Some Financial Numeracy Tasks for Secondary-School Mathematics Classes

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1 Introduction

The tasks presented in this chapter were devised by Louis-Philippe Turineck as part of his master's degree project, for which Annie Savard supervised him. These tasks, which can be used in mathematics classrooms from grade 7 to grade 9, need to be contextualised for the country in which they will be used. For instance, in many countries, taxes are included in the price, but this is not the case in Canada. The most important thing is that the tasks should engage students in modelising meaningful financial praxis.

2 Task 1: Margaret

In this task, Margaret, a student who wants to buy basketball shoes, has various options for earning money by doing good deeds for her neighbours. The task values saving, working towards a goal, helping the community, and understanding the time and value of work. It touches on percentages, arithmetic, division and decimal numbers, and can be used to explore topics such as tables of values, graphs and linear equations. The task can be approached in many different ways and is open-ended enough for students to engage in critical thinking about the situation and use an appropriate mathematical method or model to solve it.

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Margaret

Margaret is a grade 6 student on the school's basketball team. She has been saving up for new shoes since last Christmas. They cost $200 plus taxes (15% in Quebec) but she only has $15.50 in her piggy bank. Her mom tells her that she can earn money by helping out the neighbours. She has a few choices:

- Paul says he will pay Margaret $8.50 to shovel the snow for an hour once a week.
- Sally says she will pay Margaret $14.50 if she can babysit her son on Friday nights for 2 h.
- Ali says he will pay Margaret $35.50 to walk his dogs for the month. This task takes 20 min per day, five days a week.
- Jimmy says he will pay Margaret $1.50 every day, if she comes on weekdays to feed his cats after school. This task takes 5 min per day, repeatable up to five times per week.
- A local company says they can pay Margeret $7.50 per day to deliver the weekly newspaper. This task takes 30 min and is repeatable up to twice a week.

Questions to answer:

1. How long will it take Margaret to save enough to buy her shoes?
2. Which tasks offer the best price per hour?
3. Which task offers the worst price per hour?
4. Is it reasonable to assume Margaret can agree to do all the tasks above? Why or why not?
5. If you were Margaret, how would you approach this situation? What tasks would you choose to do and why?

3 Task 2: Cellphone

This situation presents students with the opportunity to explore the different options consumers have when choosing a cellphone. The prices indicated in this task were taken directly from telecommunications company websites, and reflect the actual costs associated with each service and each device. As consumers, we can either buy a phone ourselves and pay cheaper monthly fees on a "bring-your-own-device" plan, or we can pay upfront and sign up for a contract with a company (usually for 1–3 years) with significantly higher monthly fees. The tasks allow students to decide the parameters of the problem, represent the situation with a mathematical model of their choosing and justify their choice of cell phone plan. This type of mathematical situation reflects real-life choices faced by consumers choosing a specific device and cell phone plan. The task also prompts students to identify the benefits of each cell phone plan, and to question why companies can charge more for similar

service/similar devices. The financial literacy goals of this task are in line with the PISA (Program for International Student Assessment) Financial Literacy Framework (OECD 2015) under the heading of Money and Transaction: Explore and analyse a financial market.

Cell Phone Problem

You have decided to purchase a new phone but aren't sure about which phone and plan you should go for. For now, you know that you want a plan with at least 4 GB of data and Canada-wide free calls. After consulting different providers' websites, you have gathered all the information from different providers. The carriers offer you two options: you can either buy the phone outright and pay for a "bring-your-own-phone" plan monthØly; or you can sign up for a contract with an upfront cost and monthly total. Each phone has an associated upfront cost and a monthly cost.

Bring your own phone		Independent Price	Monthly Fee		
			Rogers	Bell	
Apple	iPhone 8 Plus	1059	60	55	
Google	Pixel 2XL	1159	60	55	
Samsung	Galaxy S9 Plus	1099	60	55	
One Plus	One Plus 6T	719	60	55	
Huawei	P20 Pro	1129	60	55	

contract		Rogers		Bell	Bell
		Upfront	Monthly Price	Upfront	Monthly Price
Apple	iPhone 8 Plus	329	75	129	87
Google	Pixel 2XL	199	75	0	87
Samsung	Galaxy S9	329	75	99	87
One Plus	One Plus 6T	199	75	0	87
Hwawei	P20 Pro	199	75	0	87

Questions to answer:

1. For your phone, which plan is better, the contract or the bring-your-own-device plan? Represent your solution using a mathematical model.
2. What kind of conclusions can you draw from the information given? Justify your reasoning mathematically.
3. Discuss your results with another group. What similarities and differences did you notice about the prices for different devices?

4. What conclusions can you draw about cell phone prices with each company? Is it better to go with a contract option or with a bring-your-own-device plan?
5. Name two benefits of the bring-your-own-device option.
6. Name two benefits of the contract option.
7. Why can a company offer the same service but at different prices?
8. Why do you think they can charge different prices for phones with similar performance?
9. Why do certain phones cost more? Which phone is the most expensive and which the least expensive?

4 Task 3: Chicken Shack

This task is inspired by a chapter in *Freakonomics* by Stephen J. Dubner and Steven Levitt (2005), economists who explore "the hidden side of everything". In their book, they recount a story about visiting a local chicken shop in New York City. As economists, they were baffled by the pricing model. This chicken shop offered specials which include a medium fries and small coleslaw. If you look at the first option, the 2-wing special costs $3.03 and the 3-wing special costs $4.50. The only difference between the two options is an extra wing, which costs $1.47 more. If you assume that each wing cost $1.47, then that would bring the implied price of the fries and coleslaw to $0.09. Further, the difference between the 5-wing and 6-wing deals is significantly more than the difference between the 4-wing and 5-wing deals. This is odd since usually economics of scale suggest you would be offered better value for ordering a greater quantity. This situation presents students with the opportunity to note pricing model patterns by graphing the pricing structure using a broken-line graph, and to explore any potential flaws in the pricing structure. It also encourages them to create their own pricing structure and justify their prices.

YuJin's Chicken Shack

YuJin decides to open her very own chicken store in her hometown. She calls it YuJin's Chicken Shack. She is designing her menu and wants to offer her customers chicken wing deals. All of her specials include a medium fries and coleslaw.The prices for YuJin's Chicken Shack are as follows:

YuJin's Chicken Shack	
Chicken Wing Deal: Includes medium fries and a small coleslaw	
2-Wing Deal	$3.03
3-Wing Deal	$4.50

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4-Wing Deal	$5.40
5-Wing Deal	$5.95
6-Wing Deal	$7.00

Questions to answer:

1. Graph this pricing structure on a broken-line graph. What do you notice?
2. Compare the 2-wing deal and the 3-wing deal. What do you estimate is the price of the fries and coleslaw?
3. What offers the best value? Justify your answer mathematically.
4. YuJin asks for your services as a menu consultant. She asks you to make recommendations and to re-do her pricing model for the special. Fill out the chart below with a new pricing model, providing a brief justification for your choice of prices.

YuJin's Chicken Shack	
Chicken Wing Deal: Includes medium fries and a small coleslaw	
2-Wing Deal	—
3-Wing Deal	—
4-Wing Deal	—
5-Wing Deal	—
6-Wing Deal	—

Justification for pricing model:

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5 Task 3: Chicken Shack Part 2

This task is an extension of the previous Chicken Shack task. I wanted to incorporate an element of Microsoft Excel into one of my tasks. Excel is a very useful tool for organising data, completing complex maths functions, turning data into helpful graphs and charts, and analysing data. This tool is under-utilised in schools, especially during elementary and early years of high school. Thus, I wanted to create an extension of one of the tasks that would allow students to use Excel and develop their competencies with the software. The task can be delivered following a few introductory lessons on Excel. Previous knowledge required includes how to input data,

how to do basic mathematical calculations using functions, and how to create graphs and charts to represent data. This situation presents students with the opportunity to graph the data on the restaurant menu and choose the best graph to represent the pricing model. Then students will be asked to analyse this graph and draw conclusions. They will go on to create a new menu with new prices and choose the same graph to compare their new pricing model with the old one. This will allow them to use graphs to analyse, make mathematical claims and justify their reasoning while developing their competencies with Excel spreadsheets.

Excel Task

YuJin decides to open her very own chicken store in her hometown. She calls it YuJin's Chicken Shack. She is designing her menu and wants to offer her customers chicken wing deals. All of her specials include a medium fries and coleslaw.

YuJin's Chicken Shack	
Chicken Wing Deal: Includes medium fries and a small coleslaw	
2-Wing Deal	$3.03
3-Wing Deal	$4.50
4-Wing Deal	$5.40
5-Wing Deal	$5.95
6-Wing Deal	$7.00

Questions to answer:

1. Input the data of this pricing model in Excel.
2. Choose an appropriate graphic or chart that would represent the pricing model of YuJin's Chicken Shack.
3. What do you notice about the chart? What conclusions can be drawn by examining the chart?
4. YuJin asks for your services as a menu consultant. She asks you to make recommendations and to re-do her pricing model for the special. Using an Excel function, create a new pricing model.
5. Create a new chart using your pricing model and compare it to her original pricing chart.
6. What conclusions can be drawn? Use both charts as evidence to justify your claims.
7. Using your own pricing model, use an Excel function to map out your pricing model for 7-, 8-, 9- and 10-wing deals.