Best Practices in Financial Education: Incorporating Mathematics

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There is a pressing need for improved financial knowledge across the US population. Research has shown that financial education programs can be an effective solution to this problem. A crucial project is to increase our knowledge of best practices in financial education, in order to maximize the benefits participants in future courses receive. One important dimension of this project is understanding the role of mathematics in a high-quality personal finance course. We present results from a study in which a sample of high-school students were assessed on both financial and mathematical knowledge, before and after taking a course that combined mathematics and personal finance. We find compelling evidence that mathematical learning is connected with improved financial knowledge.

Keywords: financial literacy, financial wellbeing, financial education, mathematics education

Introduction

There is a pressing need for improved financial knowledge across the US population. Research has shown that financial education programs can be an effective solution to this problem. However, there is wide variability in the success of different education interventions, and the reasons for this heterogeneity are not yet fully understood. A crucial project is to increase our knowledge of best practices in financial education, in order to maximize the benefits participants in future courses receive.

One important dimension of this goal is understanding the role of *mathematics* in a high-quality personal finance course, given the well-documented correlation between mathematical knowledge and financial literacy. We present results from a study that investigates the relationship between financial learning and mathematical learning. A sample of high-school students were assessed on both financial and mathematical knowledge, before and after taking a course that combined mathematics and personal finance.

Our goal is to investigate whether there is a connection between mathematical *learning* and financial *learning*. Previous research has primarily looked at the connection between a student's mathematical knowledge or education level and their financial knowledge at a single point in time. This leaves a lot unknown about how and why the two values are connected. To shed further light on the matter, our study measures how a student's mathematical knowledge and financial knowledge *changes* over the course of a year, and allows us to see how the changes are related. Analysis of the results confirms that there is a correlation between the two. This suggests that a course combining finance and mathematics is an effective approach to financial education.

We will begin by discussing the research that demonstrates the need for investigating best practices in financial education, and that incorporating financial education into mathematics coursework is promising approach. Next, we will describe the study and model we used to investigate this topic, followed by the results of the study. Finally, we will discuss implications for financial education and for future research.

1. Literature Review

The level of financial knowledge in the US is much lower than it should be, given the complex financial choices people must navigate in modern Western society. A vast body of research demonstrates the breadth and depth of this issue. The successive 'Financial Capability Surveys' (FINRA 2009, 2013, 2015) show that a large percentage of Americans are unable to answer a number of questions on central financial concepts, and display a lack of knowledge in "fundamental economic principles" (Lusardi 2011). A number of similar studies show this

problem is found in countries around the world (Klapper, Lusardi, & Van Oudheusden, 2015; Yakoboski, Lusardi & Hassler 2014).

Of particular concern is the lack of financial knowledge in young people in the United States, given that the country is trending towards placing more individual responsibility on financial planning (Lusardi & Mitchell 2014), and technological developments promise ever more complex financial instruments will be available in the future. It has been demonstrated that most high-school and undergraduate students fail basic financial literacy tests (Hastings, Madrian & Skimmyhorn 2012; Lusardi, Mitchell & Curto 2010; Mandell 2008; Markow & Bagnaschi 2005; Shim, Barber, Card, Xiao & Serido, 2010).

Making this even more concerning is the fact that many people are making poor financial decisions and experiencing negative financial outcomes. A recent government report found that 40% of Americans don't have $400 to cover emergency expenses (Federal Reserve 2018). Further, one third of Americans in their 50's have failed to develop a retirement plan, leaving them with a precarious financial future (Lusardi, 2011). Many households fail to diversify their investment portfolios or fail to refinance their mortgages at opportune moments, creating completely avoidable financial risk and interest expenses respectively (Campbell 2006). More generally, Ambuehl, Bernheim, & Lusardi (2014) show how many people's financial decision-making is deeply flawed. In addition, young people are again particularly at risk of adverse outcomes, being 'heavily reliant on debt" (Brown, Van der Klaauw, Wen, & Zafar, 2016).

Research indicates that the lack of financial knowledge and poor financial outcomes are connected. Higher financial literacy is connected with higher levels of wealth accumulation (Behrman, Mitchell, Soo, & Bravo 2012), with better investment portfolio diversification (Abreu & Mendes, 2010), with better 401(k) performance (Clark, Lusardi, & Mitchell 2014), and with avoidance of costly borrowing behavior (Lusardi & Tufano 2015).

As a response to this problem, there has been a growth in financial education programs across the county: from state-mandated high school courses, to on-the-job training sessions (CEE, 2016). An essential research project is to assess the effectiveness of such courses. There have been a vast number of individual course studies, such that enumerating them all would be neither practical nor informative. Instead is best to look for a systematic overview.

The earliest attempt at this was an influential meta-study by Fernandes, Lynch, and Netemeyer (2013), which found that financial education interventions were largely ineffective at improving financial behavior, with a statistically significant but minuscule effect. Results like these have led many to question the value of financial education. Willis (2011) argues that we

should abandon the project of trying to provide such education altogether, an idea that has recently penetrated the public discourse (Ogden, 2019).

However, more recent research offers more nuanced findings. While taking just any financial education course is not guaranteed to improve financial knowledge, the right kind of course can be effective. A pair of comprehensive meta-studies by Kaiser and Menkhoff (2017, 2018a) incorporated the results from a range of studies not examined by Fernades et al. (2013), including many completed after the earlier paper was written. They found that, on the whole, financial education courses did have a significant impact on financial literacy. However, they also found a high level of heterogeneity in the results: some education interventions were much more effective than others. Similar results were found in another post-Fernandes meta-study (Miller, Reichelstein, Salas & Zia 2014).

As Kaiser and Menkhoff (2017) note, though, the variance in effectiveness is far from fully understood "indicating that those offering financial education measures can still learn from best practice experiences, a development that is ongoing". Lusardi et al. (2017) find that incorporating visual learning tools improves the effectiveness of financial literacy programs, while Kaiser and Menkhoff (2018b) present a study suggesting that a financial literacy course with active learning is more effective than one with a traditional lecture format. Given the significant consequences of poor financial knowledge, further understanding best practices in financial education is invaluable work. It is to this ongoing project that we aim to contribute.

1.1 Mathematics and Finance

One promising area to explore is the relationship between financial knowledge and mathematical knowledge. Lusardi (2012) has noted that numeracy is a prerequisite for financial literacy, and she details the troublingly low levels of numeracy in the US – for example, fewer than 50% of U.S. high school graduates in 2016 were considered ready for college-level mathematics work, as measured by ACT mathematics scores (ACT 2016).

Backing up this observation, research shows that additional courses in *mathematics* improve later financial outcomes. Such coursework has been shown to improve creditworthiness, increase the propensity to accumulate assets and decrease adverse financial outcomes, including credit card delinquency and foreclosure (Brown, Van der Klaauw, Wen & Zafar 2016; Cole, Paulson and Shastry 2014). Further, a follow-up study by Cole, Paulson, and Shastry (2016) found that "additional mathematics training leads to greater financial market participation, investment income, and better credit management." In addition, Goodman (2019) shows that additional math coursework significantly increases later earnings, particularly among black students.

More generally, as Hastings et al. (2013) note, there is a well-documented relationship between numeracy and financial outcomes. Individuals with such attributes also tend to have higher levels of financial literacy (Banks and Oldfield, 2007; Gerardi, Goette, & Meier, 2010). In a detailed snapshot, Lenard and Huang (2018) showed that there is a strong correlation between math and finance scores in Wake County high school students. Ross and Wright (2020a+b) show that undergraduate students' grade in an introductory finance course is correlated with their prior mathematical knowledge. On a larger scale, *national* mathematical knowledge level is correlated with national financial literacy level (Ambuehl, Bernheim, & Lusardi 2014).

The connection is demonstrated more directly in a study by Eisenstein & Hoch (2007). They find that when people are asked to estimate compound interest, they employ one of two methods: one group calculates the value with simple interest, then 'adds on a bit extra'; while the other group uses the 'rule of 72'. The latter method is far more accurate than the former. Understanding why the former method is inadequate requires a conceptual understanding of exponential growth. Stango & Zinman (2008) argue that many mistakes related to investment and borrowing decisions are due to 'exponential growth bias' – which suggests that mathematical knowledge can improve the kind of quick estimates that guide many crucial everyday financial decisions. This idea is backed up theoretically by research that shows that greater numeracy leads to better decision making in general (Peters et. al 2006).

2. Motivation

The connection between mathematics education and financial knowledge has been used by some as an argument against financial education – the idea being that people's time would be better spent learning additional mathematics rather than personal finance (Ogden 2019). This is not the conclusion we make. As discussed above, there is compelling evidence that financial education can be highly effective, though results are variable. Our focus is whether mathematics can be used to *improve* financial education. We contend that it can and that an education intervention teaching finance within a mathematics course will be highly effective.

Whether our conjecture is correct depends on the nature of the connection between mathematical knowledge and financial knowledge. There are many plausible reasons higher levels of mathematics knowledge and mathematics education could be correlated with greater financial knowledge and better financial outcomes. For example, taking more mathematics coursework may be correlated with growing up in a higher socio-economic class, reaching a higher level of education, or with earning a higher income as an adult – all things that are themselves linked to higher financial knowledge and better financial outcomes (Lusardi 2011).

Previous studies, as cited in the literature review, have looked at the connection between mathematics and finance at a single point in time, either comparing financial and mathematical knowledge, or financial outcomes and mathematics education, which leaves the nature of the connection open. Our goal is to investigate whether financial *learning* and mathematical learning are connected. If they are, it tells us that the connection between the two isn't simply predetermined by background factors, but that it provides a potential tool for improvement.

3. Data & Model

Our data comes from a group of students taking a course in financial mathematics, who completed an assessment on both math and finance before and after the course. The results of these assessments form our datasets. The students were drawn from five US high schools that volunteered to take part in this study; the students' placement in the course was a mandatary part of their timetable, not an elective. All five schools were title I, four of them were public schools, while one was a charter school; four of the schools were located in New York City, while one was located in the Los Angeles area, outside of the city.

Our measurement instrument was a survey which asked multiple choice questions on topics in both mathematics and finance. The assessment contained 10 math questions, covering topics in algebra and probability, and 17 questions addressing key topics in personal finance. In addition we asked students to self-assess their confidence levels with regard to both mathematical and financial skills on a five point scale.[1]

Students completed this survey before and after taking a course combining mathematics and finance (we refer to these as the 'pre-assessment' and 'post-assessment' respectively). The course covered both the Jump$tart standards in financial literacy and common core standards in algebra, probability and statistics.[2] The responses were anonymous and did not count towards the student's grade. However, students input an ID number that could be used to match their beginning and end responses. Teachers were instructed to give students 20 to 30 minutes to complete the assessment in one sitting, with use of calculators allowed. We obtained 147 sets of pre- and post-assessment results with matching ID numbers – along with a number of responses that failed to enter matching numbers. Our focus will be on these results.[3]

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[1] A complete list of questions is provided in appendix 1.

[2] A list of the standards covered is provided in appendix 2.

[3]Since the group of matched participants consisted of just under 50% of the total participants (147 out of 306), we should compare the matched results to the unmatched results to check if this influenced the sample. The results do not show any significant difference between those subjects whose results could be matched, and those whose could not in either the pre- or post- assessment. This means we have no reason to think there is a selection bias in the resulting from successful entry of ID number.

Our central research question concerns the relationship between *change* in mathematical knowledge and *change* in financial knowledge. To the best of our knowledge, this specific question has not previously been addressed. Therefore, we adapt the model used by Moss and Wright (2020a+b), which predicts financial learning based upon *prior* mathematical knowledge. As the authors note, research suggests that race, gender and age may affect financial learning, so these should be included as control variables.[4] In addition, Ross and Wright (2020a) present evidence that financial knowledge is linked to confidence one's mathematical abilities, so this is also included in the model. Research has also shown that confidence in one's financial skills is related to financial knowledge (Lusardi 2011), so we a control for this as well. We produce robust statistics using the White (1980) adjustment for heteroscedasticity.

This gives us the following model[5]:

$$Finance\ Change_i = \beta_1 Math\ Change_i + \beta_2 Female_i + \beta_3 Black_i + \beta_4 Hispanic_i$$

$$+ \beta_5 White_i + \beta_6 Age_i + \beta_7 Math\ Confidence_i + \beta_8 Financial\ Confidence_i$$

Results

To get an overview of the results before applying our model, we'll look at key figures for the pre- and post-assessments, summarized in table 1.

[4] Our data does not include student age, but it does include student grade so we use this as a proxy.

[5] Full variable definitions are provided in appendix 3.

	Pre Assessment	Post Assessment	Change	SD	Change/SD
Total Score	44.08%	49.7%	5.65%***	12%	0.41
Finance Score	43.67%	47.99%	4.31%***	15%	0.28
Math Score	43.36%	51.85%	8.49%***	18%	0.45
Math Confidence	59.75%	62.17%	2.43%***	17%	0.14
Finance Confidence	56.12%	59.22%	3.11%***	14%	0.22

Table 1: Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

We see that there is significant improvement across all categories of the assessment and, as a multiple of standard deviation, it is at or above the level of many successful education interventions (Lipsey & Wilson 1993).

With this in mind we present the results from our regression model in *table 2*:

Variable	**Coefficient (β_i)**	**Standard Error**
Intercept	0.04	0.12
Math Change	0.28***	0.07
Female	0.00	0.03
Black	-0.02	0.05
Hispanic	0.1*	0.05
White	-0.01	0.09
Grade	0.00	0.02
Math Confidence	0.01	0.02
Finance Confidence	-0.15	0.11

Adjusted $R^2 = 0.19$

Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Reported standard errors are robust (White 1980)

See appendix 3 for variable definitions

In line with our hypothesis, there is a statistically significant positive relationship between change in mathematical knowledge and change in financial knowledge, with $\beta_1 = 0.28$ and significant at 1% level. In other words, on average, for every percentage point a student's math score increases from pre- to post- assessment, their finance score increases by approximately one-third of a percentage point. Note also, that the only other variable in our model with a coefficient significantly different from zero is the control for being Hispanic, and then only significant at the 10% level. Further, since adjusted $R^2 = 0.19$, our model explains around 20% of variance in improvement in finance score.

To illustrate the relationship between change in math score and change in finance score further, a scatter plot of the two variables is presented in *figure 1*:

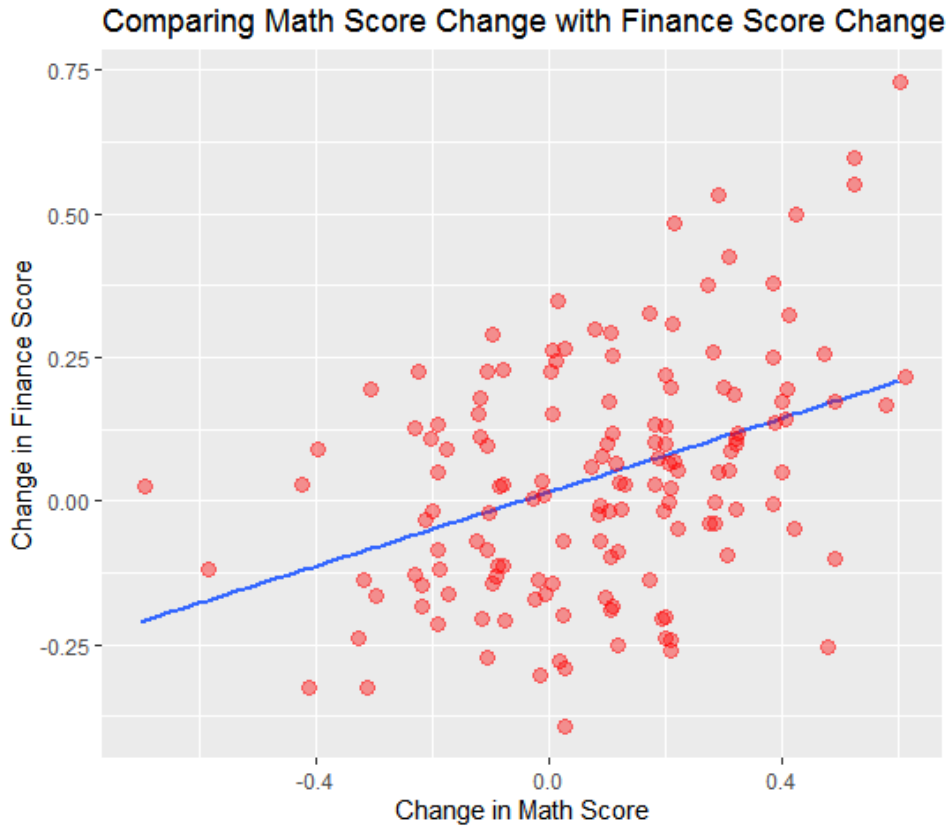

figure 1

Discussion

These results support our hypothesis that there is a connection between mathematical learning and financial learning, building on well-established results showing that mathematical knowledge and financial knowledge are correlated. We show that, with an appropriate education

intervention, improvement in mathematical knowledge is correlated with improvement in financial knowledge. This implies that the correlation between math and finance is not simply down to background factors that are contingently associated with a higher level of math education.

In addition, the improvement levels described in table 1 show that the intervention was successful in improving knowledge, by the standards established for education interventions.

Limitations & Future Research

Though these results suggest that combining finance and mathematics is an effective method for teaching personal finance, the lack of a control group means that this cannot be tested directly. Future research addressing this would need different groups of students assigned to courses in personal finance with and without mathematical integration (the assignment would need to be random, or quasi-random). Both groups would have to complete both pre-and post-assessments, to compare improvement-levels.

Conclusion

As we discussed in the literature review, there is a great deal of research on financial education, with many conflicting results. In virtue of this, it would be unwise to jump to conclusions on the basis of a single study. However, the present results complement a large amount of previous research on the correlation between mathematical and financial knowledge, and suggest that the connection persists in the context of additional *learning*.

It seems safe to conclude, therefore, that the connection between mathematics and financial literacy is genuine and that this is an important component of best practices in financial education. Further research is required to better understand the nature of the relationship and how it can be harnessed. This should be of interest to anyone concerned with maximizing the effectiveness of personal finance education.

References

Abreu, M., & Mendes, V. (2010). Financial literacy and portfolio diversification. Quantitative finance, 10(5), 515-528.

Ambuehl, S., Bernheim, B. D., & Lusardi, A. (2014). *A Method for Evaluating the Quality of Financial Decision Making, with an Application to Financial Education* (No. w20618). National Bureau of Economic Research.

Banks, J., & Oldfield, Z. (2007). Understanding pensions: Cognitive function, numerical ability and retirement saving. *Fiscal Studies*, *28*(2), 143-170. doi:10.1111/j.1475-5890.2007.00052.x

Behrman, J. R., Mitchell, O. S., Soo, C. K., & Bravo, D. (2012). How financial literacy affects household wealth accumulation. *American Economic Review*, *102*(3), 300-304.

Brown, M., Van der Klaauw, W., Wen, J., & Zafar, B. (2016). Financial education and the debt behavior of the young. *The Review of Financial Studies*, *29*(9), 2490-2522. doi:10.2139/ssrn.2334889

Campbell, J. Y. (2006). Household finance. *The journal of finance*, *61*(4), 1553-1604.

Clark, R. L., Lusardi, A., & Mitchell, O. S. (2014). *Financial knowledge and 401 (k) investment performance* (No. w20137). National Bureau of Economic Research. Cole, S., Paulson, A., & Shastry, G. K. (2014). Smart money? The effect of education on financial outcomes. *The Review of Financial Studies*, *27*(7), 2022-2051.

Cole, S., Paulson, A., & Shastry, G. K. (2016). High school curriculum and financial outcomes: The impact of mandated personal finance and mathematics courses. *Journal of Human Resources*, *51*(3), 656-698. doi:10.3368/jhr.51.3.0113-5410r1

Council of Economic Education. (2016). *Survey of the States: Economic and personal finance education in our nation's schools.* New York, NY.

Eisenstein, E. M., & Hoch, S. J. (2007). Intuitive compounding: Framing, temporal perspective, and expertise. *Unpublished manuscript*.

Fernandes, D. S., Lynch, J. G., & Netemeyer, R. G. (2014). Financial literacy, financial education, and downstream financial behaviors. *Management Science*, *60*(8), 1861-1883. doi:10.1287/mnsc.2013.1849

FINRA Foundation. (2009). *Financial capability in the United States: Report of the findings from the 2008 national financial capability study.* Washington, DC.

FINRA Foundation. (2013). *Financial capability in the United States: Report of the findings from the 2012 national financial capability study.* Washington, DC.

FINRA Foundation. (2015). *Financial capability in the United States: Report of the findings from the 2015 national financial capability study.* Washington, DC.

Gerardi, K., Goette, L. & Meier, S. (2010). *Financial literacy and subprime mortgage delinquency: Evidence from a survey matched to administrative data.* Atlanta, GA: Federal Reserve Bank of Atlanta

Goodman, J. (2019). The labor of division: Returns to compulsory high school math coursework. *Journal of Labor Economics*, *37*(4), 1141-1182.

Hastings, J., Madrian, B., & Skimmyhorn, W. (2012). *Financial literacy, financial education and economic outcomes* (18412). Cambridge, MA: National Bureau of Economic Research.

Kaiser, T., & Menkhoff, L. (2017). *Does financial education impact financial literacy and financial behavior, and if so, when?* The World Bank.

Kaiser, T., & Menkhoff, L. (2018a). Financial Education in Schools: A Meta-Analysis of Experimental Studies.

Kaiser, T., & Menkhoff, L. (2018b). Active learning fosters financial behavior: Experimental Evidence.

Klapper, L., Lusardi, A., & Van Oudheusden, P. (2015). Financial literacy around the world. *World Bank. Washington DC: World Bank*.

Lenard and Huang (2018) "Financial Literacy in WCPSS". *DRA Report, 18.01*

Lipsey, M. W., & Wilson, D. B. (1993). The efficacy of psychological, educational, and behavioral treatment: Confirmation from meta-analysis. *American psychologist*, *48*(12), 1181.

Lusardi, A. (2011). "Americans' Financial Capability." National Bureau of Economic Research Working Paper 17103.

Lusardi, A. (2012). Numeracy, financial literacy, and financial decision-making (No. w17821). National Bureau of Economic Research.

Lusardi, A., & Mitchell, O. (2011). *Financial literacy and planning: Implications for retirement wellbeing.* (17078). Cambridge, MA: National Bureau of Economic Research.

Lusardi, A., & Mitchell, O. (2014). The economic importance of financial literacy: Theory and evidence. *Journal of Economic Literature*, *52*(1), 5-44. Retrieved from http://dx.doi.org/10.1257/jel.52.1.5

Lusardi, A., Mitchell, O., Curto, V. (2010). *Financial literacy among the young: Evidence and Implications for consumer policy.* (15352). Cambridge, MA: National Bureau of Economic Research.

Lusardi, A., Mitchell, O., & Curto, V. (2014). Financial literacy and financial sophistication in the older population. Journal of Pension Economics and Finance, 13(4), 347-366. doi:10.1017/S1474747214000031

Lusardi, A., Samek, A., Kapteyn, A., Glinert, L., Hung, A., & Heinberg, A. (2017). Visual tools and narratives: New ways to improve financial literacy. *Journal of Pension Economics & Finance*, *16*(3), 297-323.

Lusardi, A., & Tufano, P. (2015). Debt literacy, financial experiences, and overindebtedness. *Journal of Pension Economics & Finance*, *14*(4), 332-368.

Mandell, L. (2008). The financial literacy of young American adults. *The Jumpstart Coalition for Personal Financial Literacy*.

Markow, D. & Bagnaschi, K. (2005). *What American teens and adults know about economics.* New York, NY: National Council on Economic Education.

Miller, M., Reichelstein, J., Salas, C., & Zia, B. (2014). *Can you help someone become financially capable? A meta-analysis of the literature*. The World Bank.

Ogden, T. (2019) More States are Forcing Students to Study Personal Finance: It's a Waste of Time. *The Washington Post.* Retrieved from: https://www.washingtonpost.com/2019/04/23/more-states-are-forcing-students-study-personal-finance-its-waste-time/?utm_term=.5e53c82ac062

Peters, E., Västfjäll, D., Slovic, P., Mertz, C. K., Mazzocco, K., & Dickert, S. (2006). Numeracy and decision making. *Psychological science*, *17*(5), 407-413.

Ross, M. M. & Wright, A. M. (2020a). Quantitative Skill and Introductory Finance Does Ability Dominate Attitude? *Journal of Financial Education*.

Ross, M. M. & Wright, A. M. (2020b). Know Math or Take a Bath on a Finance Final Exam. *Journal of Economics and Finance Education.*

Shim, S., Barber, B., Card, N., Xiao, J., & Serido, J. (2010). Financial socialization of first year college students: The roles of parents, work, and education. *Journal of Youth and Adolescence*, *39*(12), 1457-1470. doi:10.1007/s10964-009-9432-x

Stango, V., & Zinman, J. (2008). *The price is not right (not even on average): Exponential growth bias, present-biased perceptions and household finance*. Working Paper, Dartmouth College.

White, H. (1980). A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity. *econometrica*, *48*(4), 817-838.

Willis, L. E. (2011). The financial education fallacy. *American Economic Review*, *101*(3), 429-34.

Appendix 1: Survey Questions
Correct answers in bold

Mathematics Questions:

1. What number is 7% more than 50?
    a. 57
    b. 3.5
    c. 107
    d. 53.5
2. What is 6x+y, if x=3 and y=6?
    a. 9
    b. 18
    c. 63
    d. 24
3. xy=4 + 5x, x = 4, what is the value of y?
    a. 1
    b. 3
    c. 5
    d. 6
4. Mr. Davidson has a blue shirt, a white shirt, and a striped shirt. He also has a purple tie, a grey tie, a yellow tie, and a black tie. He has black pants and navy pants. How many outfits can he make? (He has no sense of style so it doesn't matter if an outfit is ugly or uses conflicting colors, it still counts as an outfit.)
    a. 9
    b. 12
    c. 14
    d. 24
5. What is the limit of the sum: 1 + ½ + ¼ + 1/8 + 1/16 …..
    a. 2
    b. E
    c. 3
    d. Pi
6. What is 5^a x 5^b equal to?(^ means raise to the power 5^a = 5a)
    a. 5^(a+b)
    b. 5^(ab)
    c. (5a)^b
    d. 25^(ab)

7. A geometric sequence has the recursive definition: an+1=an*1.1. The first term in the sequence is a1=3.7. What is the 4th term in the sequence?
    a. 3.7 x (3x1.1)
    b. 3.7 x 1.1
    c. 3.7 x (1.1)^3
    d. 3.7 x (1.1)^4
8. There are 24 odd numbers from 7 to 53. What is the sum of those 24 numbers?
    a. 600
    b. 655
    c. 720
    d. 1440
9. There are six marbles in a bag: two of them are blue, the other four are red. If you pick one marble out of the bag, what is the probability that it is blue?
    a. ½
    b. 1/3
    c. 1/5
    d. 1/6
10. There are two bags each with six marbles; one of the marbles in each bag is red, the other marbles are green. If you pick one marble from each bag, what is the probability that both marbles are red?
    a. 1/18
    b. 1/6
    c. 5/36
    d. 1/36

Finance Questions

1. At the start of the month your net worth is $500. Over the course of the month, your assets increase in value by $300, and your liabilities increase in value by $150. What is your net worth at the end of the month.
    a. $500
    b. $650
    c. $800
    d. $950
2. Claudia tries to match her expenses to her income. In June, Claudia had expenses of $120 for food, $65 for clothing and $30 for her phone service. The following month, July, she earns $270 working at the store. How much more did Claudia spend in July than in June if her income equals her expense?
    a. 55

   b. 65
   c. 215
   d. 270
3. Wealth is a measure of
   a. How much cash you have
   b. Your ability to consume goods and services
   c. Your income minus your expenses
   d. Your bank account
4. Eduardo has a monthly income of $3000 and $2000 of this covers essential expenses. Each month he likes to spend $3oo on clothes and $500 on entertainment. He wants to save $800 a month so he can start his own business. Which of the following is true?
   a. Eduardo can meet all his goals
   b. Eduardo's only option is to stop spending any money on entertainment
   c. In order to create a budget, Eduardo must make a trade-off between his goals for saving and spending
   d. Eduardo should give up on saving money
   e. Don't know
5. Financial products (like loans, bonds and stocks) help you transfer consumption across time.
   a. True
   b. False
6. Given an interest rate of 4.3%, which investment would grow fastest?
   a. An investment which earns annual compound interest
   b. An investment which earns simple interest
   c. An investment which earns quarterly compound interest
   d. Cannot be determined
7. Over time, an investment with compound interest will experience
   a. Linear growth
   b. Quadratic growth
   c. Exponential growth
   d. Logarithmic growth
8. You have $2000 in credit card debt and $100,000 debt on your mortgage. You have $1000 available to reduce your debt. What is the best option?
   a. Pay it towards the mortgage since that is the bigger debt
   b. Pay it toward your credit card as that has the higher interest rate
   c. Pay equal amounts off both loans to reduce them evenly
   d. Just keep the cash
9. Which of the following is the best way to raise your credit score?
   a. Don't take on any debt
   b. Get a large number of credit cards

c. Take out manageable loans, and repay them on time

d. Make the minimum payments on a credit card

10. What is a financial benefit to using a mortgage to buy a house, rather than paying rent?
    a. It means you get a house for free
    b. You get an asset, and increase your wealth as you pay off your mortgage
    c. Mortgage payments are always less than rent payments
    d. If you have to make mortgage payments, you don't have to pay off your student loans
11. Assuming your investment earns 7.2% per year, which will give you more money in retirement?
    a. $200 invested 30 years before retirement?
    b. $1000 invested 5 years before retirement?
12. You are starting a business selling surfboards. Each surfboard sells for $150. On the each day of the summer you think there is a 30% chance you will sell one board, a 50% chance you will sell two and a 10% chance you will sell three. What is your expected average daily sales?
    a. $135
    b. $150
    c. $240
    d. $300
13. There is a 10% chance of your phone breaking and the cost of replacement is $500. The cost of insurance is $100. There is a 0.1% chance of your home/apartment being damaged by fire, the cost of repair is $50,000. The cost of insurance is $100. Which is more useful from a financial perspective?
    a. Phone insurance, since it is more likely to pay off
    b. Home/apartment insurance, since the risk from a loss is so great
    c. They are equal since they have the same expected value
    d. Neither is good insurance since they have negative expected value
14. Company XYZ is worth $1,200,000. They offer 2000 shares. Susan buys $27,000 worth of XYZ. How many shares does Susan own?
    a. 27
    b. 45
    c. 600
    d. 1,173,000
15. You pay $1000 for 600 shares in Juan's Water Beds Inc. After a year, your shares are worth $1200. What was your return?
    a. 200%
    b. 100%
    c. 20%
    d. 12%

16. You make an investment of $1000, which after one year has an expected value of $1150, and a standard deviation of $250. What is the lowest value you will get approximately 98% of the time if the results are normally distributed?
    a. $1000
    b. $900
    c. $650
    d. $150
17. When is it most appropriate to invest in stocks?
    a. You need to double your money in a year
    b. You want to use your investment for a down payment on a house in 3 years' time
    c. You are saving for retirement which is 20 years away
    d. You will use this money to pay your bills at the end of the month

Mathematics Confidence Questions

Please mark the answer that best describes you (on a scale of 1-5 from 'Not at all like me' to 'Exactly like me').

1. I enjoy math.
2. I can figure our difficult math problems.
3. I can do even the hardest math problems if I try.
4. If I do a math problem wrong the first time, I keep trying.

Finance Confidence Questions

How confident are you that you can…? (on a scale of 1-5 from 'Not at all Confident' to 'Very Confident')

1. Choose a financial goal, and create a plan to meet it.
2. Discuss your financial goals with friends and/or family members.
3. Check your bank account balance using online banking services.
4. Consider how a current purchase will affect you financially in the future.
5. Compare the expected rate of return for savings and investment alternatives.
6. Evaluate the costs and benefits of taking out student loans.

Appendix 2: Course Information

The common core and Jump$tart standards covered, are summarized below.

Alignment with Common Core Standards

Unit	Algebra	Functions	Statistics & Probability

1	A-CED.1; A-CED.2 A-CED.4; A-REI.1 A-SSE.1	F-IF.1 F-IF.2	
2	A-CED.1; A-CED.2 A-CED.4; A-REI.1 A-REI.10; A-SSE.1		
3	A-APR.1; A-CED.2 A-REI.1; A-REI.10 A-SSE.1; A-SSE.2 A-SSE.4	F-BF.1 F-BF.2 F-LE.2 F-LE.5	
4			S-CP.1-9 S-MD.1-7
5			S-IC.1-9 S-MD.1-7
6			

The modeling standards and the mathematical practice standards are covered across the whole course.

Unit	Spending and Saving	Credit and Debt	Employment and Income	Investing	Risk Management and Insurance	Financial Decision Making
1	1, 2, 3, 4	3	1, 2, 3			1, 2, 4, 5, 8
2	1, 4	1, 2, 3		1, 2, 3		2, 4, 5, 8
3	1, 4	3	2, 3			1, 2, 4, 5, 8
4					1, 2, 3	2, 4, 5, 8
5	1, 4			1, 2, 3		2, 4, 5, 8
6						

Alignment with Jump Start Standards

Appendix 3: Variable Definitions

Variable Name	Definition
Finance Change	The difference between the percentage score on finances questions in the post-test and finance questions in the pre-test
Math Change	The difference between the percentage score on mathematics questions in the post-test and mathematics questions in the pe-test
Female	Dummy variable equal to 1 if student identified as female and zero otherwise
Black	Dummy variable equal to 1 if student identified as black and zero otherwise
Hispanic	Dummy variable equal to 1 if student identified as Hispanic and zero otherwise
White	Dummy variable equal to 1 if student identified as white and zero otherwise
Grade	Proxy for age taking values 1-4 for student grades freshman-senior
Math Confidence	Average score on mathematical confidence questions in pre-test
Finance Confidence	Average score on finance confidence questions in pre-test