# Lesson 2: Introduction to The Process

## Opening Story

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## **The Quantitative Reasoning Process**

As you saw in the introductory video, Lucas and Amanda are facing a complicated decision that impacts their family life and finances now while they are going to school as well as their future. Should they take out loans to cover their expenses and finish school more quickly? Or should they have Lucas take another part-time job to stay debt free, but cause school to take an extra three to four semesters?

This scenario is a good example of a real-world problem where mathematics can be used to help make an informed decision. In this course we will be learning how the Quantitative Reasoning Process can help us make informed decisions in many different aspects of our lives.



The Quantitative Reasoning Process is a tool for making better, more informed decisions. It gives us a systematic way to include mathematical calculations in the decision-making process. Click on each banner below to see a description of that step of the Quantitative Reasoning Process.



The Quantitative Reasoning Process is used to make decisions. Start by carefully considering the situation and making sure you understand the problem and know what decision you need to make.

Identify all the key aspects of the problem. What variables are important in the problem? What assumptions do you need to make to simplify the problem?



Use quantitative tools such as computation, algebra, statistics, and/or graphics to gain a better understanding of the situation.



Use the results of your quantitative calculations and analysis to help you make an informed decision about the situation.



Look back at every step of the process. Review and evaluate your reasoning. Reflect on your answer. Does your answer make sense? If not, go back and make necessary changes.

In order to better understand how the Quantitative Reasoning Process works, let’s use the process, step-by-step, to help Lucas and Amanda make an informed decision about their financial situation.

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Lucas and Amanda have identified two possible plans for Lucas to complete school and need to decide which one is financially better for their family.

**Part-Time Job Option:** Lucas could take on additional part-time work while going to school.

**Student Loan Option:** They could use student loans to cover their expenses.

Lucas and Amanda have already determined that they value their education. Amanda has already graduated and they want to make an informed decision about the best way for Lucas to finish school. They want to follow the advice President Dieter F. Uchtdorf gave:

For members of the Church, education is not merely a good idea – it’s a commandment. We are to learn ‘of things both in heaven and in the earth, and under the earth; things which have been, things which are, things which must shortly come to pass; things which are at home, things which are abroad.’ Joseph Smith loved learning even though he had few opportunities for formal education…Joseph taught the Saints that knowledge was a necessary part of our mortal journey, for ‘man is saved no faster than he [gains] knowledge,’ and that ‘whatever principle of intelligence we attain…in this life, it will rise with us in the resurrection.’ During challenging times, it is even more important to learn. The Prophet Joseph taught, ’Knowledge does away with darkness, [anxiety], and doubt; for these cannot exist where knowledge is.1

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#### Identify Key Variables

Now that we have an understanding of the real-world problem Lucas and Amanda are facing, we need to identify the variables in their problem.

A **variable** is an element of a situation that has the potential to vary or change in value.

To identify the key variables, we ask ourselves which elements of the situation have the potential to vary or change in value. In Lucas and Amanda’s situation, here are some variables they should consider:

* Tuition costs
* Living expenses
* Lucas’ salary after graduation
* Student loan amount
* Student loan cost
* Annual interest rate
* Wages from part-time employment.

If we consider each of these variables, we realize they are elements of the situation that could change. For example, tuition prices could go up before Lucas graduates and their living expenses could go up or down. Lucas’s salary after graduation will depend on the job he gets. Lucas and Amanda could take the maximum loan amount available or they could decide to take a smaller amount. The costs of the loan and the interest rate will vary based on the economy. Lucas’s wages from part-time employment could change if Lucas gets a raise or he loses his job.

All of these variables are important for Lucas and Amanda to consider when making their decision. Lucas and Amanda will have to decide which variables are the most important.

### Making Assumptions

Lucas and Amanda’s situation involves several different variables that could take on different values. This makes the problem more complicated because there are so many different quantities that could change. In order to simplify any situation and make it more manageable, we must make some assumptions.

An assumption is an idea or concept that is accepted as true.

Often, our assumptions are related to our variables (that is why assumptions and variables are listed in the same step of the Quantitative Reasoning Process). We frequently assume that a variable will behave in a certain way. For example, Lucas and Amanda could assume that their living expenses will remain fairly constant for the time Lucas needs to finish school. This assumption will simplify their calculations and allow them to focus their attention on other aspects of the situation.

In addition to making assumptions about variables, we also make general assumptions about situations. For example, Lucas and Amanda will need to assume that they have explored all possible options for scholarships and grants that could help them pay for school. If additional scholarship or grant money were available, that might impact their decision about taking out student loans.

These are not the only assumptions they need to make.

### **Practice: Assumptions**

### Problem 1

Lucas and Amanda need to make some assumptions in order to make their decision. Based on the information provided in the introductory video, decide if the following assumption is appropriate or not.

Assumption: **Lucas’ wages from his part-time job will stay the same.**

**How Did I Do?**

This is an appropriate assumption. They will use Lucas’s current wages in their calculation. If his wages change, it might change their decision.

Assumption: **They will get an annual interest rate of 5% on their loans.**

**How Did I Do?**

This is an appropriate assumption. They need to know what rate they will get on their student loans, so they can do their calculations. 5% is a reasonable guess at what their interest rate will be.

Assumption: **Amanda will inherit her rich uncle’s entire estate.**

**How Did I Do?**

This is not an appropriate assumption. This is probably unlikely to happen and not something they should count on, so it is not an appropriate assumption.

Assumption: **Lucas will be hired quickly after graduation.**

**How Did I Do?**

This is an appropriate assumption. They are basing their calculations on Lucas being hired immediately after graduation. If it takes longer, their conclusion might not be valid.

Assumption: **Lucas and Amanda need semiannual vacations.**

**How Did I Do?**

This is not an appropriate assumption. They are trying to avoid debt. Taking semiannual vacations would not be a good use of their financial resources.

The assumptions are important to understand because if one of these assumptions is false it has the potential to change the outcome of Lucas and Amanda’s decision about part-time work or student loans. Let’s look at what would happen if some of these assumptions turn out not to be true.

* Lucas and Amanda assumed that their expenses would remain fairly constant until Lucas finishes school. They will be basing all their calculations on this assumption. What if their expenses increase significantly over time? Then the calculations they use to make their decision might be inaccurate and they might make the wrong decision because it was based on a faulty assumption. For this assumption to be true, Lucas and Amanda will need to live frugally until Lucas graduates and until any loans are paid off. “Wherefore, do not spend money for that which is of no worth, nor your labor for that which cannot satisfy.”2
* Lucas and Amanda assumed that Lucas will have good grades with either option. But what if Lucas’s grades go down when he starts another part-time job and he ends up having to repeat some classes? This would increase the time it takes Lucas to graduate.

It is important to understand that if an assumption is faulty, the decision based on that assumption can be a poor decision. However, it is also important to remember that making assumptions is essential to decision making.

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When we have identified the key variables and made assumptions, we are ready to use algebraic, statistical, and computational tools to help us make a decision. During this semester we will learn many of these quantitative tools that help us make informed decisions. The goal of this lesson is to help you learn the Quantitative Reasoning Process, so we will not focus as much on the quantitative tools as we will in later lessons. Many of the tools we refer to in this lesson will be discussed in more detail later in the semester.

#### Estimating School and Living Expenses

First, let’s estimate how much Lucas and Amanda will need to pay for school and living expenses. BYU-Idaho has created an estimate of how much these costs should be for a BYU-Idaho student living in Rexburg. We will use the costs they provide for married campus students on the  website in January 2024:

|  |  |
| --- | --- |
| **Item** | **Cost** |
| LDS Tuition (Semester) | $2,328 |
| Loan Fees  | $24 |
| Books and Supplies  | $275 |
| Transportation | $1162 |
| Personal Expenses (Including health insurance, clothing, cell phone, etc.) | $1386 |
| Housing and Food | $5502 |
| Average Cost Per Semester | $10,677 |

We assume Lucas and Amanda and their two children, Sophia and Emmy3, will have expenses of $10,677 per semester. Because there are three semesters in a year, we will multiply this value by 3 to find their living expenses for one year.

$$ $10,677 \*3=$32,031 $$

#### Part-time Work and Scholarship Income

We need to estimate how much Lucas and Amanda make through their part-time work. We know that Amanda is doing some part-time tutoring to earn extra money and Lucas is working at a part-time job. Amanda works about 10 hours per week and charges $15/hour for tutoring. Lucas works part-time on campus for 17 hours per week and makes $12.50 per hour. Lucas also receives a $1000 scholarship each semsester.

### **Practice: Estimating Income**

### Problem 2

What will Lucas's weekly income be from part time work?

**How Did I Do?**

$212.50

Hint: To find Lucas’s weekly income, multiply the number of hours he works per week by his salary per hour.

What will Amanda's weekly income be from part time work?

**How Did I Do?**

$150

Hint: To find Amanda’s weekly income, multiply the number of hours she works per week by her salary per hour.

What will their combined weekly income be from part time work?

**How Did I Do?**

$362.50

Hint: To find their combined weekly income, add Lucas’ weekly income to Amanda’s weekly income.

If they each work 42 weeks in a year, what will their combined annual income be from part-time work?

**How Did I Do?**

$15,225

Hint: To find their combined annual income, multiply their combined weekly income by 42.

If Lucas attends school 3 semesters a year, what will his annual scholarship income be?

**How Did I Do?**

$3000

Hint:  To find Lucas's annual scholarship income, multiply his semester scholarship amount by 3.

What will be their combined annual income be from part-time work and scholarships?

**How Did I Do?**

$18,225

#### Loan Payment

In the video, we hear Lucas tell Amanda that they qualified for $6,200 per semester in loan money. However, Amanda replied by saying she thinks they could get by on a lot less. We can find how much money they need to borrow by subtracting their wages from part-time work  and scholarships from their total annual living expenses.

$$ \text{Annual Living Expenses - (Annual Wages and Scholarships)} = $32,031-$18,225=$13,806 $$

From this calculation, we see that they are short by about $13,800 per year. If they take out student loans, Lucas wants to graduate as soon as possible so he will apply for Fast Grad and go to school all three semesters. This means they would need to borrow about $4600 per semester.

If they take out a loan, Lucas will be able to graduate in 2 years (6 semesters). So when they graduate they will have a total loan of

$$ $4600\*6=$27,600 $$

Anytime we take out a loan, we have to pay the banking institution for the use of their money. The money we pay to the bank in addition to the amount we borrowed is called interest. One of our assumptions is that they could get an interest rate of 5%.

Lucas and Amanda also realize that if they don’t take out a student loan, it will take them two additional years to graduate. But, when they do graduate, they would be debt free. So, if they want to be in the same situation by taking out student loans, they want to pay off the loan in 2 years.

Now that we know they will have a loan amount of $27,600, an interest rate of 5%, and a loan term of 2 years, we can use the following online loan calculator to determine their monthly payment on the loan.

Their monthly loan payment is about $1210. Calculate the amount to be paid to the bank each year by multiplying this monthly payment by 12 months.

$$ $1210\*12=$14,520 $$

How much do they need to make?

Now the question is whether or not Lucas and Amanda can afford to make the monthly loan payment. This depends on Lucas’s take-home salary after graduation. Let’s figure out exactly how much Lucas’ take-home pay would need to be per year in order to be able to pay for their living expenses and make their loan payment. Keep in mind that this is just his take-home pay. His total salary would need to be higher in order to allow for paying taxes.

Total annual expense = Living expense + Loan payment

$$ =$32,031+$14,520=$46,551 $$

This information could also be shown in the following graph.



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Now that Lucas and Amanda have modeled the situation, they need to interpret the information they have gathered. They conclude that if they take out student loans and then repay them in the first two years, Lucas’s salary after graduation would need to have a take-home amount of at least $46,551. If his take-home amount is less than $46,551, they could not repay the loan in two years. If his take-home amount is more than $46,551, they could repay the loan and still have some money left.

What do you think Lucas and Amanda should do?

Please think carefully about your answer to this question. On your Lesson 2 Reading Quiz you will be asked to answer this question and justify your answer.

Lucas and Amanda will need to look carefully at the potential careers that correspond to Lucas’s major. They will need to evaluate salaries and the cost of living in different locations as well as other family concerns. But now that they have used the Quantitative Reasoning Process they have a well-grounded foundation upon which to base their financial decisions.

As they make their decision they should also consider the following advice of President Clark Gilbert:

"Your academic stewardship at BYU-Idaho includes your time to graduation. Did you know that your probability of being an engaged future employee nearly doubles when you graduate on time and with modest college debt? Work hard in your classes. Take your education seriously. Never steal from the Lord or yourself by cheating in a class. Be a profitable servant, and return with increase the talents He has given you in this remarkable faculty and rich academic environment“4

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Once Lucas and Amanda have made a decision, it is important that they reflect on and evaluate their decision. They should ask themselves questions like

* Does this decision make sense?
* Are my assumptions reasonable?
* Are there any consequences of this decision I haven’t considered?
* What types of events could happen that would violate my assumptions? (Perhaps an unplanned illness or the loss of a job.) Do I have a plan to deal with these events?
* Have I prayed about the decision?

Why is it so important that Lucas and Amanda make a careful, informed decision in this situation? Heber J. Grant answers this question:

"If there is any one thing that will bring peace and contentment into the human heart, and into the family, it is to live within our means. And if there is any one thing that is grinding and discouraging and disheartening, it is to have debts and obligations that one cannot meet.“5

## Conclusion

The Quantitative Reasoning Process gives us a way to carefully consider difficult choices and to make informed decisions. Through the Quantitative Reasoning Process we identify the real-world situation, identify the assumptions and key variables, apply necessary quantitative tools, and then use our results to make informed decision.



The financial situation presented in this lesson is just one example of how the Quantitative Reasoning Process can help us make informed decisions. During this semester as we learn to make informed decisions in all aspects of our lives, we will be more prepared to serve others in our homes, churches, and communities.

## Lesson Checklist

At the end of this lesson, you should be able to do the following:

* Identify the steps of the Quantitative Reasoning Process.
* Identify assumptions.
* Identify key variables.
* Perform arithmetic to solve a real-world problem.
* Make and justify an informed decision.
* Reflect and evaluate a decision.

1Dieter F. Uchtdorf, ,  Ensign, November 2009

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3  Sophia and Emmy are named after famous female mathematcians: , , and

4Clark Gilbert, , September 13, 2016 Devotional

5President Heber J. Grant, ,  comp. G. Homer Durham [1941], page 111

Read this online at <https://books.byui.edu/math_108x/lesson_2_introduction_to_the_process>