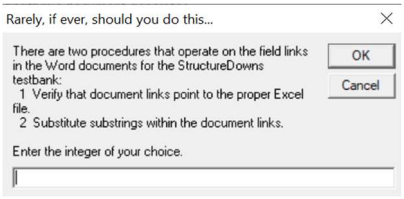
2. This step puts <u>your</u> username in the *Word* documents that got extracted from **Algogen.zip**. Right click on the Windows **Start** button, select **Run**, then browse to **C:\Users*your username*\Documents\Algogen.exe**
and hit **Enter**. The main *Algogen* form shown below pops up.



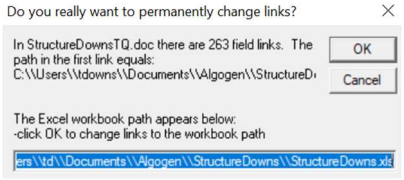
Click the **Maintenance** button on the form above and see the form below:



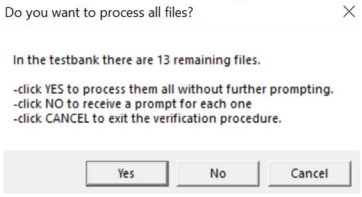
Click **Check or change testbank field links** and see:



On the form above type in the number **1** and click **OK**. The form below pops-up.

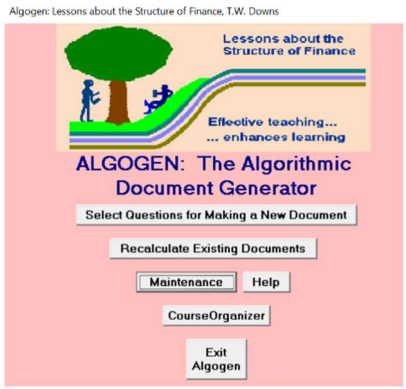


Click **OK** to replace the link already in the document with <u>your</u> actual username. Your actual username should appear in blue. Clicking **OK** shows the form below.

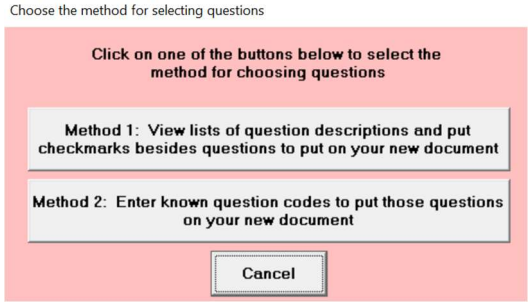


Click **Yes** to process all 13 of the remaining question files, click **OK**. And **Exit**.

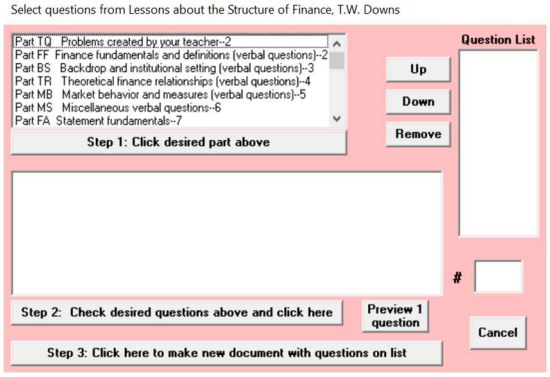
3. This last step verifies that *Algogen* functions properly, nothing else new . Right click on the Windows **Start** button, select **Run**, then browse to
C:\Users*your username*\Documents\Algogen.exe
The entry menu displays:



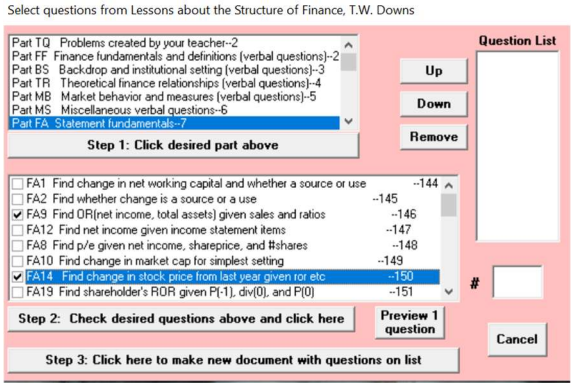
Click the top button, **Select Questions**, and the form below displays.



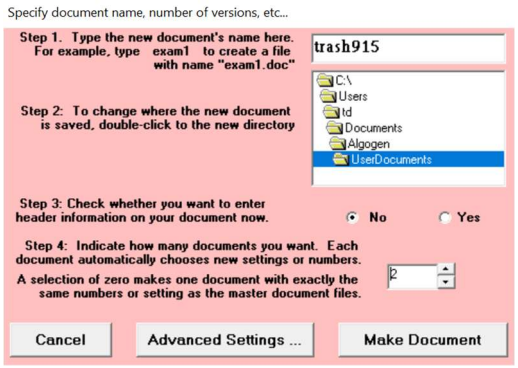
Click **Method 1** and the form below populates with content from the collection.



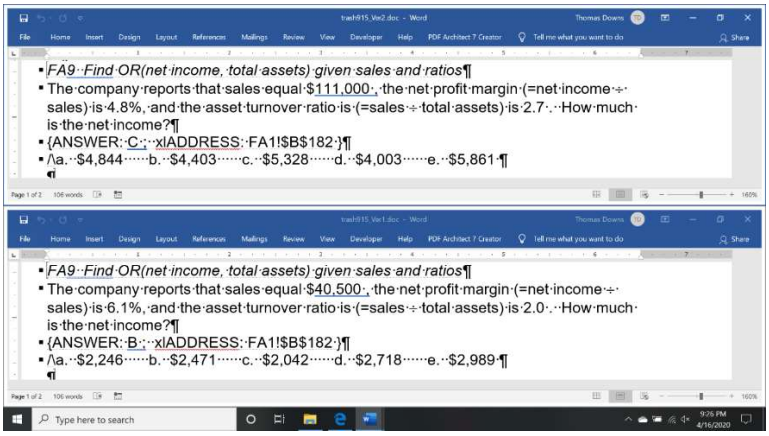
Click **Part FA Statement fundamentals**. The empty white box above Step 2 populates with bunches of question codes and brief descriptions. Check the box for 2 of them, say **FA9** and **FA14**:



Click **Step 2** and see the codes copy onto the **Question List** toward the right. Next click **Step 3.** The form below pops-up.



For the **Step 1** box, type in a filename for the output. A handy name for files that you won't mind deleting is **trashxxx** where **xxx** is the time your computer shows at the bottom right, like **trash915**. Increment the **Step 4** indicator to **2** (steps 2 and 3 are fine as is). Click **Make Document**. The procedure should halt normally and return to the main menu. **Exit** *Algogen*. Proceed to open the 2 files that were made in the **...\Documents\Algogen\UserDocuments** folder, **trash915_Ver1.doc** and **trash915_Ver2.doc**. Inspect the two documents to make sure, like the two shown below, that they look unique and error free!



The uppermost line with the question identification code and description plus the line after the question body showing the answer are formatted as hidden text. Formatting text as hidden is analogous to formatting as, say, bold. The display of hidden text on the screen is toggled by the shortcut keys CTRL * (or the ¶ symbol on the **Home** menu or **File** > **More Options** > **View** > **Hidden** setting). The *Word* **Print** Options determine whether the hidden text prints. In the two versions above all numbers differ. The description indicates, too, that one view might ask how much is net income whereas the next view might ask how much is total assets. A student could be viewing different versions in order to practice and learn. Alternatively, maybe the viewing occurs on an assessment in which case adjacent students have different views of the same scenario setup. They are being tested on the same learning outcome, however. Furthermore, the advantage of perusing neighboring papers has been reduced significantly.

The algorithmic documents from the 12 chapter *Elements of Finance* collection includes 14 Microsoft *Word* files with about 600 unique questions created by one of 8 algorithms. The relation between each source document and relevant location in the book is close but not identical. Most non-numerical question scenario setups all are in one document regardless of the chapter, class discussion, or event that motivated creating the question scenario setup. The 14 source files map into chapters of *Elements* as follows:

1. ElementsOfFinanceTQ.doc = About 2 dozen questions from throughout the book; this is the file that receives any new problems added to *Algogen* through the front door procedure. *Part codes*: TQ.
2. Backdrop.doc = About 120 verbal questions pertinent to topics throughout the textbook. These are non-computational strictly verbal problems. *Part codes*: BS, FF, TR, MB, and MS
3. FinAct.doc = Financial accounting, chapter 2. *Part codes*: FA and BE
4. Growth.doc = Accounting for growth, chapter 3. *Part codes*: BA, GR, and EFN
5. CashFlows.doc = More accounting problems, chapters 2 & 3. *Part codes*: CF
6. PVFV.doc = Lump-sum time value problems, chapter 4. *Part codes*: ROR, LS, CY, and MC
7. Annuities.doc = Chapter 5. *Part codes*: FV, PV, AM, and TS
8. CapB.doc = Capital budgeting, chapter 6. *Part codes*: CB
9. BondV.doc = Bond valuation, chapter 7. *Part codes*: BD
10. StockVal.doc = Stock valuation, chapter 8. *Part codes*: TK, ST, and SV
11. Port.doc = Portfolio and asset pricing problems, chapters 10 & 11. *Part codes*: ER, MR, AP, AR, and CC
12. RiskMgt1.doc = Mostly futures problems, chapter 12. *Part codes*: FT
13. RiskMgt2.doc = Mostly option problems, chapter 12. *Part codes*: DS
14. InterN.doc = Triangle arbitrage, currency, and parity problems, chapter 12. *Part codes*: CR and PR

Algogen uses the file below to maintain or update the above information.

C:\Users*your username*\Documents\Algogen\elementsOfFinance\elementsOfFinance.ini

Intrinsic random variables

The *Algogen* system has four sets of intrinsic random variables that often are useful when constructing the question setup in the *Excel* worksheet. These named variables can be used in a standard formula. They are described below.

sign1 – This intrinsic random variable has an even probability (50%) of equaling either +1 or -1. This may be useful for making a secondary variable that deviates either above or below a primary variable. Consider this illustration. Suppose the primary variable for a question is an interest rate that is set in cell **B10**, as "**= randbetween(350,950)/10000**". The **randbetween(a,b)** function resides in the Analysis ToolPak and returns an integer from the range **a** to **b** (inclusive, **a** < **b**) with a uniform probability. Thus, the function above returns one integer from 350 to 950 (601 possible values). The formula then divides the integer by 10,000. The result is a primary interest rate in this question that could equal 3.50%, 3.51%, …, 5.21%, 5.22%,…, 9.49%, or 9.50%. Suppose the question learning objective involves a secondary interest rate set in cell **B11** with the formula "**= B10 + sign1*2%**". The secondary rate is set to equal the primary rate plus 2% (@50% chance) or minus 2% (@50% chance). That is, if the primary rate is 7.37% then the secondary rate

has 50% chance of equaling 5.37% and a 50% chance of equaling 9.37%. The independent random variables ***sign2, …, sign5*** are analogous to ***sign1.*** Each is either +1 or -1 with a 50-50 chance. For example, if cell **B12** sets a primary variable as **"=randbetween(25,75)*10"** then the range for the variable is from 250, 260, 270, …, 740, 750. If a secondary variable is set in **B13** as **"=B12 + sign2*25**" then this variable always is either 25 less or 25 more than the primary variable. Sometimes **sign1** and **sign2** might both be positive, but not always, it depends on the luck of the draw! For a given recalculation of the workbook, however, **sign1** has the same value in all question setups that use the variable. This introduces a dependence between those questions that could be problematic. The cell that sets **sign1**, say **B8**, contains the formula "**=IF(randbetween(0,1)=0,1,-1)**". When **randbetween** returns zero then cell **B8**, which is named **sign1**, is set equal to 1. When **randbetween** returns 1 then **sign1** is set equal to -1. Eliminate the dependence between different questions using **sign1** by putting into each question scenario a formula like shown for **B8**. All secondary variables would reference this question specific formula instead of referencing the common variable **sign1**.

flag1 – This intrinsic random variable has an even probability (50%) of equaling either 0 or +1. This may be useful when setting a random variable that chooses one of two choices. For example, suppose that a question asks either "How much is the price-to-book ratio?" or "How much is the price-to-earnings ratio?" Different views of this question display one statement or the other with a 50-50 probability. The *Excel* cell that asks the question, say **B15**, contains the formula "**=If(flag1=0, "price-to-book", "price-to-earnings")**". The cell displays price-to-book when **flag1** equals 0. Otherwise, it displays price-to-earnings. The *Word* document with the question scenario setup has the sentence "How much is the **{link displaying contents of cell B15}** ratio?" The question creator wizard automates in *Word* the insertion of field links to *Excel*. The independent random variables **flag*2, …,* flag*5*** are analogous to **flag*1.*** There is a dependence between all the different question scenario setups that reference the same common intrinsic variable that might be problematic (because students sometimes might get clues about one question by something that happens in a different question).

mask10 – This intrinsic random variable has an even probability (50%) of equaling either 1.10 or 0.9091 (i.e., 1/1.10). This may be useful when setting a secondary variable to either 10% greater or 10% less than a primary variable. For example, suppose that a question sets a price in cell **B16** as "**=randbetween(5,20)*5**". That is, the price might equal $25, $30, $35,…, $95, $100. A secondary variable might be the price of a different asset that is set in cell **B17** as "**=B16*mask10**". Thus, **B17** is either 10% greater than **B16** or 10% smaller. Analogous independent random variables are set at 20% (i.e., **mask20 =IF(randbetween(0,1)=0,1.2,1/1.2)** , 30%, 40%, … , 90%, 100%, and 200% (i.e., **mask200 =IF(randbetween(0,1)=0,3,1/3).**

vmask10 – This intrinsic random variable works like **mask10** described above but variability around 10% exists. That is, **vmask10** ranges from 8% to 13% greater or smaller than unity. The cell that sets the named variable **vmask10** contains "**=(1+randbetween(8,13)/100)^(IF(randbetween(0,1)=0,1,-1))**" Likewise analogous independent random variables are set at 20% (i.e., **vmask20**

=(1+randbetween(18,25)/100)^(IF(randbetween(0,1)=0,1,-1))), 30%(i.e., **vmask30**
=(1+randbetween(26,35)/100)^(IF(randbetween(0,1)=0,1,-1))), etc.

Developing QuestionSets for Blackboard

Find this document in http://elementsOfFinance.net/AlgorithmicDocumentGenerator.pdf

Install Algogen on your computer: As long as you already have *Microsoft Office* with *Word* and an *Excel* version that has the "Analysis ToolPak" add-in, then this installation has all additional files that *Algogen* needs. To install *Algogen*, including the testbank for title *Elements of Finance*, download from
http://elementsoffinance.net/Algogen.zip
Then carefully follow the installation instructions found near the top of this help document.

PART 1: Create a Self-Test for an existing question
Suppose that you want to create a Self-Test with 100 alternates of one question that students can practice over and over in Blackboard. You examine the textbook and decide to make a self-test for question code **FF31**.

STEP 1 Launch *Algogen.* Select and add question **FF31** to the list > click **Make the document** > type a filename for an intermediate document, e.g. **trash** > click **Advanced Settings** and select **Make a questionset.rtf** = **Yes** > **Save settings** > enter **100** in order to make 100 alternates, don't print > let the job finish > **Quit** *Algogen*.

STEP 2 Inspect **FF31_100.rtf** in *Word* for question integrity. Make sure that no questions would need to be thrown out of a quiz.

STEP 3 Launch *Respondus*., a third party software often licensed to clients using Blackboard. Click **Import** > type = ***.rtf** > **Browse** > select **FF31_100.rtf** > Create a new document with name = **FF31** > **Preview** > **Finish**.

STEP 4 Click the **Publish** tab > **Publish** > set **Self-Test** = **True**, Name = **FF31**, select the course > **Publish**.

STEP 5 In Blackboard > **Build** > **Assessments** > integrate the self-test into your course.

PART 2: Create an online quiz or exam with existing testbank questions
Suppose that you want to create a 4 question quiz that students can take in Blackboard. You examine the textbook and decide to tell the students that their quiz includes these 4 questions from the book *Elements of Finance*: **FF31**, **TR34**, **BS26**, and **BS36**.

STEP 1 Follow steps 1 and 2 from the preceding Part to make the four files **FF31_100.rtf**, **TR34_100.rtf**, **BS26_100.rtf**, and **BS36_100.rtf**.

STEP 2 Launch *Respondus*. Click **Import** > type = ***.rtf** > **Browse** > select **FF31_100.rtf** > Create a new document with name = **Quiz 1** > **Preview** > **Finish** > click the **Start** tab > **Import** > type = ***.rtf** > **Browse** > select **TR34_100.rtf** > **Append** to **Quiz 1** > **Preview** > **Finish** > continue to **Import** and **Append** questions **BS26** and **BS36**.

STEP 3 Click the **Settings** tab > **Question sets** > now set **First row** = **1**, **Last row** = **100**, Randomly select **1** from the question set for the quiz, **Points** = **25** > **Add.** Repeat for **TR34** in rows **101** to **200**, **BS26** in rows **201** to **300**, and **BS36** in rows **301** to **400**. Each view of the quiz randomly pulls 4 out of 400 questions. Students sitting side by side gain no advantage viewing neighboring computers. Similarly, allowing multiple attempt quizzes is feasible since the next view of the quiz will be unique from the previous view.

STEP 4 **Publish** the quiz to Blackboard. See steps 4 and 5 Part 1 above.

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Find this document in http://elementsOfFinance.net/AlgorithmicDocumentGenerator.pdf

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5. EXPORT. SOFTWARE is subject to regulation by local laws and United States government agencies, which prohibit export or diversion of certain products and information to certain countries and certain persons. You agree that you will not export any SOFTWARE or direct product of SOFTWARE in any manner without first obtaining all necessary approval from appropriate local and United States government agencies.

6. LIMITED WARRANTY.

6.1 The COMPANY warrants that during the license period the SOFTWARE, when properly installed on a computer satisfying the minimum system requirements listed below, substantially conforms to this functional specification: the SOFTWARE generates numerically distinct document files of questions contained in the testbank that is installed by the SOFTWARE. Minimum system requirements for running the SOFTWARE include: (1) Microsoft Windows98© operating system or later; (2) Microsoft Office97© or later (requires installation of Microsoft Word© and Microsoft Excel© with the Analysis ToolPak add-in); The COMPANY does not warrant that SOFTWARE will meet your requirements or that operation of SOFTWARE will be uninterrupted or error free.

6.2 To exercise the right of warranty you agree to perform the following: (1) Notify the COMPANY in writing or the DISTRIBUTOR by email of any nonconformity within the license period; (2) Provide evidence satisfactory to the COMPANY that you are the purchaser of the SOFTWARE from the DISTRIBUTOR; (3) Provide evidence satisfactory to the COMPANY that you are the one specific person that uses the single computer that downloaded this SOFTWARE from the DISTRIBUTOR; (4) Provide evidence satisfactory to the COMPANY that the computer meets minimum system requirements; (5) Provide evidence satisfactory to the COMPANY that the software does not conform to the functional specification; (6) Provide effort satisfactory to the COMPANY, including but not limited to installation of diagnostic programs and upgrades, and other efforts in association with the COMPANY technical support personnel, that attempt to correct the nonconformity. This warranty shall not be valid if SOFTWARE has been subject to misuse, unauthorized modification or installation. The entire liability of the COMPANY and DISTRIBUTOR, and your exclusive remedy shall be, at the COMPANY'S option, either (a) refund of the price paid or (b) modification or replacement of SOFTWARE that does not meet this limited warranty, provided you have otherwise complied with this agreement.

6.3 The warranties set forth in this section 6 are exclusive. Neither the COMPANY nor its DISTRIBUTOR make any other warranties, express, implied, or statutory, with respect to SOFTWARE or other material provided under this agreement. The COMPANY and its DISTRIBUTOR specifically disclaim all implied warranties of merchantability and fitness for a particular purpose and non-infringement of intellectual property.

7. LIMITATION OF LIABILITY. To the maximum extent permitted by applicable law, in no event shall the COMPANY or its DISTRIBUTOR be liable for any special, incidental, indirect, or consequential damages whatsoever (including, without limitation, damages or any other pecuniary loss) arising out of the use of or inability to use the SOFTWARE or the failure to provide support services, even if the COMPANY has been advised of the possibility of such damages. In any case, the entire liability of the COMPANY and DISTRIBUTOR under any provision of this EULA shall be limited to the amount actually paid by you to the DISTRIBUTOR for the SOFTWARE license. Because some states/jurisdictions do not allow the exclusion or limitation of liability, the above limitation may not apply to you.

8. INDEMNIFICATION. You agree to indemnify and hold harmless the COMPANY and DISTRIBUTOR from any claims, loss, cost, damage, expense, or liability, including attorneys' fees, arising out of or in connection with your use of software.

9. CONTROLLING LAW AND JURISDICTION. This agreement shall be governed by and construed under the laws of the state of Alabama, USA. All disputes arising out of or in relation to this Agreement shall be submitted to courts with jurisdiction within the city of Tuscaloosa in the state of Alabama. This section shall not restrict the rights of the COMPANY to bring an action against you in the jurisdiction where you live, operate or use the software.

10. SEVERABILITY. If any provision of this Agreement is held by a court of competent jurisdiction to be void, invalid, unenforceable or illegal, such provision shall be severed from this Agreement and the remaining provisions will remain in full force and effect.